

Towards an Automated (Anti-)Utopia? A Critical Discussion of the Contemporary Discourse on Automation and Its Future

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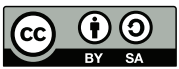
DISSERTATION

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Summary

This dissertation deals with the societal implications of the automation of wage labour. It takes as its starting point an examination of the contemporary debate on the automation of labour in Germany. This debate is examined in terms of its epistemological foundations as well as the dominant political and economic assessments and assumptions that shape it. This analysis reveals a fundamental marginalisation of the social, political and ecological risks of automation resulting from a one-sided focus on the macroeconomic potentials of automation which reinforces a fair-weather scenario that assumes a massive increase in international competitiveness and correspondingly strong economic growth.

The ensuing discussion of these marginalised risks highlights the need for an active technopolitical management of automation to avoid these risks and to unleash the emancipatory potential of productivity gains. Building on the early Frankfurt School, the outlines of such an emancipatory technopolitical project are developed. Finally, policy options are discussed that concretise this project. They are designed to promote automation while making its implementation ecologically sustainable and economically inclusive. Specifically, these policies aim to stabilise wage levels and to increase public investment – combined with the socialisation of the corresponding dividends – while translating the increased adoption of automation into collective reductions in working hours.

This dissertation contributes to two fundamental tasks of technology assessment: to promote a more enlightened debate about the consequences of technological change and to identify alternative policy options to shape technological development in the interest of a democratic, pluralistic debate.

This book addresses the first task by exposing some of the often implicit assumptions and interests that shape the current debate on automation. This is true both in epistemological terms – by reflecting on the epistemic merits and limitations of studies that attempt to predict future automation potentials or even employment effects - and in political terms, for example, by reconstructing the technocorporatist foundations that structure the contemporary debate in Germany on the use of automation, as exemplified by the negotiation processes surrounding the so-called "Industry 4.0".

Reconstructing the socioeconomic determinacy of the social consequences of automation allows for the development of a theoretical position that transcends naive technological optimism and fatalistic technological determinism, as well as economic strategies that

understand automation merely as a means of capitalist competition. Beyond these limitations, a perspective opens up that demystifies the spectre of technological unemployment, makes the goals of technological change negotiable, and attempts to spark hope for qualitative societal progress. This perspective provides the interface for a dialogue between the early Frankfurt School, more contemporary forms of social critique, and the policy debate on the management of automation.

This dialogue has a strong international dimension in that it translates the British debate on policy options for managing automation into a German context, while at the same time making the German debate on automation and lesser-known authors of the early Frankfurt School accessible to an English-speaking audience. At the same time, the relative neglect for issues of ecological sustainability within the techno-optimistic debate of recent years on the emancipatory use of automation is critically reflected, with the aim of contributing to the further development of a normatively oriented yet nuanced and differentiated approach to the possible consequences of automation and the potential for its emancipatory appropriation.

Zusammenfassung

Die vorliegende Arbeit befasst sich mit den gesellschaftlichen Implikationen der Automatisierung von Lohnarbeit. Sie nimmt ihren Ausgang in einer Betrachtung der zeitgenössischen Debatte um die Automatisierung der Arbeit in Deutschland. Diese wird hinsichtlich ihrer erkenntnistheoretischen Grundlagen und dominanten politischen Deutungsmuster reflektiert. Dabei wird eine weitgehende Marginalisierung sozialer, politischer und ökologischer Risiken der Automatisierung deutlich, die aus einer einseitigen Fokussierung auf ein Schönwetterszenario der makroökonomischen Potentiale der Automatisierung resultiert, das von einer massiven Steigerung der internationalen Wettbewerbsfähigkeit und einem entsprechend starken Wirtschaftswachstum ausgeht.

Die anschließende Diskussion dieser marginalisierten Risiken verdeutlicht die Notwendigkeit einer aktiven technikpolitischen Rahmung der Automatisierung, um diese Risiken zu vermeiden und die emanzipatorischen Potentiale steigender Produktivität zu erschließen. Unter Rückgriff auf die frühe Frankfurter Schule werden Grundzüge eines solchen emanzipatorischen technikpolitischen Projekts entwickelt. Abschließend werden politische Gestaltungsoptionen diskutiert, die dieses Projekt konkretisieren und helfen sollen, beschleunigte Automatisierung wirtschaftspolitisch in ökologisch und sozial nachhaltige Bahnen zu lenken. Konkret werden Möglichkeiten zur Stabilisierung des Lohnniveaus und zur Ausweitung öffentlicher Investitionen – verbunden mit einer Sozialisierung der entsprechenden Dividenden – ebenso identifiziert, wie die Möglichkeit, steigende Produktivität in kollektive Arbeitszeitverkürzungen zu übersetzen.

In der Arbeit begegnen und befruchten sich zwei grundlegende Anliegen der Technikfolgenabschätzung: zu einer aufgeklärteren Debatte über die Folgen technologischen Wandels beizutragen und im Sinne einer demokratischen, pluralen Debatte alternative Gestaltungsoptionen aufzuzeigen.

Das erste Anliegen befördert diese Arbeit, indem sie einige der häufig impliziten Annahmen und Interessen expliziert, die die gegenwärtige Debatte über Automatisierung prägen. Dies gilt sowohl in erkenntnistheoretischer Hinsicht – etwa durch die Reflektion der epistemischen Vorzüge und Limitationen von Studien, die zukünftige Automatisierungspotentiale oder gar Beschäftigungseffekte vorherzusagen trachten – als auch in politischer Hinsicht, etwa durch die Rekonstruktion der technikkorporatistischen Grundzüge, die die zeitgenössische Debatte in Deutschland über die Nutzung von Automatisierung prägen, wie am Beispiel der Aushandlungsprozesse rund um die sogenannte „Industrie 4.0“ gezeigt wird.

Die Rekonstruktion der sozioökonomischen Determiniertheit der gesellschaftlichen Folgen der Automatisierung ermöglicht dabei die Entwicklung einer theoretischen Position, die naiven Technikoptimismus und fatalistischen Technikdeterminismus ebenso transzendiert, wie ökonomische Strategien, die Automatisierung lediglich als Mittel in der kapitalistischen Konkurrenz begreifen. Jenseits dieser Verengungen eröffnet sich eine Perspektive, die das Schreckgespenst der technologischen Arbeitslosigkeit entzaubert, die Ziele, die mit technologischem Wandel verfolgt werden, aushandelbar macht und Hoffnung auf qualitativen gesellschaftlichen Fortschritt zu wecken versucht. Diese Perspektive bildet die Schnittstelle für einen Dialog zwischen der frühen Kritischen Theorie, zeitgenössischeren Formen der Gesellschaftskritik und der Debatte über politische Gestaltungsansätze.

Dieser Dialog hat dabei eine starke internationale Dimension, insofern er die britische Debatte über Gestaltungsoptionen im Bezug auf die Automatisierung in den deutschen Kontext übersetzt und zugleich die deutsche Debatte über die Automatisierung und weniger bekannte Autoren der frühen Frankfurter Schule einer englischsprachigen Öffentlichkeit näherbringt. Gleichzeitig wird im Sinne des aufklärerischen Impetus dieser Arbeit der Versuch unternommen, die technikoptimistische britische Debatte der letzten Jahre zur emanzipatorischen Nutzung der Automatisierung insbesondere im Hinblick auf ihre Leerstellen in Bezug auf ökologische Nachhaltigkeit zu reflektieren, mit dem Ziel, einen zwar normativ orientierten und gleichwohl nuancierten und differenzierten Zugang zu den möglichen Folgen der Automatisierung und den Potentialen ihrer emanzipatorischen Aneignung zu entwickeln.

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List of Abbreviations

BDA	Confederation of German Employers' Associations
BIBB	Federal Institute for Vocational Education and Training
BMAS	German Federal Ministry of Labour and Social Affairs
BMWi	German Ministry for Economic Affairs and Energy
DGB	German Trade Union Confederation
FRG	Federal Republic of Germany
GDP	Gross Domestic Product
IAB	Institute for Employment Research
IAQ	Institute for Work, Skills and Training
ILO	International Labour Organization
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPPR	Institute for Public Policy Research
OECD	Organisation for Economic Co-operation and Development
PAQ	Projektgruppe Automatisierung und Qualifikation
SPD	Social Democratic Party of Germany
TA	Technology Assessment
UBI	Universal Basic Income
UK	United Kingdom
US	United States (of America)
ver.di	German United Services Trade Union

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1 Introduction

A spectre is haunting modern society – the spectre of technological unemployment: This is how Theodor W. Adorno characterised the debates on technological development of his time in a lecture held in Vienna in 1967. Invited by the Socialist Students of Austria to give a lecture on the roots of the success of the far right in the 1960s, Adorno discussed a number of tendencies that threatened to undermine social and political stability in post-war Germany, just decades after the fall of the Nazi regime. According to him, the fear of technological unemployment, or automation anxiety, was among the factors contributing to the rise of a new authoritarianism, which would promise to secure mass employment in times of economic uncertainty (Adorno 2019).

Although Adorno's worst fears did not come to pass in the last 50 years, the spectre he addressed continues to haunt public debate on the societal implications of technological development, provoking both anxieties as well as utopian longings. While some fear the erosion of social cohesion in the wake of ever-increasing automation, others express the hope that automation might make possible a society wherein the drudgery work, or at least the existing regime of wage labour, has been largely transcended.

Given the highly polarised debate on the societal implications of automation, it is an almost obvious candidate for reflection from a technology assessment (TA) perspective. This is partly due to the fact that TA – as a scientific advisory practice operating at the interface between science and society (see Grunwald 2019b: 36) – is specifically tasked with enhancing the reflexivity of debates on technological development and its implications (Grunwald 2019b: 89).¹ But there also exists a strong public demand for advice on the subject.²

This interest in the topic is hardly surprising: Given the importance of wage labour in capitalist societies and the distinct quality of technological innovation unleashed by capitalism, the fear of losing one's livelihood as more and more labour is automated, is understandable. And to be sure, the labour market effects of technological development in general and automation in

¹ For a general introduction to the history and practice of technology assessment, see Grunwald (2010, 2019b).

² According to a 2017 special report commissioned by the European Commission, automation is seen as a major societal challenge by the majority of citizens: in a survey, 74% of the questioned European citizens shared the assumption that the use of robots and artificial intelligence would lead to the disappearance of more jobs than new jobs would be created. Almost nine out of ten respondents agreed that the introduction of automation technologies needs to be carefully managed (Special Eurobarometer (2017)).

particular have been the subject of a burgeoning debate within TA (see for instance van Est/Kool 2015; EPTA 2016; Grunwald 2019a; Krings et al. 2021).

In my dissertation, I intend to expand this debate in the interest of a more enlightened and pluralistic democratic debate on the use of automation technologies. I set out to do this by developing a critique of certain limitations of both the scientific debate on automation and the dominant policy discourse on automation in Germany. This critique will be complemented by theoretical insights – broadly inspired by the early Frankfurt School and other strands of Marxist critical theory – into the challenges that our societies might face in the context of increased automation, as these challenges tend to be marginalised in current policy debates. Finally, I will formulate basic features of a technopolitical project that promises to advance an emancipatory approach to automation on both a theoretical level and in terms of policy.³

In doing so, I hope to incidentally demonstrate that the early Frankfurt School and associated Marxist critical theories can provide a valuable point of departure for a more comprehensive, economically reflected and normatively informed assessment of automation as well as for a debate about its future use. Furthermore, I aim to demonstrate the scientific topicality of the pioneering research into the political economy of technological development under capitalism developed by today lesser known proponents of the early Frankfurt School such as Friedrich Pollock, while simultaneously expanding upon it.

More specifically, in chapter two, I will first introduce the reader to the state of the art of the scientific debate on automation by reconstructing key concepts of the scientific debate on automation and basic notions on how technological development and labour markets interact in today's economy. Additionally, I will provide an in-depth analysis of two competing scientific approaches to assessing the potential for automation and its labour market effects and reflect their respective epistemic virtues and limitations. In doing so, I seek to clarify the epistemic basis on which claims about the future of automation can be made, and the relevance of these claims to policy debates.

In chapter three, I will introduce the contemporary German debate on automation, focusing on documents published between 2007 and 2016 by the social partners⁴, represented by the federal Confederation of German Employers' Associations (abbreviated BDA for *Bundesvereinigung*

³ By "technopolitical", I mean politics – particularly policy making – related to technological development. By project, I mean a point at which different social groups with potentially divergent political and economic interests converge around an issue, cf. Keil/Wissel (2019).

⁴ The term *Sozialpartnerschaft* or social partnership refers to the specific German model of corporatism, see chapter 3.

der Deutschen Arbeitgeberverbände), the German Trade Union Confederation (abbreviated DGB for *Deutscher Gewerkschaftsbund*) and the federal government.⁵ The subsequent reflection on how automation is framed in the contemporary debate will reveal that the dominant contemporary discourse on automation in Germany is extremely focused on a one-dimensional understanding of automation as a tool to increase global competitiveness. I will argue that this one-dimensionality leads to the marginalisation of automation anxiety and concerns about ecological sustainability, as well as of more utopian ways of thinking about automation and its potentials.

Chapter four is devoted to highlighting potential societal risks of automation that are being neglected in this debate. After discussing the possible risks to both social and political stability, I will argue that a key problem with today's dominant economic strategy of managing the labour market effects of automation through economic growth is that while it may be successful in the short to medium term, it will ultimately destabilise the ecological systems on which social reproduction is based, thereby leading to increased instability further down the line. From here, I will turn to developing some basic theoretical features of an alternative approach to automation that seeks to employ automation in an ecologically sustainable and socially inclusive way in the face of rapidly escalating ecological crises and polarising societies.

The final chapter, chapter five, will then be dedicated to assessing possible policy options to promote automation while making its implementation ecologically sustainable and economically inclusive. To do so, I will present and discuss six different policy papers I developed. These policy papers will deal with the implementation of collective working time reduction, with potentials to reconcile ambitious policy making to protect the environment and social well-being, with manipulating the relative costs of automation through redistributive wage policies and with the democratisation of investment. This focus on the discussion of policy options corresponds to the character of TA as a problem-oriented advisory practice, and also to the strong interest of stakeholder groups such as trade unions, politicians and activists from civil society more generally in concrete policy options to shape automation in a societally beneficial way. It also represents a vehicle for a more propositional line of thinking about automation which concretises my earlier theoretical discussion of the subject.

By reflecting on some of the (often hidden) assumptions and interests that shape the contemporary debate on automation, I hope to help enlighten it. At the same time, I hope to

⁵ In order to give English readers more direct access to German-speaking sources, I have opted to translate parts of the quotations, particularly in the empirical chapter 3 but also sporadically throughout the dissertation.

contribute to a more pluralistic democratic debate on the subject by offering insights on how automation might be used not just to execute the economic impositions of the capitalist mode of production, but rather to become a cornerstone of a project that seeks to transcend them. In doing so, I hope to contribute to a demystification of the spectre of technological unemployment by showing that it is ultimately social conditions, not technological development itself, that determine the social consequences of automation – and that, under different social conditions, automation might indeed become the blessing that its utopian proponents take it to be.

Before embarking on this endeavour, it is worthwhile to further illuminate the normative foundations of this book; after all, the adoption of a perspective that seeks to transcend the normative framework of many, if not most, of today’s studies on automation is not self-explanatory. Such an endeavour is prone to face criticism, even and especially within TA – an interdisciplinary field of study that extensively reflects upon its inherent normativity and transformative character as well as the respective limits of these, particularly given rapidly changing social and political conditions (Grunwald 2018b, 2018d; Nierling/Torgersen 2019, 2020; Grunwald 2021). The tension between TA’s aspiration to “achieve better technology in a better society” (Schot/Rip 1997: 266) – whether in the form of constructive technology assessment (Schot/Rip 1997) or transformative research such as real-world laboratories (Parodi et al. 2018) – and its aspiration to provide non-partisan expertise to legislative bodies (Grunwald 2018d) needs to be continuously negotiated.⁶

How, then, might normatively informed research perspectives on technological change be justified within TA? In general, TA can hardly be considered an a-normative endeavour: a commitment to the promotion of strong democracy, enhanced reflexivity, rational discourse, and sustainable development (itself an umbrella term implying a wide range of normative dimensions) is widely shared, or at the very least prominently advocated (e.g. Grunwald 2019b: 176–179). However, the question remains as to how these normative commitments can be theoretically justified, or whether they merely represent the sum of the individual dispositions of the scientists who constitute the larger TA community. In the face of this conundrum, requirements have been identified that should be met when introducing normative claims; namely, that they ought to be “well-legitimized” and made transparent (Grunwald 2019b: 179). Still, the question remains as to what can be understood as well-legitimised: If this legitimisation were to be understood as an empirical feature of a given normative position, e.g. its acceptance in wider policy or public discourse, the validity of TA’s normative framework would have to

⁶ The following discussion is based in part on Krüger/Frey (2020).

be understood as hinging on the acceptance of an external authority in a contingent way, which in the worst case would amount to little more than the statement “what has been widely accepted, is accepted (in TA, too)”. Such a structurally conservative understanding of “well-legitimised” clearly conflicts with aspirations of academic freedom and autonomy. Rather, well-legitimised ought to be understood in this context as the ability to be rationally explained: after all, if normative claims cannot and perhaps should not be avoided in the context of TA studies, they ought to be at least rationally argued for (cf. Grunwald 2019b: 179). I will therefore try to explicate the primary normative orientation of this book.

The normative framework of my research is the early Frankfurt School – represented by contributions by Max Horkheimer, Theodor W. Adorno, Herbert Marcuse and Friedrich Pollock in particular – and their attempts to develop a renewed, undogmatic Marxism and a theory “dominated at every turn by a concern for reasonable conditions of life” (Horkheimer 2002: 199). Accordingly, I hope to demonstrate that TA research in particular, as well as the more general public debate on automation, could well benefit from a scientific perspective that is aimed at human emancipation and transcends the narrow, one-dimensional framework of most contemporary policy debates.

The legitimacy, much less the relevance, of this normative framework cannot be considered self-evident, nor can it be regarded as a simple ideological presupposition, however: On the contrary, the reflection of the normative dimensions of science can be considered a – if not *the* – cornerstone of the early Frankfurt School. Its very existence as a distinct intellectual project is predicated on an understanding of the normativity of science that contrasts with ostensibly a-normative forms of science. A case in point is the probably best-known programmatic text of the Frankfurt School: Horkheimer’s “Traditional and Critical Theory”, first published in 1937.

Faced with the immense societal wealth created under capitalism and an unprecedented triumph of technology and (natural) sciences on the one hand and similarly unprecedented social catastrophes on the other hand, Horkheimer (2002) identified a discrepancy in the societal development of reason: the reflexive use of reason lagged behind an overpowering development of instrumental reason. Reflecting on the scientific practices of his time, Horkheimer introduced the differentiation between the dominant, so-called “traditional theory” and the emerging “critical theory”. In introducing these different forms of theory, he highlighted that this

distinction was not to be understood as one between “bad” and “good” science – or that Critical Theory⁷ should replace so-called “traditional theory” altogether.

Rather, it was meant to distinguish between two forms of theory in regards to their respective conceptions of themselves and the specific utility of the knowledge they produce. “Traditional theory”, according to Horkheimer, deals with the instrumental dimension of reason, investigating how we can and must act in the light of causal relationships in order to achieve our ends, and understood itself as a-normative and independent of the rest of society – with natural sciences serving as its model. Critical Theory, on the other hand, as noted above, would be “dominated at every turn by a concern for reasonable conditions of life” (Horkheimer 2002: 199) – a distinctly normative endeavour. But, one might ask, are these “reasonable conditions of life” not advanced by what Horkheimer calls “traditional theory”?

Far from denying the emancipatory potential of “traditional theory” – after all, understanding the causalities that govern nature would enable humanity to promote, oppress, and use natural processes according to its needs – Horkheimer emphasised the societal embeddedness of both scientific research and its objects, frequently themselves constructed or formed by human practices. “Traditional theory”, in contrast, would be prone to perceive its remit as a set of “simply natural” facts (Horkheimer 2002: 197–200), which in turn would limit its ability to reflect whether dominant social conditions (and the ends associated with them) were reasonable. Horkheimer argued that since current social structures are characterised by the fact that human beings and nature alike are regarded as mere resources for the perpetuation and intensification of capital accumulation, “traditional theory” effectively serves the control of human beings and nature for this purpose by disassociating itself from the reflection of these conditions.⁸ The practical usefulness of “traditional theory” would thus primarily benefit existing social conditions, deepening the domination of humanity. Instead of empowering humanity, it ended up contributing to its subjugation to social processes, conceptually naturalising them and thus stabilising them in the process.

⁷ In the following, I will use capital letters to denote the thinking of the first generation of the Frankfurt School (Critical Theory) in order to distinguish it from, for example, postmodern critical theory – this is not intended as an evaluative statement, but rather as a way of clarifying the theoretical point of reference.

⁸ Horkheimer builds on Marx’s critique of capitalist political economy, characterising the primary goal of capitalist economy as the surplus-value production in the interest of a theoretically infinite accumulation of capital. Many monographs have been devoted to the reconstruction of Marx’s critical theory and the introduction of a thesis is hardly the place to do so. For two more recent introductions, see Postone (1993) and Fuchs (2015). For a painstaking treatment of the *Neue Marx-Lektüre* that owed central impulses to two of Adorno’s students, Helmut Reichelt and Hans-Georg Backhaus, see Elbe (2008), for a collection of essential works by Marx, see Marx (2018).

Since Horkheimer saw "traditional theory" as productively integrated into societal structures that it would not question, he argued that the development of instrumental reason needed to be complemented by a form of reasoning that had "society itself for its object", taking an active role in societal development while at the same time breaking with the imperative to contribute to a "better functioning of any element in the structure". Instead of seeking "simply to eliminate one or other abuse", "it regards such abuses as necessarily connected with the way in which the social structure is organized" (Horkheimer 2002: 206–207). This qualifies the demand for "reasonable conditions of life" as a radical one, effectively aimed at the fundamental transformation of existing social conditions.

Critical Theory as a theoretical practice would focus on assessing the rationality of social conditions themselves. Horkheimer recognises that "the present form of economy and the whole culture which it generates [are] the product of human work as well as the organization which mankind was capable of and has provided for itself in the present era [...]. It is their own world." He emphasises, however, that the individual members of today's society "experience the fact that society is comparable to nonhuman natural processes, to pure mechanisms, because cultural forms which are supported by war and oppression are not the creations of a unified, self-conscious will. That world is not their own but the world of capital." (Horkheimer 2002: 207–208).

This fact – that contemporary society and its dynamics are the product of human practices and yet confront the individual in the form of an alien, seemingly uncontrollable power, reducing potentially free individuals to objects of dynamics beyond their control – is key to understanding the Frankfurt School's critique of capitalist society as both rational and irrational and will come up at several points in this dissertation. The quest for "reasonable conditions of life" then leads Critical Theory to argue for overcoming existing social conditions that are "conditioned by the blind interaction of individual activities", in the interest of conditions that allow for a greater realisation of human freedom and the collective "rational determination of goals" (Horkheimer 2002: 207); this amounts, arguably, to a Marxian formulation of the demand for strong democracy.

Introducing this comprehensive demand for partisanship in the interest of a more rational way of shaping societal, and thus technological, development into TA debates provides a foundation for normative claims for strong democracy and sustainable development, insofar as the deepening of democratic structures and sustainable development promise to foster conditions in which individual and collective autonomy is greatly increased (rather than structurally

undermined). As I will show, bringing together TA and the Frankfurt School's oeuvre of critique promises to increase awareness for the ways in which economic conditions shape technological development and its impacts, and offers a perspective that allows us to transcend these conditions and open up the discussion to alternative ways of designing and using technology.

In the face of destructive ecological and socio-technical dynamics that threaten to seriously restrict the freedom of present and future generations, this perspective would imply insisting on the primacy of reason in the application and development of technology, even and especially where currently profit maximisation determines social life, leading to the reduction of human beings to powerless objects of antagonistic economic processes and the careless degradation of our collective basis of existence. Horkheimer was not under the delusion that such a scientific programme would be widely popular. On the contrary, he predicted that because of its radical opposition to "prevailing habits of thought, which contribute to the persistence of the past and carry on the business of an outdated order of things", it would be construed as biased, one-sided and subjective, despite its own insistence on the rationality of its position (Horkheimer 2002: 218).

From a perspective that recognises the urgency of today's social and ecological challenges it is in turn curious to see that studies that reinforce political and economic concepts that at least in their central significance might be atavist (competitiveness, economic growth), and thus help perpetuate problematic social conditions, remain largely unscrutinised. As exemplified in chapter two, for example, hardly any of the studies dealing with the potentials of modern technology to boost the competitiveness of German companies consider the sound economic question as to whether an expansion of the German export surplus is a rational objective and what increases in national competitiveness might mean for other economies globally. Instead they rely on the common sense that competitiveness between national economies is a given fact, naturalising social conditions that are specific to capitalist political economy.⁹ Rather than accepting these social conditions as a given, the central emancipatory promise of the early Frankfurt School – and Marxist theory more generally – is that these conditions themselves can become the object of conscious design, thereby overcoming "a fundamental condition of all

⁹ This reinforces Horkheimer's observation that the question whether "new views in fact win out" in science is strongly influenced by historical circumstances and impulses to research that owe much to current social situations and relatively little to purely logical considerations (Horkheimer (2002: 195)).

previous history and complet[ing] the self-constitution of mankind: the end of prehistory.” (Habermas 1970: 116)

Given that there is likely little time left before tipping points in the climate system are crossed with fatal consequences and that the increasing political and social polarisation may bring catastrophe even more quickly (see chapter four), it may be time to reverse the burden of proof: How can one seriously continue to do research that reaffirms social conditions that are fairly certain to, as Horkheimer puts it, “drive [...] humanity into a new barbarism” (Horkheimer 2002: 227), instead of trying to make at least some small contribution to tackling the challenges of the historical situation we find ourselves in? One could even go so far as to claim that even the demand for a non-partisan position of equidistance towards different normative positions – a position that can confuse pluralism with indifference (as criticised at length in Marcuse’s polemic against “Repressive Tolerance” (1970)) – becomes unacceptable in times of existential threat. In other words, certain forms of behaviour should not be met with tolerance if they threaten to impede or perhaps even destroy “the chances of creating an existence without fear and misery” (Marcuse 1970: 82).

This brief recourse to the beginnings of the Frankfurt School is somewhat abstract and can hardly be considered conclusive.¹⁰ This thesis, however, represents the attempt to connect with some of the theoretical debates within the early Frankfurt School and to mobilise them in the interest of a better understanding of the contemporary debate on automation – and to move beyond it. The basic tenets of the early Frankfurt School – that contemporary society is a capitalist society, a society best characterised by the pursuit of profit and the pervasive dominance of commodity exchange, that these social conditions profoundly influence the thinking of members of society, and that need to be transcended to reconcile the emancipatory potentials of technological change with social and ecological sustainability – inform my research throughout.

As such, it illustrates how an approach inspired by Critical Theory – often seen as highly theoretical and abstract – can be concretised when dealing with a research subject such as automation. This applies in particular to my discussion of a technopolitical project around technological development in chapters four and five which allows me to show how early Critical Theory and more contemporary forms of social critique and progressive policy debate

¹⁰ A plethora of introductions and discussions of the early Frankfurt School and the biographies of its proponents exists, of course, ranging from handy paperbacks to monumental studies (Jay (1996); Demirović (2000); Schwandt (2010)). For a more detailed discussion of possible approaches to the question of normativity in TA, see Krüger/Frey (2020).

can be brought into dialogue. Despite its clear focus on promoting an alternative, normatively informed approach to automation, this book should nevertheless be understood as an attempt to open up, rather than close down, the debate on automation, both in its scientific and its more popular forms, rather than as an (in any case futile) attempt to dictate more enlightened policies from an allegedly privileged epistemic position. Rather, my discussion of policy options is intended to broaden the range of options available for public consideration.

But before attempting to discuss an alternative trajectory for automation, we should first clarify the epistemic grounds on which these debates might take place. Let us therefore first consider the state of the art of the scientific discussion on automation and its impact on labour markets.

2 The State of the Scientific Discussion on Automation

2.1 Understanding Automation

Any study dedicated to understanding the debate on automation and technological unemployment needs to establish a basic understanding of what these terms actually mean. The term technological unemployment seems clear enough, referring to a state of unemployment induced by technological development. As we will see later on, this apparent clarity needs to be questioned too, as technological unemployment can be understood as a complex phenomenon emerging from the interaction between technological development and a social system: the labour market. As such, the term technological unemployment is helpful in that it helps to draw attention to a socially relevant interaction between technological development and the economic sphere and yet it runs the risk of oversimplifying possible discussions of unemployment insofar as the roots of actual unemployment are concerned.

When it comes to automation, things get even more complicated. Migrating back from the United States of America (US) where the Frankfurt School, and most of its members, had found refuge from institutional and physical annihilation during the Second World War,¹¹ the scholars of the Frankfurt School brought with them exposure to the latest scientific debates in the US. It is generally accepted that it was there that the term automation first gained prominence in 1947, when Del Harder, a vice president of the Ford Motor Company, set up an automation department in the corporation (Rifkin 1995: 66).¹² The term quickly caught on to describe the dynamic technological development of the post-war economy, with the Subcommittee on Economic Stabilization of the US Congress dedicating a report on “Automation and Technological Change” as early as 1955 and the establishment of a dedicated subcommittee on Unemployment and Impact of Automation soon after (cf. Pollock 1964; for a historical overview see Nye 2006).¹³

¹¹ A notable exception is Walter Benjamin who in 1940 committed suicide on the French-Spanish border after a failed attempt to escape, rather than risk being surrendered to German troops.

¹² The term *Automatisierung* was however already used in German Marxist debate at least as early as 1903, when J. German published an article on the limits of automation in the production process in *Die Neue Zeit*, the theory journal of German Social Democracy (German (1903)).

¹³ The noun automation itself was preceded by the adjective “automatic” which already was used by Marx, who investigated the notion of an “automatic system of machinery”, a system that “executes, without man's help, all the movements required to elaborate the raw material, and needs only supplementary assistance from the worker”, already ascribing a merely supplementary role to workers within advanced production systems organised after “the automatic principle” (Marx (1982: 503); cf. Ropohl (2013)). Marx even goes so far to refer to such a production system as a „vast automaton“ (Marx (1982: 502–503)). Automaton is the latinised form of the ancient Greek αὐτόματον (acting of one's own will). These ancient Greek roots contain a suggestive core: as there is no not clearly distinction between the fact that an artefact is moving without immediate human action

As a result of this exposure, Friedrich Pollock, the Frankfurt School's chief economist and its long-time director, was uniquely positioned to become one of the pioneers of research on automation in the early Federal Republic of Germany (FRG).¹⁴ Still introduced as a resident of Los Angeles, he was invited to Munich to give a lecture on the "Economic and Social Consequences of Automation".¹⁵

Struggling to offer a generally accepted definition of the term automation, Pollock introduced three different ways to define it: the first definition would suggest that automation merely was a new term to describe the continued mechanisation of the labour process that started with the first use of tools by early humans. A second definition would suggest that the term automation denotes a set of radically new methods of production, for example featuring control from machines by machines. The third definition would focus on automation as the property of machines that gain the ability to substitute labour that before could only be carried out by humans – which according to Pollock means primarily "brain functions" – possibly banishing "direct" labour from factory floors and offices. To Pollock, the reason to use a new term to denote the phase of technological development he was analysing was primarily justified not so much due to the advent of some particular "technological wonder", i.e. some new features of technological artefacts, but rather due to the new and radical implications of technological development for the societal structure, namely through high levels of mass unemployment, possibly undermining social stability and implying the need for a reasonable governance of economic processes to avoid social and economic crises (Pollock 1956: 68–70).

Despite a continuous scientific debate on the subject, in Germany represented for instance by the prolific Projektgruppe Automation und Qualifikation (PAQ), this polymorphism of the term automation persists (see for instance PAQ 1975: 5).¹⁶ However, the PAQ achieved greater progress exploring the limits of the "substitutional logic" of automation. Illustrating the necessity for humans to intervene into automated processes by regulating and fixing them as

and the attribution of a "will" to it, the term already seems to imply the contemporary confusion between machines as a tool that serve human interests (for instance to save labour costs) and actors of their own accords (e.g. "coming for the jobs of human workers" out of some inexplicable craving).

¹⁴ Today, Pollock's work has largely fallen into oblivion, despite his innovative contribution to the scientific discussion on automation, highlighting both the lack of historical awareness in many discussions on technological development – oftentimes enveloped by an air of radical novelty – and the marginalisation of economic thinking in the reception of the early Frankfurt School. One recent exception to this neglect is Jason Smith's work on automation (cf. Smith (2020)).

¹⁵ Pollock's lecture was part of a lecture series whose proceedings were published under the colourful title "Revolution der Roboter" (Revolution of the robots). See Pollock (1956).

¹⁶ In some publications, the PAQ however focuses on the cognitive dimension of automation, leaning towards the third of Pollock's definitions (see PAQ (1987)).

well as by further improving them and by specifying and planning their target conditions, gradually an understanding of automation arose that moved past visions of deserted factory floors to a more nuanced understanding that focused on automation of particular tasks and the increase of output per hour worked (cf. PAQ 1987: 26–29, for further discussion of the social limits of automation and persisting engineering challenges see below).

For the purposes of my study, I will adopt the understanding of the term automation put forth in the final sense suggested by Pollock, focusing less on specific properties of particular technologies, but rather stressing a qualitative challenge associated with technological development: an overall substitutional effect of technology that might call existing economic arrangements, particularly concerning the labour market, into question.¹⁷ Certain semantic grey areas remain, however. Does a 3D-printer that allows for the production of complex spare parts on site qualify as an automation technology, despite the fact that it does not substitute existing human labour directly (for example in assembly work or logistics) but rather allows for a whole new organisational model? What about self-service terminals that do substitute for human labour from the point of view of a business owner, but not by eliminating the need for it, but simply by transferring paid wage labour to the unpaid individual consumer? What about electric cars, which might be less labour intensive to manufacture – but primarily due to reduced product complexity, again eliminating rather than substituting existing human labour?¹⁸

At the same time, focusing on the substitutional effects of technological development and its challenge to social arrangements does not represent the only meaningful direction of inquiry regarding technologies that could be considered automation technologies, as for instance the burgeoning research on human-machine-interaction illustrates. Furthermore, this way to conceptualise automation reinforces an analytical perspective that focuses mainly on paid wage

¹⁷ Chapter 4.2 is dedicated to discussing these qualitative challenges to societal development discussed in the context of automation in Marxist theory.

¹⁸ The challenge of finding an applicable definition of the term automation is, of course, not unique to my work. When asked to provide data on the level of automation within the German economy, the Federal government dismissed the question due to the lack of a generally accepted definition of automation levels (Bundestag (2018: 4)). Researchers, confronted with similar challenges, have resorted to measuring proxy-indicators, such as productivity gains, patenting activity or the adoption of specific automation technologies, primarily robotics (cf. C. Frey (2019: 243)). All of these proxy-indicators have clear downsides (productivity increases might also be accrued from work intensification or organisational innovation, patents can refer to all sorts of inventions and measuring the level of automation by counting the number of robots is similar to assessing the general use of fossil fuel by counting the number of cars in use) but they nonetheless seem to be useful approximations – it just seems quite challenging to clearly differentiate automation technologies from other forms of technological innovation in the economy.

labour and thus, as with much of the debate on automation, marginalises the recognition and discussion of private care work and its automation.¹⁹

One might thus criticise that such an understanding of automation remains to a certain extent abstract and problematic, but perhaps this is a necessary concession in order to obtain a term that is capable of bringing together debates on various technologies and technological visions (robotics, artificial intelligence, computerisation, digitalisation, Industry 4.0, etc.) which, despite their diversity, share a meaningful aspect – their concern for the labour market impacts of technological development. The term of the spectre introduced by Adorno into the debate on technological unemployment seems all the more apt now however, as the terms automation and technological unemployment display an enigmatic feature: applicable to a variety of technologies, they are not immediate properties of the specific technologies themselves, but of their interaction with a social sphere – allowing for alternative framings of “automation technologies” that highlight other properties and possible consequences of said technologies. The meaningfulness of the two terms for research then is intimately linked to the specific epistemic interest guiding it: understanding how technological development might challenge existing social arrangements.

¹⁹ For a short discussion of the automation of private care work, see sub-chapter “The realm of freedom at home” in chapter 5.4.

2.2 State of the Art: Automation and Technological Unemployment

A Short History of Technological Development, Productivity and Employment

How exactly does automation challenge existing social conditions? To learn more about this, let us start by briefly taking a historical perspective: In their short *History of technological revolutions and employment*, Carl Benedikt Frey²⁰ and Michael A. Osborne – amongst the most prominent contemporary automation scholars – trace the roots of this debate back to as early as the late 16th century and the invention of the stocking frame knitting machine by William Lee. Lee's invention was met by fierce resistance from the British guilds, which were dedicated to maintaining traditional labour market conditions that valued the guild members' skill sets and therefore the corresponding technological status quo. Lee eventually was forced to migrate to France, being denied a patent to his innovation by the Crown. His story helps us to learn two things: first, that technological development, and to an even greater extent the large-scale use of technologies, does not necessarily follow a straight-forward, autonomous path, but rather interacts closely with existing social conditions, with “powerful social and economic interests” exercising selection pressure on technological innovations and their adoption. Furthermore, Queen Elizabeth I refused Lee his patent specifically citing concerns regarding the effect his invention might have for the labour market, possibly reducing her subjects to beggars (cf. C. Frey/Osborne 2013: 6). As early as the 16th century, the spectre of technological unemployment was haunting the debate on public policy.

Roughly a quarter of a millennium later things had changed decisively when riots, partly fuelled by workers' fear of technological unemployment, erupted throughout the first decades of the 19th century. Thousands of soldiers were deployed to suppress the workers with military force. This turn was at least in part enabled by the establishment of parliamentary supremacy over the Crown, which led to a shift of political power towards the “property owning classes” (C. Frey/Osborne 2013: 7), which plausibly both had a vested interest in the protection of its property as well as less of a propensity for sentimental concerns that might hinder the employment of more effective tools for capital accumulation.

In the long term, both legislative resistance and worker militancy aimed at suspending technological development proved largely unable to halt the onslaught of technological

²⁰ In the following, literature references to contributions by Carl Frey are quoted as C. Frey to distinguish them from references to earlier contributions by myself.

development that accompanied the triumphant march of capitalism.²¹ And this development turned out to be transformative, multiplying productivity and turning once agrarian societies into modern economies.

To take Germany as an example, in the middle of the 19th century almost 57% of the population of the German Confederation were employed in the primary economic sector (including forestry, fishery and agriculture), a little more than 23% worked in the secondary sector (for the most part synonymous with manufacturing) and 20% in the tertiary sector (i.e. service industries). Shortly after the foundation of the German Empire the share of employees in the primary sector had fallen below 50% for the first time, with the secondary sector surpassing the primary in terms of the employment by 1907. At the end of the Weimar Republic, the employment share of each of the economic sectors was roughly split equally²² and the early FRG saw manufacturing becoming the undisputed main sector of employment, with the employment share rising to 47,6% in 1960 (cf. Pierenkemper 2015: 146). While the 1950s and 1960s can thus be understood as the heyday of manufacturing in Germany, the works of Pollock and others provide powerful testimony to the concerns at that very time that continuous technological development might eventually undermine employment in the manufacturing sector, after rapidly increasing productivity had already enabled coinciding growth in agricultural output and relative decrease of employment in the primary economic sector.²³

²¹ This is not to deny that workers' resistance or legislative action can play a key role in shaping technological development however.

²² This holds equally true if you include unemployment as an "employment" sector which in 1933 was at an extreme high with 26,3% of the working population being unemployed, providing part of the socioeconomic conditions that gave rise to the barbarism of German fascism. In comparison, unemployment rates rarely went substantially above 10% in most of modern German history.

²³ For an insightful and entertaining introduction to the past and the future of technological development in agriculture, including the processes of economic concentration that took place in this context, see Kurz/Rieger (2013).

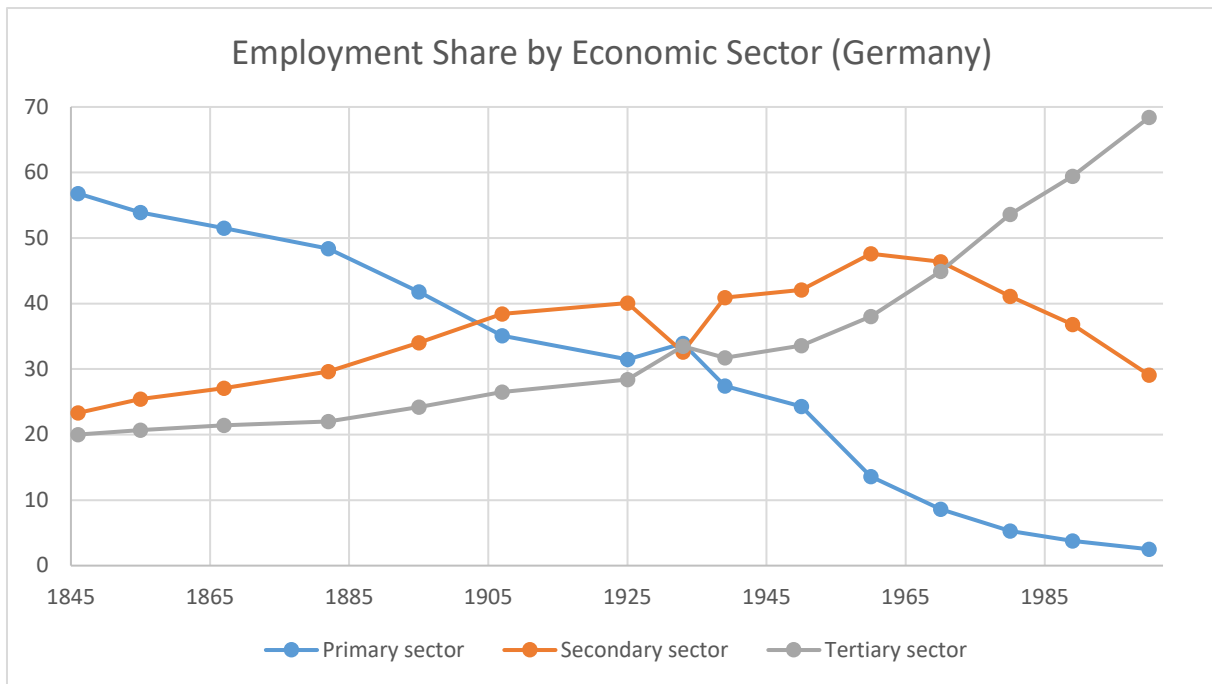


Figure 1: Employment Share by Economic Sector (Germany)

In a relative short period of time, tertiary employment all but overtook the secondary sector by 1970 (46,4% vs. 44,9%), eventually leading to a second transformation of the composition of the German economy. At the beginning of the 21st century, there existed more than twice as much employment in the service sector than in the manufacturing sector (29,1% vs. 68,4%), despite the continuously high economic and political importance of the manufacturing sector. Meanwhile, the primary sector has become virtually insignificant in terms of employment with a share of 2,5% (cf. Pierenkemper 2015: 146). The extremity of these figures betrays the scale of the radical changes to the lives of hundreds of millions of people who took part, willingly or unwillingly, in processes of fundamental societal transformation:

People being forced to leave their rural origins to seek employment in the sprawling cities of industrializing Germany, seeing their professional qualification made redundant by the introduction of new technologies, baring witness to the deindustrialisation of communities and the rise of oftentimes badly paid service sector employment; at the same time, overall wealth grew to unprecedented dimensions, new jobs were created and consumption levels reached ever new highs. To some extent, this can be illustrated by the growth of the national Gross Domestic Product (GDP) – one of the most established indicators of economic performance, measuring all goods and services produced in an economy in a given time period. Within 150 years, the German GDP per capita for instance grew from 1,775 Euro in 1850 to 21,521 Euro in the year

2000, or to staggering 1,212% of its original value (Metz 2015: 189).²⁴ In effect, in 2000 the German economy produced more riches per capita, per month, than it used to produce *in a whole year* in 1850. At the same time, average weekly working hours more than halved (Pierenkemper 2015: 152). Accordingly, it would be no exaggeration to claim that workers today are dozens of times more productive now than only 200 years ago.

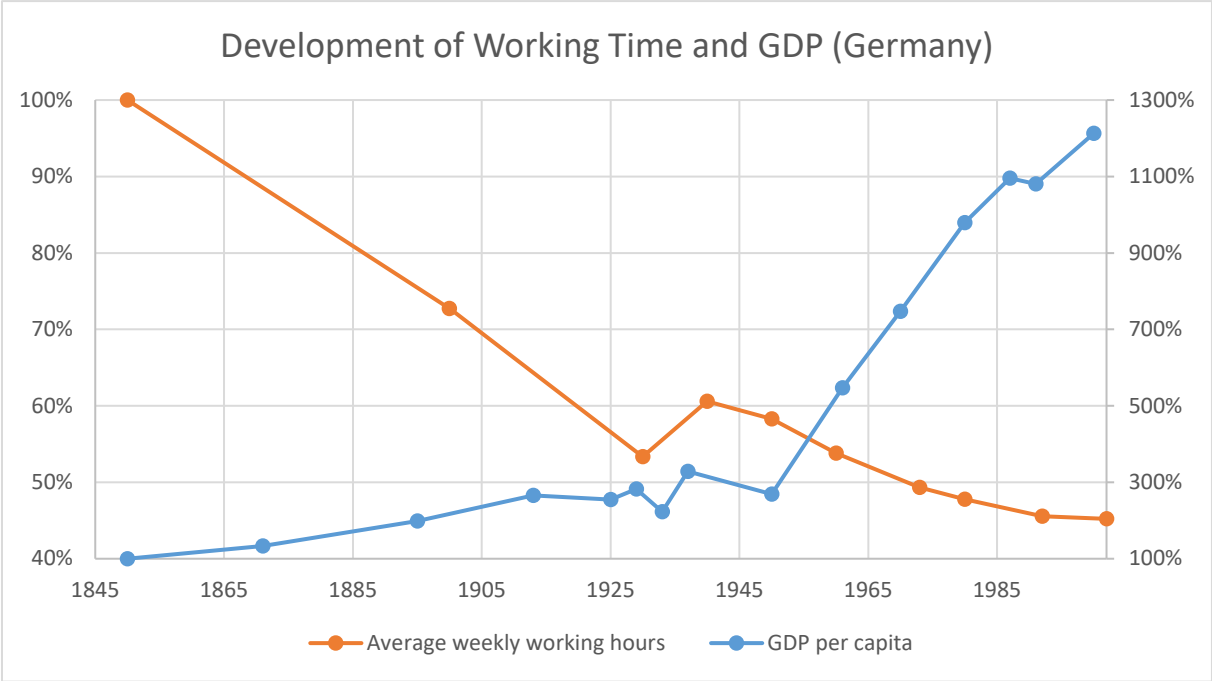


Figure 2: Development of Working Time and GDP (Germany)

In the bigger picture, the population in the Global North has largely profited from this development, as can be illustrated by the doubling of the German Human Development Index within a century (Pierenkemper 2015: 152).²⁵ Likewise, the periodically re-emerging fears of extensive technological unemployment seem not to have been realised. On the contrary, thanks to low unemployment rates and increased labour market participation, Germany’s employment rate in 2018 was at an all-time high of 75.9% of the population aged 15 to 65 (IAQ 2019), spawning talks of a *Jobwunder* (job miracle).²⁶ Against this backdrop, it might seem that

²⁴ Metz provides data on the GDP per capita in 2005 constant prices, not discussing details of how this conversion was carried out.

²⁵ The Human Development Index was developed by the United Nations Development Programme and aggregates various indicators on life expectancy, education levels and per capita income on a national level.

²⁶ It should not be forgotten, however, that this record-high employment rate is based on much lower working hours. While German employment rates in 1925 and 2000 were pretty much identical, today’s high employment rate are being accompanied by high levels of part-time work and, historically speaking, a dramatic decrease in overall working hours. While in the German Empire working hours per capita (not per employed person!) equalled around 1,500 hours, it fell to around 1,200 hours in 1925 and below 700 hours around the year 2000 (Schildt (2008)). This illustrates that today’s high employment rates do testify that growing productivity can in the long run coincide with stable employment levels – provided radical reductions of working hours take place (see below).

concerns of technological unemployment (or ‘automation anxiety’) are at best grounded in a misunderstanding of the macro-economics of capitalist societies. At worst, it might indicate an irrational, stubborn sentiment, counterproductive to both individual well-being as well as social development.

To reach a more comprehensive assessment of the (ir-)rationality of automation anxiety, I will first discuss some of the mechanisms that have thus far prevented the spread of technological unemployment despite substantial increases in productivity. Next, I will discuss some of the circumstances under which these mechanisms might fail and reflect whether there is reason to take automation anxiety seriously, even in cases where technological unemployment might prove only to be transitional or even non-existent.

Automation and the (Labour) Market

So, let’s start out by asking ourselves: *why are there still so many jobs?* In a 2015 paper with this title, David H. Autor, one of the most prolific economists active in the contemporary automation debate, starts out by highlighting the labour-saving effect of technologies, posing the question as to how a reduction of aggregate employment might be prevented, despite increasing productivity (Autor 2015b: 6). Citing the popular example of the positive effect the introduction of automated teller machines (ATMs) have had on employment in the banking sector, he illustrates that the relationship between employment and technological development is not as straight-forward as one might expect. Although ATMs allowed the partial substitution of human labour, they also reduced “the cost of operating a bank branch”. The falling costs of additional branches encouraged banks to open additional branches, thus increasing the total demand for human labour. Having automated the task of tallying currency, bank tellers could focus on their tasks as salespersons for the bank in a move towards “relationship banking” (Autor 2015b: 6–7), leading to a change of the tellers’ job profiles, rather than their wholesale substitution.

This of course requires a certain elasticity of demand to exist: if there is no demand for additional bank branches, even investing the reduced costs of maintaining them might turn out to be economically unattractive. At the same time, it demands a certain elasticity on the side of labour supply: if the tallying of currency were to be automated but the existing bank tellers would prove to be unable to fulfil the tasks demanded from them for “relationship banking”

(and no other workers could be found who would be qualified to fill these positions) then opening up new bank branches would likewise turn out to be difficult.

But even if market saturation for a certain type of commodity (or service) might be reached, the increased productivity of a national economy might lead to an increase in wages – or at least free up money for consumption in other parts of the economy, as the price of commodities falls thanks to lower production costs. The increased purchasing power might then provide the ground for newly emerging products, services and jobs (C. Frey/Osborne 2013: 13; cf. Autor 2015b; Srnicek/Williams 2015: 99). As the Institute for Public Policy Research (IPPR), a self-defined progressive British think tank, concludes in its illuminating report *Managing Automation*:

“Whether a machine performs all, or some, of the tasks previously performed by workers, it will likely increase labour productivity [...]. With the aid of machines, workers can then produce the same amount of outputs as before but in less time. Whether higher productivity leads to fewer or more labour hours then depends on the level of demand for the product.” (Roberts et al. 2017: 8)

Historically, one of the best examples for increased employment in a sector displaying strong productivity growth is the car industry: cars fairly quickly became a product of mass consumption after novel production methods pioneered by the Ford company – the birthplace of 20th century automation (see above) – drove down product prices, with strong employment in this sector leading to increased demand in other sectors of the economy. Simply put, even if you manage to double productivity, if the commodity you produce suddenly is demanded (and can be afforded) by the majority of the population rather than a small elite, you might yet need to hire more workers to match this demand.

At the same time, even moderate increases in productivity in a sector might lead to a corresponding reduction in employment if demand lacks elasticity (either due to market saturation or lack of purchasing power). But even then, as indicated above, aggregate employment might not fall over the whole of the economy as wages are spent in other parts of the economy. The additional demand for commodities and services in other sectors might then lead to a shift of employment towards these new growth sectors. The expansion of the leisure industry is a good case in point for this kind of “spill over” effect (cf. Vermeulen et al. 2018: 3). Of course, like the adaption to the changed profiles of existing jobs, the build-up of employment in other economic sectors might require a different set of skills of workers, possibly devaluing existing qualifications and introducing the need of requalification, where possible, to ensure the elasticity of labour supply required for adaption. Job growth in other parts of the economy does also not guarantee that these jobs will be equally well-paid. The

contrary seems to have been the case in the last decades, with increased automation leading to slightly higher rates of unemployment but even more pronounced wage depression, coinciding with an increased polarisation of the labour market as small numbers of well-paying new jobs are created while low-paying service jobs substitute former manufacturing jobs (Autor/Dorn 2013; Acemoglu/Restrepo 2020).

And finally, the quantity of labour supply is not fixed either: not only can individual working times be reduced to prevent job losses by redistributing work, but the share and size of the working population also depends on other factors such as time spent in the educational system, incentives and obstacles for labour market participation (particularly for female workers), migration and demographic change. The latter has drawn particular attention in some of the latest contributions to the debate on automation in Germany, where automation and demographic change are positioned as competing forces, one representing a possible labour demand shock, the other a possible labour supply shock, with the German working population projected to shrink by around 11% by 2060 (Suedekum 2018).²⁷

All in all, one can conclude that there exists no direct link between technological development and so-called technological unemployment. Rather – and this observation seems helpful in interpreting the highly charged discourses on automation – statements issued in the context of the debate on technological unemployment can be understood to, consciously or not, be more general statements on the future prospects of the national economy as a whole: if one is doubtful about the economy’s ability to generate growth, to reskill workers and to supply sufficient funds to people to keep up and even expand demand for commodities and goods, fears of technological unemployment are perfectly reasonable. If one is of the opposite conviction, one might be more prone to disregard automation anxiety as an ignorant prejudice. Especially in export-oriented sectors, automation might actually be considered a strategy to prevent the loss of employment (see chapter 3) since falling product prices might actually lead to growing global market shares and thus the consolidation of employment.

²⁷ Making predictions is notoriously difficult (see below) and projections of demographic change and whether it might be (over-)compensated by productivity increases are highly dependent on assumptions made regarding both productivity growth and fertility and migration rates. Nikolai Stähler’s assessment that productivity increases might likely overcompensate for a declining working population (Stähler (2020)) seems plausible however, as in light of the impressive productivity increases of the past, a loss of 11% of the working population over the course of 42 years seems almost negligible (for comparison: according to the OECD ((2019)), per hour productivity more than doubled between 1977 and 2018 in Germany, meaning that even a slightly smaller working population would be able to easily produce a much greater total GDP).

This does not mean, however, that automation anxiety would be entirely unfounded: labour supply elasticity might turn out to be too low, for instance due to a lack of (re-)qualification opportunities or the inability of workers “to keep up” (Srnicek/Williams 2015: 89) – a fear that might be very real for individual workers. Against the backdrop of low growth rates, the promise that productivity increases will smoothly be compensated by the creation of new jobs also seems increasingly doubtful, at least on a national level. It becomes even more doubtful considering the fact that the strategy to gamble on ever-increasing economic output to prevent drops in aggregate labour demand might not be ecologically sound (see chapter 4.2).

In extreme cases, it might even be conceivable that automation technologies are deployed at such a speed that either there are negative “spill overs” into other sectors (i.e. the reduction of employment in one sector leads to an overall reduction in aggregate demand for goods and services, exercising stress on other sectors of the economy), particularly if these rapid innovations take place in a key sector of the economy (such as the car industry in Germany) or in several sectors at once (Srnicek/Williams 2015: 89). Such a vicious cycle in which rapid technological development leads to a depressed labour demand, leading to depressed purchasing power, leading to a drop in aggregate demand and therefore to a further depression of labour demand (and so on) was indeed one of the scenarios Marx considered in his famous *Maschinenfragment*. As long as the speed of technological development outpaces that of economic growth, overall labour demand might become increasingly depressed, leading to a secular crisis (see chapter 4.2 for a more detailed discussion).

Of course, even then, as my discussion of policy options in chapter 5 will illustrate, there exist ways to manage automation or at least its socioeconomic effects. One obvious option for stabilising the labour market, to foreshadow later chapters briefly, would be to react to reduced aggregate labour demand by shortening the working week, thus contracting the aggregate labour supply. Alternatively, some of the possible downsides of depressed wages might be counteracted by a partial decoupling of income and work and/or a more equal redistribution of the profits generated by increased automation throughout the whole of society, ensuring that overall purchasing power does not drop decisively and that the elasticity of demand required to absorb increased production may be maintained, even if there is a drop in employment.

The discussion of the societal challenges introduced by automation thus far has been very much related to the economy as a whole. Aside from these somewhat abstract considerations regarding the overall stability of the economic system, automation can also appear as an

individual challenge: in a society in which the satisfaction of most needs is mediated through the market and thus requires access to financial resources, where most people are directly or indirectly dependent on wage labour to acquire these resources, where people are taught that wage labour is a key component of their personal identity and where even the prospects of your children very much depend on your prospect of earning an income, it is understandable that people might feel threatened by automation. This automation anxiety itself constitutes another societal challenge, as fear of automation (unfounded or not) might lead to increased political instability (see chapter 4.2).

These concerns are widely shared²⁸ and even scientists who opt for more optimistic perspectives accept “that rapid automation may create distributional challenges that invite a broad policy response” (Autor 2015b: 8). Others highlight that “the most likely outcome of automation is an increase in inequalities of wealth, income and power”, should there be no robust policy intervention (Roberts et al. 2017: 24ff.). These concerns can hardly be satisfied by the observation that, over the long run, one can generally say that labour markets in the past have stabilised despite all technological developments either. For one, the basis for induction is extremely small within a historical perspective: subscribing for a moment to the popular notion that we might be witnessing a ‘Fourth Industrial Revolution’, we might feel inclined to critically consider the statement “it went well enough three times, why should it not work out the fourth time?” as a bit of an intellectual gamble (cf. Autor 2015b: 4; Grunwald 2019a: 55–56).

One could also call into question the usefulness of such an observation more generally. As Keynes once neatly expounded: “[the] *long run* is a misleading guide to current affairs. *In the long run* we are all dead. Economists set themselves too easy, too useless a task if in tempestuous seasons they can only tell us that when the storm is long past, the ocean is flat again.” (Keynes 1924: 80) Not only is the preconception that things will eventually turn out well eventually very little help in responding to the widespread concerns about automation, it also obfuscates the possibility of the catastrophes, individual and collective, that might arise from just a few years of transitory unemployment or the very fear of technological

²⁸ In 2017, a Special Eurobarometer on *Attitudes towards the impact of digitisation and automation on daily life* found that 72% of German citizens interviewed agreed, or totally agreed, that “Due to the use of robots and artificial intelligence, more jobs will disappear than new jobs will be created”. Only 4% totally disagreed, barely matching the number of people answering “Don’t know” (Special Eurobarometer (2017: 80)). 91% of the respondents agreed that “Robots and artificial intelligence are technologies that require careful management”, with a whopping 59% totally agreeing to this statement, compared to only 2% of respondents totally disagreeing with this assessment (Special Eurobarometer (2017: 62)).

unemployment itself (cf. Pollock 1964: 28ff; C. Frey 2019), especially as the adaption of the labour market to major technological developments has taken longer than an average working life in the past (Mokyr et al. 2015).²⁹ References to the long run regarding processes of sociotechnical change are at best ill-informed and distract from the need to shape sociotechnical development in the short, medium and long run. Accordingly, the question as to which policy options exist to manage automation persists (see chapter 4 and 5).

The Future(s) of Automation

But what insights can the contemporary scientific debate on automation provide when it comes to the extent that automation might happen in the future? A myriad of studies has been published in recent years on the impact of technological development, most often described as automation and digitalisation (for overviews with a German focus see Matuschek 2016; Kaltenborn 2019; Laukhuf et al. 2019). Aside from different methodologies applied and differences in the data employed, it is the differences of the research questions dealt with in these studies in particular that make it difficult to give a general assessment of the current state of research on automation.

One might broadly distinguish two lines of inquiry regarding the future of automation in the literature: studies that explore the *technological potentials* for automation today or in the near future on the one hand, and studies that try to predict actual, future *job losses* on the other. While these two lines of inquiry are easily confused, they nonetheless represent crucially distinct paths: as discussed above, there is a number of reasons why increased automation cannot simply be equated with aggregate job losses. To read even the simplified statement “every second worker in today’s economy could be substituted by robots and AI” as “we will soon have a rate of 50% technological unemployment” presupposes that there will be no countervailing job creation at all, an assumption that is highly improbable. What is more, even if the substitution of human labour would be technologically feasible, there is no automatic mechanism that would ensure that this automation would actually take place. Indeed, adoption of automation technologies is dependent on a number of additional variables, the relative costs of automation being a central one. If the costs of automation technologies vastly exceed the amount of wages that could be made redundant by introducing them, adoption across the

²⁹ In this context, it might be particularly worthwhile to remind ourselves of the fact that it took less than half a decade for the NSDAP (the historic Nazi Party) to surge from only 2.6% of the national votes in 1928 to power in 1933.

economy will likely be slow. Furthermore, increasing political opposition to automation technologies might slow down their adoption – for instance through legislation, strong union opposition or worker militancy (cf. C. Frey/Osborne 2013: 43–44). As such, technological feasibility does not directly translate into economic reality.

Much seems to be technologically feasible, however. Frey and Osborne famously found that 47% of jobs in the US featured more than 70% probability of “potentially [being] automatable over some unspecified number of years, perhaps a decade or two” (C. Frey/Osborne 2013: 38). Applying their methodology to Germany, Carsten Brzeski and Inga Burk concluded that 59% of jobs in Germany might be at risk (Brzeski/Burk 2015).³⁰ Another study by the Leibniz Centre for European Economic Research in Mannheim for the Federal Ministry of Labour and Social Affairs (BMAS) attempting to apply the methodology of Frey and Osborne to Germany slightly lowered this number to 42% (Bonin et al. 2015). Several other studies published are situated in the same general order of magnitude: The study *A future that works: Automation, employment and productivity* by the McKinsey Global Institute concludes that around 45% to 47% of work “activities [...] can be automated by adapting currently demonstrated technologies” (Manyika et al. 2017: 47) and two studies by the Institute for Employment Research, the research branch of the German Federal Employment Agency, seem to suggest a potential of substitution of around 40% (cf. Kaltenborn 2019: 35).

Studies following the other line of inquiry (focused on net effects on the labour market) tend to highlight the economic opportunities provided by technological development, citing weak positive effects or negligible negative effects on total employment and chances of an upskilling of the work force as well as increased competitiveness supporting strong employment (cf. Laukhuf et al. 2019: 69ff.).

The overall takeaway of this state of the art of research could therefore be summarised as: there is a shared sentiment in the scientific field that there exists great potential for automation, with almost every job in today’s economy possibly becoming substitutable in the next one or two decades. On the other hand, technology has proven not to undermine aggregate employment in

³⁰ Brzeski and Burk are employees of the ING DiBa bank. In general, research on automation in Germany is frequently connected to financial institutions, ministries, unions, consultancy firms and political think tanks. While not problematic in and by itself, as long as the methodology is more or less clearly described, it nonetheless reinforces the particular importance of reflecting the normative dimensions of studies published in this field (see my discussion of Wolter et al. 2016 below).

the past and the economic opportunities afforded by technological development should make sure that employment remains roughly the same while productivity increases.

This would be an error however. While ascribing every study the same claim to truth and trusting in collective intelligence might seem a plausible and even pluralistic-democratic approach it is nonetheless problematic. First of all, the quality of the methods, data and so forth employed by the various studies might differ greatly³¹, rendering the “principle of indifference” unjustified (cf. Betz 2016: 7). Additionally, as the collective failure of the economic profession to anticipate the last great financial crisis illustrates, not even a strong agreement within scientific discourse can guarantee the correctness of this agreement, particularly when it comes to the social sciences. The validity of studies needs to be accessed based on their own merits, not based on some form of ‘common sense’.

Therefore, apart from identifying general strands of research and discussing their common features, a proper assessment of the epistemic power of research on automation can only be made on a case-by-case basis. In the following two sections, I will introduce two exemplary studies on the future of automation, one for each strand of the research approaches introduced above, and discuss their epistemic advantages and limitations. The hope is that by discussing these two exemplary studies, we can gain a better understanding of how to approach and assess studies in this field more generally.³² In a last step, I will discuss what societal functions these different forms of studies might serve and try to give an assessment of these two competing research strands from the point of view of Critical Theory.

³¹ For a discussion of quality criteria for studies conducted regarding future impacts of technologies, see Grunwald (2010).

³² These studies will also provide us with an opportunity to learn more about what automation technologies are currently discussed in the scientific debate on automation and what novel properties are ascribed to these technologies that might change the dynamics of automation in the future.

2.3 The Future of Automation: Two Approaches³³

Investigating Future Technological Potentials

The first study we will review in some detail will be the (in-)famous study *The Future of Employment: How susceptible are jobs to computerisation?* by Frey and Osborne. Not only can it be considered the prototypical contemporary study on the technological potentials of automation, spawning a multitude of adoptions of the study with reference to different nation states, it also is perhaps the central study of the contemporary debate on automation which helped to reemphasise the importance of the subject to policy-makers and the general public (EPTA 2016: 85). And finally the study was scrutinised extensively by the scientific community, laying bare possible weak points of the approach and triggering the authors to expand on their already extensive description of the study's methodical approach (C. Frey/Osborne 2018).

After their introduction to the history of debates on technological development and employment that we have already engaged with in some detail above, the authors turn towards the future by discussing “advances in fields related to Machine Learning (ML), including Data Mining, Machine Vision, Computational Statistics and other sub-fields of Artificial Intelligence (AI)” that might allow both for the automation of cognitive tasks in the future and further advances in the development of robotics and thus the automation of manual labour. They highlight that historically, the automation of non-routine tasks was deemed impossible. As such, the question of automatability largely came down to whether a task was based on explicit, standardised procedures with little to no need for adapting on the fly.

But advances in the field of machine learning, combined with increasingly complex and comprehensive datasets that could be employed for the training of the algorithms and rapidly declining costs of computation, sensor technologies and robots would now, according to Frey and Osborne, render previously unautomatable non-routine tasks more and more automatable, as illustrated by progress in the field of, for instance, deciphering handwritings, translation and autonomous driving (cf. C. Frey/Osborne 2013: 14–22). As a consequence, Frey and Osborne turn away from the classical distinction between routine and non-routine tasks and embark on a search for other so-called “engineering bottlenecks” – technical challenges that are, according

³³ The second half of this chapter has been published as Frey (2021a).

to their review of the research field, unlikely to be mastered in the near future and thus limit the scope for automation.³⁴

Searching for Refuges of Human Labour

They identify three such bottlenecks: complex perception and manipulation, creative intelligence and social intelligence. They point out that algorithms still struggle with “identifying objects and their properties in a cluttered field of view” and thus also with the manipulation of irregular objects (C. Frey/Osborne 2013: 25). They also highlight challenges in terms of failure recovery and the development of soft manipulators and tactile feedback mechanisms. Regarding challenges to emulating creative intelligence, Frey and Osborne emphasise that tasking an algorithm with novel recombination of existing knowledge would by itself not much of a challenge. The real challenge would be to “find some reliable means of arriving at combinations that ‘make sense.’” (C. Frey/Osborne 2013: 26). In other words: having algorithms create something “novel” might be perfectly technologically feasible, but the result might not match our needs, which might themselves be difficult to elaborate beforehand. Lastly, and maybe more importantly, Frey and Osborne point out that even if an algorithm were to provide an output that could be described as creative, “there would still be disagreement about whether the computer appeared to be creative”, indicating the relevance of mechanisms of cultural persistence related to creativity. Lastly, the authors turn towards the challenges of emulating social intelligence, which is required in persuasion, negotiation and care. They refer to progress in the research field of affective computing but nonetheless point out that “[w]hile algorithms and robots can now reproduce some aspects of human social interaction, the real-time recognition of natural human emotion remains a challenging problem, and the ability to respond intelligently to such inputs is even more difficult.” (C. Frey/Osborne 2013: 26–27) Even in simplified settings, typical social tasks would likely continue to be challenging to automate, let alone complex ones involving negotiating skills or high levels of empathy (C. Frey/Osborne 2013: 24–27).

³⁴ Their approach thereby also circumvents the distinction between manual and cognitive labour, acknowledging the fact that the implicit identification of manual labour with (automatable) routine labour and cognitive labour with (unautomatable) non-routine labour might hold less and less true over time, allowing more widespread automation in the tertiary economic sector.

In a next step, Frey and Osborne employ the O*NET database of the US Department of Labor, containing information on hundreds of occupations, collected through “regularly updated [...] surveys of each occupation’s worker population and related experts”. These occupational descriptions contain variables such as Finger Dexterity, Originality, Persuasion, etc. which Frey and Osborne then link to the engineering bottlenecks they identified (C. Frey/Osborne 2013: 28ff.). In addition, they convened an expert workshop with machine learning researchers which were tasked with going through 70 occupations, assessing “whether each task for the occupations was automatable, given the availability of state-of-the-art computer equipment and conditional upon the availability of relevant big data for the algorithm to draw upon.” (C. Frey/Osborne 2018) These subjective assessments then served as the training data set for an algorithm providing probabilistic classification of occupational automatability.³⁵ But why pursue this highly intricate approach, rather than just assessing job profiles linearly based on their task composition and the related bottleneck variables? Frey and Osborne claim that their algorithm

“provides a smoothly varying probabilistic assessment of automatability as a function of the variables. For our Gaussian process classifier, this function is non-linear, meaning that it flexibly adapts to the patterns inherent in the training data. Our approach thus allows for more complex, non-linear, interactions between variables: for example, perhaps one variable is not of importance unless the value of another variable is sufficiently large.” (C. Frey/Osborne 2013: 36)

In other words: the algorithm would allow for the assessment of the probability of a job becoming automatable based on an assessment of whole job profiles – but not on a task-by-task basis, but in the specific configuration these tasks find themselves embedded in. These probabilistic assessments were then used to assign jobs to three different categories (low risk of automation, from 0 to 30% probability, medium risk of automation between 30 and 70% and high risk of automation from 70% onwards). Jobs in the high risk category accounted for 47% of US employment, triggering alarmist headlines around the world claiming every second job in the US (and by way of assumption: probably in other countries) would be lost to automation. There is good reason to urge caution with this finding: for a number of reasons (see above), technological automatability and net job losses are not the same. As a matter of fact, Frey and

³⁵ To verify the reliability of the hand-labelled classification, Frey and Osborne used Gaussian process classifiers based on the set of O*NET variables linked to the engineering bottlenecks. The algorithm accurately managed to reproduce the hand-labels of the experts, verifying “that our subjective judgements were systematically and consistently related to the O*NET variables.” (C. Frey/Osborne (2013: 34))

Osborne dedicate a substantial share of their paper to discussing why this distinction is important and conclude by pointing out that they “make no attempt to estimate how many jobs will actually be automated.” (C. Frey/Osborne 2013: 42)

It might help to revisit the central claim of the study against this backdrop: “According to our estimate, 47 percent of total US employment is in the high risk category, meaning that associated occupations are potentially automatable over some unspecified numbers of years, perhaps a decade or two.” (C. Frey/Osborne 2013: 38) It is noticeable that the claim is phrased in rather cautious language, speaking of potential automatability and leaving the temporal scope deliberately open, at maximum giving a vague indication. What is more, it necessarily compresses most of the assumptions made by the authors up until this point into the term “our estimate”: to conclude the reconstructive part of this discussion of their study, we can represent the assumptions and argumentation contained within, for further scrutiny:

If

- a) Our assessment of the potential of contemporary and near-future automation technologies is correct (based on the identification of engineering bottlenecks and the reverse assumption that all activities not affected by these engineering bottlenecks are technically automatable).
- b) O*NET data adequately represents the real nature and composition of occupations.
- c) Nothing went wrong in composing the training data set.
- d) The machine learning algorithm we used on the data adequately generalised the training data set in order to assign its probabilistic assessments,

then we find that 47% of today’s US employment has a risk of over 70% of being automatable in in the future (perhaps in a decade or two).

Reviewing Frey and Osborne’s Assumptions

A critical review of these assumptions can serve as a useful platform for further inquiry: while the literature review of Frey and Osborne appears to be thorough and their engagement with technical experts can be reasonably expected to increase the quality of their assessment of the field further, one should nonetheless be somewhat cautious when it comes to reproducing what is ultimately a self-assessment on the part of researchers. Overestimating technological potentials has been called a typical *déformation professionnelle* of scientists involved in the

advancement (and promotion) of specific technologies (Autor 2014: 130; Pfeiffer/Suphan 2015: 9).³⁶ Additionally, while the approach to identify possible engineering bottlenecks and to then reversely conclude that anything not covered by them might be automatable has some evidence to it, it runs the risk of downplaying the possibility of unwelcome surprises in technology development. This limitation of their approach is briefly addressed by Frey and Osborne, claiming that their focus on “near-term technological breakthrough in ML and MR [mobile robotics]” and the deliberate temporal flexibility in their estimate might compensate for some of these uncertainties (C. Frey/Osborne 2013: 43).

As for the O*NET data: it can be considered “the most detailed and comprehensive assessment of skills used in employment that exists” (OECD 2017: 41). Yet, the database has not been compiled with automatability studies in mind, as indicated by Frey and Osborne (2013: 29), forcing them to identify variables and indicators that they deem relevant to automatability. Furthermore, the occupational profiles of the O*NET represent necessarily somewhat abstract generalisation of actual job realities. As such they fail to both capture perhaps crucial variations within certain job profiles as well as run the risk of failing to account for the importance of tacit knowledge in practising certain professions.

While the job title of some people might for instance still say “office assistant“, they might have long outgrown their original job profile and might have been tasked with much more complex and challenging tasks, rather than ‘just‘ ensuring that the office is supplied with coffee and doing basic scheduling tasks. This also applies to more subtle, informal shifts in work activities. The job reality of some administrative staff might actually be much more akin to Mental Health Counsellors (0.48% probability of automatability according to Frey and Osborne’s study) than to the average file clerk (97% probability) (for probabilities, see C. Frey/Osborne 2013: 57ff.). With regards to the challenge posed to the assessment of automatability by tacit knowledge, a worker might be limited by the way she answers a questionnaire she is presented with, leaving out the importance that “intuition” plays in handling a certain workpiece – which might upon further investigation be deciphered as a way to unconsciously account for certain properties of the work piece or work environment that might be missed by a robot due to the limitations of sensors or deemed unimportant while programming its control software (How does it feel to

³⁶ To be fair, this should not be interpreted simply as a sign of excessive enthusiasm or even personal conceit, but (at least in part) as an effect of a highly competitive scientific system in which any scientist is called upon, even forced, to highlight the great potentials of the respective field she is researching, lest the scarce funding go to the development of some other promising technology – or even worse, the humanities. (cf. Nuffield Council on Bioethics (2012); Edwards/Roy (2017)).

the touch? What is today's humidity like?). A task that might be described both by experts and workers as a simple manipulation task might thus actually turn out to depend on levels of perception difficult to automate with today's, or even near-future, technology.

This criticism has been addressed by the authors in some detail, both in the initial study as well as in its aftermaths. While they raise doubts as to whether tasks performed in occupations vary that significantly (C. Frey/Osborne 2013: 24, 2018), they draw attention to two important ways the challenges stemming from variations within job profiles and tacit knowledge might be reduced: the first one is standardisation and simplification.³⁷ Imagine a skilled tradesperson of the early 19th century carefully hand-crafting a workpiece from start to finish. Their labour process might be impossible to automate, even today. Industrial robotics has excelled however in automating specific steps of highly standardised and fragmented production of standardised mass-consumer products. In the same vein, it might be difficult to automate all possible activities a worker categorised as a file clerk might engage with in the course of their workday – but to be able to save labour costs, this is not necessary in the first place. Instead, one might investigate ways in which for instance the tasks of a file clerk central to the economic success of a company could be automated and to do without the rest. Or one might axe a number of administrative positions and hire one dedicated Mental Health Counsellor to make up for the social intelligence lost in the process.

In addition, one of the key achievements expected from the development of artificial intelligence is solving Polyani's paradox. The term was coined by David H. Autor who built on Michael Polyani's "observation that, '[w]e know more than we can tell.'" (2014: 136), pointing out that "the scope for [technological] substitution is bounded" by the fact that "engineers cannot program a computer to simulate a process that they [...] do not explicitly understand." (Autor 2014: 135) Autor also picks up on the promises of machine learning to surmount this challenge. Rather than having to "teach" an algorithm how to solve a specific task through a predefined process, they might "be able to program a machine to master the task autonomously by studying successful examples of the task being carried out by other." Instead of codifying explicit procedures, the algorithm might undergo "a process of exposure, training and reinforcement" allowing it to "potentially infer how to accomplish tasks" not automatable before (Autor 2014: 159). Frey highlights this new technological possibility "to unravel Polyani's paradox, at least in part" as the most significant advance of automation technologies

³⁷ In composing the data training set, the machine learning experts were accordingly asked to consider „the possibility of task simplification“ to the best of their knowledge (C. Frey/Osborne (2013: 30)).

over the last decade (C. Frey 2019: 301), reinforcing the importance of tacit knowledge as a (persistent) challenge to automatability.

Frey and Osborne are also aware of the centrality of properly composed training data for machine learning. As such, they implemented several precautions to reduce expert bias while compiling the training data. Specifically, they tested their subjective hand-labelling with “objective” O*NET variables (see above) and only hand-labelled professions whose automatability the experts collectively were “highly confident about” (C. Frey/Osborne 2013: 31). This can be understood as an attempt to counteract the bias of an individual expert. Yet, as noted before, collective overestimation (or underestimation) cannot be ruled out altogether.

What is puzzling to me, however, is the prevailing silence in the scientific discourse around this study when it comes to the utilisation of the training data – the actual machine learning. Whether a set of 70 occupations is large enough to generalise across hundreds of other occupations for instance seems doubtful.³⁸ One might also challenge whether a machine learning algorithm is actually able to reliably generalise hand-labels, where the hand-labelling by experts was deemed too unreliable, generalizing their expertise beyond what they explicitly state they could do. Frey and Osborne certainly seem to think so (C. Frey/Osborne 2018) and discuss established quality criteria and associated literature within the field of machine learning (C. Frey/Osborne 2013: 32ff.). Yet, without basic training in the field of machine learning, there are few alternatives to simply trusting their self-evaluation.³⁹

What is the reason for the relative absence of discussion of the methodological robustness of the study’s use of machine learning?⁴⁰ The most plausible explanation seems to be that although the findings of the study drew high levels of attention, the fine detail of the technical description was daunting to many researchers. The blame for this incomprehension cannot rest exclusively

³⁸ In light of the immense volumes of data utilised in today’s machine learning, a training data set of 70 feature vectors each containing only nine variables (the engineering bottleneck-related variables of O*NET, deemed relevant to the question of automatability) seems rather modest. Although the amount of data needed for machine learning depends on the specific use case, this concern seems particularly relevant in this case, as non-linear algorithms are known to require even bigger training data sets (cf. Brownlee (2019)).

³⁹ In a notable exception, Philipp Brandes and Roger Wattenhofer, two computer scientists of the Swiss Federal Institute of Technology in Zurich, dedicate themselves to “Opening the Frey/Osborne Black Box” (2016). But although they refer to the study as a black box, they do not engage in great detail with its workings. Rather, they build their own model to identify outliers in the results of Frey and Osborne in order to allow for a more detailed scrutiny of the study’s results.

⁴⁰ A scientific discussion on the epistemic power of computer simulations does exist (see for instance Krohs (2008); Durán (2017); Durán/Formanek (2018)), but it does not play a substantial role in the papers discussing Frey/Osborne.

on Frey and Osborne, who tried to supply “a non-technical description” of their approach (C. Frey/Osborne 2018). Rather, this situation confronts us with an interesting question: how can institutions central to scientific progress in the past (scientific discourse on an equal footing, peer review etc.) be sustained when the dissemination of new ways to do research introduces a high level of “epistemic opacity” for many experts – let alone the interested public (Humphreys 2011: 139–140)? Indeed, the study and the discussion that followed it seems to represent an example of epistemic opacity that led to a partial failing of scientific discourse.⁴¹

Following the above discussion, the two most common forms of critique levelled against Frey and Osborne – that they vastly exaggerated the technological potential for automation and that they assume “a direct cause-and-effect relationship” between innovation and the substitution of human labour (Valenduc/Vendramin 2016: 16) – can now be evaluated much more clearly. However, while their approach based on a reverse assumption of automatability in the absence of engineering bottlenecks is likely to return an estimate of automatability towards the upper end of the range of what might become technologically possible, their discussion of the state of the art of research as well as their engagement with technical experts seems to suggest a fairly up-to-date, albeit optimistic assessment of the field and its technological potentials. Concerning the second criticism, there are good grounds to disregard it altogether: after all, Frey and Osborne time and time again stress that they do not intend to give the impression that they made an “attempt to estimate how many jobs will actually be automated” (C. Frey/Osborne 2013: 42, 2018; C. Frey 2019: 323), let alone answer the question how many new jobs might be generated simultaneously, and they certainly did not claim that their approach could be simply applied to other economies,⁴² limiting the scope of their assessment further.

Yet, despite the clear and apparent focus on technological potentials rather than labour market outcomes throughout most of the study, the use of provocative terms such as “expected employment impact” (C. Frey/Osborne 2013: 36) and “expected impacts of future computerisation on US labour market outcomes” (C. Frey/Osborne 2013: 1) at key passages of the study seems to run contrary to this intention. Even a very charitable interpretation of the use of the word “expected” cannot entirely alleviate the impression that key passages of the study

⁴¹ I would like to thank Paul Grünke for his insight into the issue of epistemic opacity. For his research on artificial intelligence and epistemic opacity, see Boge/Grünke (2019); Grünke (2020).

⁴² The literature review on cross-country validity of O*NET scores of a recent OECD study concluded however “that occupational titles refer to very similar activities and skill demands across different countries” (OECD (2017: 42)), implying that the claim that the finding of Frey and Osborne could not be applied to other economies might owe less to actual differences in job realities and more to an implicit nationalist bias.

are phrased in a way that might attract maximum attention, contradicting the study's ultimately rather sober and earnest approach.⁴³

To conclude the evaluation of the study, we can ask what might be learned after all this scrutiny from Frey and Osborne's study. On the one hand, the study presents us with a generalised version of an assessment of near-future automation potentials by technical experts, applied to a multitude of occupations covering most of the US labour market. The study highlights potential impacts of advances in machine learning and robotics on the automatability of jobs. In particular, it draws attention to high potentials for automation in transport and logistics, as well as office and administrative support and manufacturing. But Frey and Osborne also provide higher resolution insights, for example regarding the potential automatability of "cashiers, counter and rental clerks" and a number of service occupations who happen to work closely with other humans but whose function – according to the authors and the experts they consulted – does not require high levels of social intelligence or dexterity. Lastly, the output of the machine learning algorithm draws attention to unused potentials for standardisation and simplification of tasks, for instance through prefabrication in construction or the rationalisation of food delivery processes within restaurants (C. Frey/Osborne 2013: 38–39) – sometimes even to the surprise of the involved experts (C. Frey/Osborne 2018). On the other hand, the study also reinforces the persistence of obstacles to automation. As such, it also highlights potentials for future automation-resistant employment as well as skill sets that might reduce the risk of being personally affected by automation, reinforcing the importance of education in general and creative and social skills in particular.

Combining their assessment with data on occupational educational and wage levels, Frey and Osborne were able to conclude that "both wages and educational attainment exhibit a strong negative relationship with the probability of computerisation." (C. Frey/Osborne 2013: 42) In other words: the higher the wages and the educational attainment within a given occupation, the less likely it is to be automated. Their conclusion that this would imply "a truncation in the current trend towards labour market polarisation, with growing employment in high and low-wage occupations, accompanied by a hollowing-out of middle-income jobs" (C. Frey/Osborne 2013: 42) should be met with some scepticism however. Their claim that future automation would "mainly substitute for low-skill and low-wage jobs in the near future" (C. Frey/Osborne

⁴³ One might of course also criticise their study by claiming that they *should* have dealt with labour market impacts, rather than simply highlighting technological potentials. I will return to the "use value" of these studies at the end of this chapter. Thus far, I focused on a form of immanent critique, reviewing the study in the light of the objectives it sets itself.

2013: 42) again overstrains the explanatory power of the model they built, as – as we have learned by now – automatability does not equal actual future substitution. As a matter of fact, the high potential for automation in low wage jobs can be relatively easily explained: many of them might have been automatable with tried and tested automation technologies for decades – but low wage levels might have raised the relative costs of automation to a level unattractive to capital investment. On the contrary: it would in fact have been surprising if automation potentials in low wage jobs would have been equally actualised in comparison with higher paying jobs, given the political economy of automation under capitalism. Whether this potential will eventually be utilised will, under current conditions, ultimately depend on possibly falling prices of automation technologies and the increase of wages on the lower end of the wage spectrum; it likely won't depend on some novel technological features alone.

To summarise, the Frey and Osborne's study provides an innovative approach to the question of technological automatability as well as an insightful introduction to the contemporary debates on automatability. Their approach is informed by an extensive literature review, first-hand experience with the field and expert input. The assumptions made by the author teams are fairly clear and largely well justified, although hardly altogether unproblematic. The data employed by them can be considered a world-wide gold standard and their machine learning-based approach must be called cutting-edge. At the same time, the use of machine learning perhaps represents the most fundamental source of epistemic uncertainty regarding the study – but has hardly been picked up in scientific debate. The greatest scientific achievement of the study, and studies like it, is the fact that they sensitise rather concretely for the potentials for automation offered by advances in technological development, in this case in the field of artificial intelligence (and related robotics). As such, they are useful tools in synthesizing assessments of (technical) experts which they allow to generalise to the level of entire labour markets. Their greatest potential drawback is that they lend themselves well to misinterpretations that draw conclusions laying beyond their explanatory power – a fact that is illustrated both by a myriad of critiques missing the core of the study of Frey and Osborne, as well as a number of assertions by the authors that seem to contradict their own discussion of the limitations of their approach. Rather than trying to answer the question as to what impacts of automation upon employment we can expect in the future with a model ill-equipped to do so, we shall now turn towards an exemplary study that makes the claim to address this question more directly.

This section discusses the study *Economy 4.0 and its labour market and economic impacts* by Marc Ingo Wolter et al. (2016) to interrogate studies trying to provide concrete estimates of future labour market impacts of technological change in Germany. This study is pertinent because it is available in English, provides extensive documentation of its methodological approach and positions itself as a study addressing the gap in research left open by Frey and Osborne as well as being a key scientific contribution to the Work 4.0 discourse that I engage with extensively in the next chapter (cf. Wolter et al. 2016: 7–9). Additionally, the study was developed in collaboration between scientists of the Institute of Economic Structures Research (a research consultancy), the Institute for Employment Research (the research branch of Germany's Federal Employment Agency, abbreviated IAB) and the Federal Institute for Vocational Education and Training (an independent federal institution charged with conducting research on vocational education and training and therefore, the future of work; abbreviated BIBB). The latter two institutions, IAB and BIBB, are specifically charged with providing expertise on labour market policies to decision-makers. The author list consists of distinguished experts on labour market development and its study builds on an economic forecasting and simulation model that has been in use and continuous refinement for almost a quarter of a century (Wolter et al. 2016: 16). In other words, it would not be much of a stretch to claim that there is hardly any scientific expertise more reputable in Germany when it comes to possible labour market transformations – and indeed, research by IAB and BIBB is frequently referenced by policy-makers and a key epistemic resource in the discourse on the future of work and automation in Germany (see chapter 3).

As we have been dealing with the scientific literature on automation quite extensively already, I will limit my discussion to those aspects of the study that promise to provide novel insight into the scope of automatability and its societal consequences, as well as a few general epistemic considerations. In general, the study builds on existing labour market analyses and economic modelling by IAB and BIBB. To project the labour market impacts of the so-called Economy 4.0⁴⁴, they modify an established scenario (“baseline projection”) through five deviating “partial scenarios”, assuming increased investment in equipment and buildings, education and software, and reflect upon impacts of these changes on cost and profit structures within the

⁴⁴ The term Economy 4.0 represents an extension of the Industry 4.0 term, popular in contemporary German debates to denote the current phase of technological development, to the whole of the economy, as the study does not limit itself to changes within industry and agriculture (cf. Wolter et al. (2016: 9)). For an introduction to the Industry 4.0 discourse, see chapter 3.

economy, on its occupational structure and on the demand for new goods and services (Wolter et al. 2016: 10). These partial scenarios are detailed through a set of 18 assumptions covering everything from modifications in the capital stock of sensor technologies, to the increased need for consulting services and higher government spending on (cyber-)security. Most of the study is dedicated to introducing and discussing these modified assumptions in detail, as well as conducting step by step analyses of the partial scenarios, allowing to grasp the impact of individual assumption sets on labour demand. In the end, these scenarios are integrated for final comparison with the baseline projection. Wolter et al. conclude that their comparisons “shows that the effects digitisation has on the overall level of labour demand at minus 30,000 jobs [in 2025] and minus 60,000 in 2035 will carry no weight” (2016: 56). In other words: according to their projection, only 30,000 additional jobs would be lost to accelerated technological change by 2025 compared to the base scenario – out of a total of 43.4 million projected jobs. At a share of 0.07% of jobs lost to accelerated technological change, one can consider this number miniscule. But the insight provided by the study is of course not limited to these figures – and just as with the study by Frey and Osborne, one has to be careful when interpreting them.

The (Dis-)Advantages of Classical Macroeconomic Models

First of all, both the baseline projection used for comparison as well as the Economy 4.0 scenario presented by Wolter et al. are created through use of the Q-INFORGE model. Q-INFORGE itself is a modified version of the IAB/INFORGE model for econometric forecasting and simulation, a time-tested software developed by the Institute of Economic Structures and Research and employed by the IAB to calculate projections for the future of the German economy. The documentation of the original IAB/INFORGE model (Zika/Schnur 2009) is almost two hundred pages long, with the sub-sub-sub-module for the labour market computing 19 different parameters (ranging from yearly working time per full-time/part-time-employees, to average hourly wages, to the number of unemployed or employer contributions to social security), for which various interdependencies are assumed (Ahlert et al. 2009: 79ff.). The complexity of the German economy is represented in around 20 of such modules and sub-modules with the claim to deliver a “bottom-up” and “completely integrated” model (Wolter et al. 2016: 16–17).

To further refine the existing modelling of the labour market, IAB/INFORGE was combined with the BIBB/IAB Qualification and Occupational Field Projections model (QuBe), resulting

in the creation of Q-INFORGE.⁴⁵ Both source models are briefly introduced through info-boxes and diagrams stretching out over roughly half a dozen pages and references to in-depth information is provided. Nonetheless, even though documentations of these models exist, their highly formalised writing consisting in parts mostly of equations and their sheer extent represents substantial obstacles to comprehension.

This is not to imply any sinister intent on the side of the researchers involved in developing these models. On the contrary, the fact that it is possible to describe a more or less comprehensive model of such a highly complex social system as our economy in less than 200 pages is testament to the effectiveness of this mode of expression. And in comparison to the machine learning employed by Frey and Osborne, such classical macroeconomic modelling has a key advantage: although it certainly is not self-explanatory, it can, in principle, be understood by anyone with sufficient time, motivation and education, whereas the model trained by Frey and Osborne might be subjected to statistical tests regarding its robustness, but the inner functioning remains opaque, or has to be laboriously reverse engineered (cf. Burrell 2016). Accordingly, the model employed by Wolter et al. can be considered to be more readily accessible to scrutiny by peers, reinforcing its reliability, particularly given its prominence and long-term use.

That should not imply however that this kind of modelling would be altogether unproblematic: First of all, one might question the relevance of the differentiation of forms of opacity just introduced by me above, as it matters little in day-to-day operations whether a certain model cannot be understood due to technical illiteracy (or even just the lack of time) or due to an essential epistemic opacity fundamentally related to the scientific method employed. In the end, the question whether a model is “essentially epistemically opaque” (Humphreys 2011: 139) or just *functionally* opaque might be interesting on a theoretical level, but since it is common practice of both researchers and policy-makers to signal expertise within the debates on automation by referencing a plethora of studies, rather than limiting oneself to the careful discussion of a small number of selected papers one might actually be able to grasp comprehensively, the concern that this distinction might not be worth much might not be entirely unfounded.⁴⁶

⁴⁵ The QuBe was developed by the BIBB and focuses on modelling the general demography of Germany (by nationality, gender and age), labour supply (with factors including for instance levels of labour participation and qualification) and labour demand (with factors including occupational requirements and wage and price levels).

⁴⁶ In part, this is meant as self-criticism.

Another issue I will return to in the final part of the chapter is the empiricism of the models employed by IAB and BIBB: Not only the value of specific parameters within the model, but also the relationships between these parameters are largely derived by science based on empirical observation (e.g. when estimating the average operating life of various groups of capital goods (Ahlert et al. 2009: 43ff.)). Accordingly, they can rightfully claim that they are not just arbitrarily making things up (Zika/Schnur 2009: 5). Indeed, as Holm Tetens (2013) argues in his introduction to the philosophy of science, scientific prognosis is generally limited to talking about the future based on knowledge derived from past observations of existing structures and the laws governing them and their dynamics. Projecting them into the future might seem unproblematic in many cases – for instance when it comes to assuming that gravity will persist in the future. Yet, this empiricism introduces a structural conservatism to these models: ultimately, the scenarios derived from these models represent little more than a reproduction of the past – and the more concrete and detailed their economic modelling is, the greater its accuracy, the less they are able to transcend the present and provide knowledge that could prepare policy-makers and civil society for unexpected labour market disruptions or other crises. What is more, this approach is likely to be skewed to the present even when conscious assumption-setting takes place as well: rather than assuming radically different dynamics of societal development than before, the submission to an empiricist logic makes researchers prone to select sets of assumptions that deliver more or less status quo scenarios, normatively informed by a broadly shared, seemingly apolitical "common sense" (cf. Frey/Schaupp 2020b).

And finally, once formalised, the uncertainty and the normative dimension of the sets of anticipatory assumptions that ultimately determine the outcomes of the projection are covered up. The computational output is unambiguous and appears to be “objectively” derived compared to, for instance, philosophical reasoning about possible future developments conducted in natural language (cf. Colander et al. 2009: 254; Timcke 2020: 436). This is particularly important as picking the right set of assumptions can enable you to reach almost any result one sets out to reach (Naidu et al. 2020). Accordingly, the importance of the assumptions of the study of Wolter et al. can hardly be overestimated (cf. Wolter et al. 2016: 60). Let us thus address them next.

Reviewing Wolter et al.'s Assumptions

The first set of assumptions postulates that between 2017 to 2035 investment is moderately expanded by 185 billion euros compared to the baseline scenario, with agriculture and manufacturing contributing 45 billion euros and the service industry the remaining 140 billion (Wolter et al. 2016: 24). While these numbers certainly sound ambitious, they correspond to less than an additional 10 billion euro of investment annually (for comparison: Wolter et al. state that “current investments in new equipment and other new systems” stand at around 300 billion euro annually (2016: 23), adjusted for prices – implying an increase by a little more than 3%). In addition, the public sector is assumed to support the push for an Economy 4.0 by investing 12 billion euros to ensure widespread broadband coverage (95% of households should have access to a 50 Mbit/s connection by 2018 (Wolter et al. 2016: 26)).⁴⁷ So far, these assumptions seem perfectly plausible, if a bit meagre in size (cf. chapter 5.4): if the adoption of new technologies is to increase, it seems reasonable to assume investment will need to be expanded as a prior condition.

The next set of assumptions within the Wolter et al. study covers the changes in cost and profit structures. Estimates are given regarding additional educational demands and costs, the level of diffusion of digital technologies through the economy, increased need for consulting services and potentials for cost saving through decreases in raw materials, consumables, supplies, purchased services and costs of logistics. Finally, labour productivity is projected to “be 1 percent higher until 2025 than in the QuBe baseline projection”. The setting of their assumptions on potentials for cost savings and productivity increases is informed by two company surveys of IAB, polling about 2000 companies on “digitisation and its desired effects” (Wolter et al. 2016: 30).⁴⁸

After setting these macroeconomic parameters, they turn towards a more detailed modelling of changes in the labour market, focusing on the question what jobs might be automated and what

⁴⁷ The study actually reads „95 percent of all households will have a 50 Mbit/s connection by 2018“ (Wolter et al. (2016: 26)). I would suggest to interpret this assumption as saying that they *in principle* could access broadband, rather than that they *in fact* have such a connection, provided that there might be a number of reasons for households not to opt for more expensive broadband tariffs – unless the connection would be supplied by the public sector to all households free of charge as a public service. However, Wolter et al. give no indication that they had that in mind.

⁴⁸ I would suggest that the reservations towards the (self-)assessment of practitioners that were raised above regarding AI experts should also be taken into account here. After all, within a societal context that is buzzing with high expectations and the normative pressure to endorse and enact innovation to attract investors, the assessment of technological potentials appears to be at very least skewed (regarding the normative power of the Industry 4.0 discourse, see chapter 3).

shifts in the occupational composition might be expected. Wolter et al. build on an earlier IAB-publication by Katharina Dengler and Britta Matthes (2015) that investigated the possibility to assess substitutability potentials in the German economy. They do so by combining data from the BERUFENET (the German counterpart to the O*NET) and substitutability assessments of experts of the Federal Employment Agency.

Leaving aside the question whether BERUFENET adequately represents occupational realities,⁴⁹ and whether employment experts are actually better qualified to assess the technical substitutability of tasks than technical experts (which seems a somewhat problematic claim), their approach differs in a key respect to the one of Frey and Osborne discussed above: rather than asking for assessments as to whether tasks might become automatable in the near future, the assessment of Dengler and Matthes is based on the factual automatability of a task in the year 2013 (Dengler/Matthes 2015: 11). Accordingly, they fail to take into account most of perhaps the most intriguing and promising features of the latest technological developments: the automation of non-routine tasks and the affiliated conquest of Polyani's paradox (C. Frey/Osborne 2013; Autor 2014; Susskind 2017). Although the worry that technical experts might overestimate the potentials of future technological development is legitimate, the assumption that there will be no further development at all up until the year 2035 almost certainly has to be regarded as a severe underestimate.

By using the framework of Dengler and Matthes, Wolter et al. enshrine the technological level of development of the year 2013. What's more, they assume that only half of the technological potentials identified by Dengler and Matthes will actually be utilised. Their rationale for this assumption is that levels of automation "cannot be determined beforehand, as there will be other changes to the occupation field structure endogenous to the model – e.g. due to different the development in wages [sic] – in addition to the assumption made" (Wolter et al. 2016: 41). Although they are of course correct in pointing this out, their rule-of-thumb approach to the assessment of the impacts of accelerated technological development of the economy is nonetheless problematic: not only do they fail to take into account some of the defining features of the latest developments in the field of automation technologies, they also simply assume that even the technological potentials that will be almost a quarter of a century old at the end of their projections in 2035 will go severely underutilised. In contrast, modelling likely levels of

⁴⁹ See my discussion of O*NET above. The BERUFENET for instance also does not cover differences in occupational realities within job profiles. Nonetheless, it should be positively noted that using a German database bypasses issues resulting from applying assessments from the US labour market to the German one.

automation utilisation based on the development of wage levels etc. would have been a key contribution to redeem their self-imposed goal to economically ground the debate sparked by Frey and Osborne.⁵⁰

The decrease in labour demand due to increased automation is in their model counteracted, at least in part, by the last set of assumptions, detailing increases in demand through increased government spending, additional demand from private households due to higher wages and an increased willingness to pay for customised Industry 4.0 products, as well as increased exports. All these assumptions are predicated on the assumption that the German economy will be a trailblazer of the Industry 4.0, “generating ‘temporary monopoly profits’ over foreign competitors.” (Wolter et al. 2016: 21) While some of the details of these assumptions raise question marks,⁵¹ the general picture is fairly clear: moving swiftly and decidedly to adopt Industry 4.0 would boost productivity and product quality, making German products more attractive to domestic as well as foreign consumers. As a result, the competitiveness of the German economy in global competition would be strengthened.

Wolter et al. are keenly aware of the precarious nature of this basic premise. In light of this, it is only fitting that the final paragraph of their study should be no less than a call to arms:

“The scenario calculations [...] make one thing clear: There ultimately is no other way – if Germany’s unable to implement Economy 4.0, other countries will still do so. And the assumptions which have a positive effect on Germany in the above scenario (pioneer, additional demand abroad, competitive edge) will then count against Germany as a business location. Decreases in production and further unemployment will result. Those are triggered by a loss in competitiveness and domestic

⁵⁰ To be fair, in a more recent paper, published after the peak of the Industry 4.0 debates and unavailable in English, Wolter et al. (2019) addressed both these desiderata by moving towards a methodology much closer to the one developed by Frey and Osborne (which can be understood as a tacit vindication of their approach) and by modelling branch-specific utilisation levels based on investment activities. Although the projected job losses due to accelerated technological development are much higher in comparison to the 2016 study (e.g. they project that 100.000 jobs will be lost in 2030 compared to just 30.000 in the 2016 projection), they remain miniscule in comparison to the whole of the labour market. This is consistent with my earlier expositions regarding the socioeconomic determinacy of technological unemployment: even if one assumes a higher technological dynamic and use, the development of unemployment ultimately depends strongly on demand for goods and services, rather than technological development per se.

⁵¹ For instance, their projections of increased governmental consumer spending is limited to the areas of cyber crime and/or cyber warfare, with the state projected to hire 14.000 additional soldiers and boost the federal police force by 2.000 employees (Wolter et al. (2016: 45)). The exclusive focus on additional military and police spending seems, for lack of a better term, odd. Another assumption – that domestic consumer demand will be boosted by rising wages as productivity increases – is normatively appealing and should in my opinion indeed be pursued as a policy goal (see chapter 5.4), but is currently not as self-evident as Wolter et al. assume. After all, the erosion of the link between productivity and wage increases can be considered one of the key contributors to the increased social polarisation of the last decades (see chapter 4.2).

demand shifting toward imported products. So the task must therefore be to make the transition as sustainable as possible.” (Wolter et al. 2016: 61)

As the quote indicates, the authors are aware that other countries similarly aim to strategically boost innovation as a tool to strengthen competitiveness (Wolter et al. 2016: 21) but they are unable to envision any alternative to deepening international competition and economic chauvinism. The demands and necessities of capitalist competition are naturalised (“There ultimately is no other way”) and the study is firmly entrenched in what has been called a “dialectics of pessimism and optimism” (Schiølin 2020): things can go on as they are – the German economy can continue to be a leading exporter, strengthening employment domestically while conquering global market shares, and thus jobs, from less competitive economies – as long as everyone gets behind Industry 4.0. In this respect, the study has a strong pedagogical undertone; it is not a “self-fulfilling prophecy” but a projection whose realisation is actively pursued by its authors.

To make myself clear: the fact that Wolter et al. openly address this basic premise of their scenario modelling does not constitute a failing on their part. On the contrary, this transparency should be welcomed and is a virtue of this study compared to studies who operate with similar sets of assumptions but fail to disclose these assumptions that are integrated into a specific normative framework – the affirmation of capitalist social relations, commitment to economic growth as the basis of social stability and (“ultimately”) economic chauvinism. One ought also not disregard this scenario as merely an overtly optimistic outlook provided by scientists tasked with the management of the status quo (of the labour market) to policy-makers who are also committed to a more or less frictionless continuation of the status quo of the national economy and welfare state (see chapter 3). Indeed, their modelling substantially refines and expands the understanding of the possible impacts of automation on the labour market, providing insight on the likely winners and losers of accelerated technological development, thereby generating helpful new insights.

One of the key insights of the study, for instance, is that contrary to all the attention and homage paid to manufacturing in the Industry 4.0 discourse, increased investment into technology is actually likely to speed up the occupational deindustrialisation of the German employment base (Wolter et al. 2016: 56–58). Additionally, the study provides insights into what occupational groups might grow or contract under the assumptions of the scenario (with commercial office occupations and electrical occupations worst hit and Core IT and teaching occupations seeing the biggest growth (Wolter et al. 2016: 55)), as well as on changes in the educational

requirements of a technologically-upgraded economy (Wolter et al. 2016: 59). Accordingly the scenario can be understood as a meaningful tool for the researchers involved to sensitise policy-makers to the challenges that might arise while pursuing the Industry 4.0 strategy – even under “fair weather” conditions.⁵² More generally, the extensive discussion of the assumptions of the scenario can serve as a meaningful launch pad for reflection on the relationship of various economic factors that shape the labour market – bearing in mind that the assumptions made by Wolter et al. need to be examined critically, as they emphasise themselves (Wolter et al. 2016: 60). This critical examination itself can then be understood one of the key opportunities to deepen one’s understanding of the subject matter.

But despite these merits of the study, there are also serious drawbacks: not only do the assumptions made by Wolter et al. require scrutiny – at least as crucial is the fact that while the assumptions draw attention to specific issues that the authors apparently find essential, they divert attention from other possible lines of inquiry regarding the forces that might shape automation’s impact on the labour market and normative orientations that might inform the assessment of its general impact. To give only two examples: it seems suspect that Wolter et al. should discuss the number of soldiers hired for cyber warfare but omit discussions of working time reduction. The length of the working week clearly is a non-negligible factor when it comes to managing labour demand and supply and as such is covered by the modelling framework they employ – and very clearly has a greater potential for bolstering employment than the creation of jobs for policemen and soldiers (a mere few thousand in their estimations). Additionally, working time reduction is one of the key policies advanced in scientific and public discourse in response to automation (see chapters 4.3 and 5). Such an omission betrays a lack of imagination, or perhaps even a more ideological attachment to the existent ways of living and working.

Another omission that is telling is the lack of any attention to ecological sustainability in the construction or evaluation of the scenario. While the term “sustainable” is used in the study (see the longer quote above), it is best understood in the meaning of “economically sustainable”, or more precisely: sustainability is equated with increased economic competitiveness. While the

⁵² Its findings should not be mistaken as direct “instructions” for policy making however. Not only, normatively, because of the relative autonomy of the political sphere, but also because the study seems to lack robust sensitivity analyses for individual factors that that might then inform policy making (Dieckhoff et al. (2014: 33)). The approach to create a number of scenarios that build on each other, each linked to a more limited set of assumptions, could be charitably interpreted as serving as an “aggregate sensitivity analysis” of sorts, but even then we do not know what changes in the scenarios are dependent on what exact assumption.

vast difficulties of measuring the ecological impacts of economic changes should be appreciated, and one also has to take into account that it is not their area of expertise, it is nonetheless noteworthy that they for instance were able to give estimates on possible monetary savings for companies in raw materials – but omitted any ecological implications of the so-called Industry 4.0 whatsoever.

This dominance of economic reasoning (to the exclusion of other approaches) is consistent with the overall approach of the study, whose design principle is that investment has to “yield a good return [to companies]” (Wolter et al. 2016: 31) and therefore has to consistently highlight possible cost savings as well as profit opportunities – leaving other considerations aside. Even if one deems this exclusive focus legitimate, it should nonetheless be noted that leading economists feel comfortable discarding ecological sustainability as an evaluative dimension without feeling the need to address this omission at all, while references not only to employment opportunities but to economic growth and profit opportunities abound. Not only does this raise doubts regarding the depth to which ecological challenges have been recognised within the field, it also casts some shadows over the usefulness of economic modelling that brackets out one of the most profound contemporary developments which might reasonably be expected to, among a myriad of other effects, shape future labour markets even more fundamentally than consumer enthusiasm for customised sneakers or, at the risk of repeating myself, the creation of a relatively small amount of jobs in the military.

To summarise, the study by Wolter et al. represents a high-profile example of macroeconomic expertise, employing a scenario method to model the expected effects of increased technology use within the German labour market. It builds on a well-established methodology and the scientific institutions involved can draw on substantial expertise and long running, well-respected research. It substantially goes beyond the approach developed by Frey and Osborne by modelling the development of the labour market by embedding the reflection of the impacts of technological change within a projection of macroeconomic development. In comparison to Frey and Osborne, their approach does not feature a degree of essential opacity, but is in principle comprehensible.

However, this would require the reader to engage with vast sets of assumptions, both specific to the concrete scenario as well as a general to the modelling frameworks employed by the authors. These assumptions are necessarily much more wide-ranging than those employed by Frey and Osborne as the assumptions regarding automatability form just one sub-module of the

whole modelling endeavour. As many critics of Frey and Osborne have pointed out: modelling the actual progress of automation in a whole economy simply is much more complex than looking at the latest developments in artificial intelligence or robotics research (or other engineering fields) and has to account for a number of other factors. But in accepting this precaution, one also has to accept that such a macroeconomic approach is by its very nature much more speculative. My critique of their assumptions notwithstanding, one nonetheless has to acknowledge that Wolter et al. strive for a high level of transparency regarding their assumptions and actively encourage criticism. Leaving aside the factual validity of their assumptions,⁵³ one central observation of my discussion was the high degree of normative saturation of their anticipatory assumptions.

Again, its transparency in this regard should be considered a virtue, rather than a failing of the study. But imagine for a moment a team of scientists that would have intended to model the impacts of the so-called Industry 4.0 with the explicit goal of proving that it could lead to mass unemployment and/or ecological catastrophe. By slightly shifting a small number of assumptions – for instance the positive effects of the Industry 4.0 on domestic and international demand – or by reorienting the evaluative dimension, one could rather easily derive radically different conclusions than those Wolter et al. were able to derive. This is not to invite radical relativism and to claim that *any* conclusions might be *legitimately* drawn by the use of scenario modelling: the assumptions used after all have to be justified and defended in scientific discourse, first and foremost by showing that they are consistent with established knowledge (cf. Dieckhoff et al. 2014). But given that hopes of “temporary monopoly profits” can by definition only be fulfilled for a limited number of economies, leaving the other economic competitors the short end of the stick, and that an interference-free continuation of the past seems highly unlikely, such variations of assumptions and evaluative frameworks can hardly be ruled out as altogether “unrealistic”. Given that we are facing a deepening ecological crisis, which escapes their modelling, the disconnect from realism within their account is even more clear.

⁵³ Since it is central to this dissertation’s subject, I would only like to remind you of the exemplary fact that the assumption about the form and extent of automation in the future used by Wolter et al. is based on an outdated understanding of automatability and an additional ad-hoc assumption (see above, also for a reference to the 2019 study that improves on this assumption). It is also noteworthy that while the assumptions are discussed individually, there is no attempt to justify them in combination (i.e. is it possible for all of these assumptions to come to pass at once?), although it seems likely to me that such a justification could be achieved. On the need to justify not only individual assumptions in scenario modelling but also their combination, see Dieckhoff et al. (2014: 24).

Despite these weak presuppositions and obvious exclusions, the mere fact that studies such as that of Wolter et al. dominate much of the academic and of the policy discourse on automation, rather than being marginalised as “partisan science”, cannot be explained on the merits of their methodology alone. Rather, I would argue, it should be explained by the conformity of their approach and the linked anticipatory assumptions to the dominant “common sense” and the socioeconomic conditions that give rise to it.⁵⁴

⁵⁴ This realisation echoes earlier comments by Horkheimer, who pointed out that directions and goals of research “are not self-explanatory nor are they, in the last analysis, a matter of insight.” (Horkheimer (2002: 196)) Rather, they should be understood as being shaped by social conditions.

2.4 Potentials, Projections and Indeterminacy

Let us recapitulate: after a brief introduction into the history of the terms automation and technological unemployment, we have established that there is no direct link between technological innovation and unemployment as (un-)employment is an effect of a complex social system: the labour market, which is embedded in capitalist social relations. With regard to future potentials of automation and possible labour market impacts, we have also established that the technological potentials for automation are generally considered to be significant within research, whereas there seems to be a more or less shared consensus in macroeconomic prognosis that negative labour market impacts of increased automation could be negligible – or even slightly positive, given the hope that automation might boost economic growth and economic competitiveness.

At the same time, we were able to see that while analyses of technological potentials are able to manage with relatively modest sets of assumptions (which nonetheless can be problematic), their explanatory power correspondingly is rather limited and should not be misinterpreted as statements approaching the exactitude of facts about actual future developments. The other type of study – macroeconomic projections of various forms – seems to have a stronger claim on anticipating future developments, due to their multi-faceted nature. Their statements about future developments are however also based on much more expansive sets of anticipatory assumptions which oftentimes exhibit a strong normative bias and exclude other important considerations. Not only that, but their very approach is informed by the analysis of our economic past. Projections about the future, then, are based on the assumption that our economic future will have strong continuity with our economic past; without this assumption the whole argument for the epistemic validity of the modelling crumbles. By perpetuating the past, these models obfuscate (or at the very least do not address) “the political and contingent basis” of this past (Srnicek/Williams 2015: 88; see also Weeks 2020). By doing so, they obfuscate the fact that rather than forming the indisputable basis for discussions about the future, this past might have looked altogether different if, for instance, other social and economic policies would have been in place.

Consequently, any futures that might depend on radically transformed social relations, any future that might not be qualified as a mere continuation of the past, is thereby axiomatically ruled out in these analyses. While this seems a perfectly adequate and useful approach to the management of the status quo, Critical Theory has been wary towards such scientific usefulness from the beginning. Rather, the seminal characterisation of Critical Theory by Horkheimer

starts out by urging scientists not to simply accept the dominant normative orientations of their time “as nonscientific presuppositions about which one can do nothing” and opt for “conscious opposition” in the interest of “emancipation and [...] an alteration of society as a whole” (Horkheimer 2002: 205–208) instead.

Therefore, it should not come as a surprise that although research into possible futures cannot be considered a research focus of the early Frankfurt School, Adorno in particular engaged critically with attempts to “calculate” the future. It is noteworthy that he developed his critique at a time at which scientific prognosis was first constituting itself as a field of research and was charged with a high level of optimism, often bordering or crossing over to deterministic understandings of societal development (for introductions into the development of research on the future, see Gransche 2015; Grunwald 2019b). This was precisely one of the key aspects of Adorno’s critique: that the very form of scientific prognosis would reduce historic development to a simple analytical judgment and by treating humans and their behaviour as just another variable, their agency would be fundamentally denied. By assuming that future developments could be anticipated deterministically in the same way as solving just any other mathematical problem, the very possibility of alternatives would be excluded (Adorno 1977: 64).

In his attempt to outline a critical approach to empirical research, Adorno connects the concreteness and binding character of scientific hypotheses with the fact that they are unable to qualitatively transcend dominant social relations – much like I have argued above in regards to macroeconomic models. He claims that the attempt to anticipate future developments through hypotheses that are confined to existing social relations amounts to little more than the intellectual reproduction of the past. And it is incommensurable with the primary motivation of Critical Theory: advancing collective human emancipation in a liberated society (Adorno 1972b: 198–199). Indeed, it seems rather evident that a group of Marxists convinced of a radical need for societal transformation would take offense by technocratic scientific endeavours that suspend qualitative societal progress in the interest of the perpetuation of a smoothly managed status quo. However, it would be intellectually dishonest to apply this critique to studies such as the one of Wolter et al. without caveat: their approach is much more sophisticated and nuanced than early scientific prognostics – not just in terms of the past decades of refinement of computational modelling but also insofar they do not claim to predict *the* future. Rather, their projection is to be understood as one *possible* future which is contrasted both with a “baseline” scenario and a vaguely outlined scenario in which international competitors beat German

business in adopting the Industry 4.0.⁵⁵ To this extent, the study is non-deterministic. Despite this relative indeterminacy, the critique remains that rather than enabling a wide-ranging debate on societal alternatives, the framework employed by Wolter et al. limits the development of scenarios to a quite narrow corridor of possibilities.

On a less abstract and normatively charged level, the fixation on “fair weather” scenarios that seems predominant in macroeconomic modelling around the Industry 4.0 should be a matter of concern to anyone interested in reliable scientific expertise. After all, reality might defy common sense (in the case of Wolter et al. regarding the economic opportunities offered by the Industry 4.0), even one that is widely shared among economic, political and scientific thought leaders. This was the case for instance when in the years following 2008 reality asserted itself against the wishful thinking of economists, bankers and politicians alike. When in the aftermath, British economists from both academia and the banking sector were confronted by the Queen with the question why they failed to notice that a crisis was looming, they convened at the British Academy to draft an explanation. In it, they cite “wishful thinking combined with hubris”, “politicians [...] charmed by the market”, a “psychology of denial” and the “failure of the collective imagination of many bright people” with regards to systemic economic risks as reasons for the collective failure of their discipline. They are also keen to highlight the role economic models played in abetting these individual misjudgements – models that turned out to be “good at predicting the short-term and small risks” but were largely ill-equipped “to say what would happen when things went wrong as they have.” (Besley/Hennessy 2009).⁵⁶

This is not to say that automation will necessarily lead to any sort of systemic crisis in the near future. But in light of the fact that the experience of the Financial Crisis seems to have had little effect on the methodology of macroeconomic modelling, the evaluative dimensions of scenarios or even the selection of values for specific assumptions threatens to make sure that

⁵⁵ The awareness of alternative futures constitutes a key epistemic advantage of scenario modelling in comparison to earlier prognostic models as it owns up to the epistemic uncertainty linked to any attempt to “look into the future”. (cf. Kosow/León (2015)).

⁵⁶ Much in the same spirit, the Committee on Science and Technology of the US Congress convened a year later for a hearing committed to „Building a science of economics for the real world“ (note the delegitimization this title implies – after all, one should have expected economics to always have been about the real world particularly in light of the prominence of economists in scientific advisory practices). Among the witnesses was Robert Solow, one of the most highly decorated and influential economists of the period after the Second World War (not only did Solow receive the Nobel Prize for Economics himself, but so did four former PhD students of his). In his statement, he echoes his British colleagues, pointing out that “the approach to macroeconomics that dominates serious thinking, certainly in our elite universities and in many central banks and other influential policy circles, seems to have absolutely nothing to say about the problem [of justifying their basic concepts, particularly in relation to (un-)employment]. Not only does it offer no guidance or insight, it really seems to have nothing useful to say.” (Solow (2010: 14)).

dominant economic research might again fail to be of any use to see a socioeconomic crisis coming – or that its socioeconomic consequences might be exacerbated by automation (for a more detailed discussion of possible connections between crises and automation, see chapter 4.2). Or as Jonathan Aldred, a heterodox economist at Cambridge University, put it: “Conventional economic theories have had little to offer [to face looming crises triggered by ecological deterioration and technological change]. On the contrary, they have acted like a cage around our thinking” (Aldred 2020). In light of this, it does not seem to be excessively critical to demand at least a fraction of scrupulous self-critique and reflexivity from established economists – particularly because their normative biases and professional failings have caused significant societal devastation in the past (cf. Grunwald 2018d).⁵⁷ To summarise, not only does the form of scenario building discussed in this chapter not promote the exploration of societal alternatives, but it even fails to satisfy the demands that would need to be met to even responsibly manage the status quo.

In contrast, the exploration of the tension between social reality and objective societal potentials is a defining feature of critical thinking (Adorno 1972b: 197, see also chapter 4.2 for a more detailed discussion of this approach, including its normative and epistemic (self-)limitations). I would argue that the analysis of technological potentials, represented by Frey and Osborne, lends itself well to an emancipatory appropriation in this context, as it offers insight into one dimension of potentials. Of course, not all the answers they give are necessarily accurate, but by limiting themselves to a question that is of special interest to Critical Theory (what *might* become (technologically) possible in the future?) they offer insights less burdened with the plethora of normative assumptions informing the scenario modelling we subsequently examined. That is not to say that scenario methods might not also be useful to inform, for instance, strategy building and planning in the context of social transformation, but given the normative biases presented in some of today’s scenario frameworks, existing frameworks would have to be heavily adapted (or substituted by new frameworks).

This distinction might also explain the quite different reception both studies received: while the study of Frey and Osborne sparked vivid discourses about the impacts of technological change

⁵⁷ On a side note, the disproportionate scrutiny facing scientific critics of contemporary society was already reflected by Horkheimer, as discussed in this book’s introduction: “[A]lthough critical theory at no point proceeds arbitrarily and in chance fashion, it appears, to prevailing modes of thought, to be subjective and speculative, one-sided and useless. Since it runs counter to prevailing habits of thought, which contribute to the persistence of the past and carry on the business of an outdated order of things [...], it appears to be biased and unjust.” (Horkheimer (2002: 218)).

on society (and alternative ways to make use of these technological potentials), Wolter et al.'s study was also met with interest – but mostly by labour market experts and policy-makers. I would suggest that this should not be explained exclusively by factors external to the studies themselves.⁵⁸ Rather, the fact that Frey and Osborne highlighted vast technological potentials allowed for an opening up of public debate as established social relations seemed challenged by technological change, offering a chance to present radical alternatives to the status quo (e.g. a society in which the dominance of wage labour in our lives would be transcended). As such, the Frey and Osborne study exhibited a strong discursive function. Wolter et al. on the other hand, provided an expertise that might provoke relatively little attention in public discourse: that there is a way to implement the Industry 4.0 that allows things to stay the way they are, although quite a number of workers might have to be requalified.⁵⁹

We will now turn to the specialist discourse of the German federal government and the social partners on automation. In doing so, we will irrevocably leave the realm of more or less sober scientific discourse and immerse ourselves in the negotiations that help shape actual, real-life innovation. This will also start us out on a more interesting line of inquiry: rather than discussing what effects automation *will* have in the future – a question that cannot be answered conclusively in a non-deterministic framework – investigating the positions of these actors presents us with propositions regarding a much more meaningful question: what automation *should* be used for.

⁵⁸ E.g. that Frey and Osborne were first, that the public outreach of Oxford University might be better than that of IAB and BIBB or that statements about the US labour market are deemed more interesting internationally than those about the German labour market.

⁵⁹ Again, this is not deny the immediate usefulness of Wolter et al.'s study, and others like it, for specialist discourses and strategy formation of policy-makers (for an overview over the practical functions of scenarios, see Dieckhoff et al. (2014: 28ff.)).

3 Analysis of the Contemporary German Debate on Automation⁶⁰

3.1 Methodological Considerations

We have learned that the questions of which (wage) labour might be technologically substitutable in the future and whether, to what extent and under what conditions, negative effects on aggregate labour demand are to be expected, are subject of heated scientific debate, with research findings hugely varying depending on both the methodological approach and the assumptions on which they are based. The high level of epistemic uncertainty and heated debate characterising the scientific discourse does not alleviate the societal need to manage the further introduction of automation technologies however, but rather reinforces the importance of active policy making around this issue.

To gain a better understanding of the form this regulation might take under current conditions, I will discuss which assessment of the possible labour market impacts of automation technologies is dominant in the debate of the *Sozialpartner*⁶¹ and the German federal government and which, if any, policies are discussed in this context. I will do so through a document analysis of selected sources that illustrate key assumptions and assessments of the contemporary debate of the *Sozialpartner* and the federal government in Germany. This document analysis will be supplemented by a discussion of the so-called “Industry 4.0”, the “future” (see below) central to the contemporary debate on automation in Germany in my period of investigation.

The motivation to engage with these sources is less to learn “how things will turn out”⁶², but rather to understand which assessments of technological development, its labour market effects and its regulation in terms of employment and social policy dominate the contemporary debate. By noting the influence of these assessments on these key societal actors, who are central in the regulation of our world of work, we can glean some understanding of policy making processes in the here and now. Such an approach does not come without limitations. For instance, both

⁶⁰ This chapter is in part based on Frey/Schneider (2019a), Frey/Schaupp (2020a) and Frey/Schaupp (2020b).

⁶¹ *Sozialpartnerschaft*, or Social partnership, is the German term for the national corporatist arrangement, with the German Trade Union Confederation, *Deutsche Gewerkschaftsbund* (DGB) being the aggregate representative of employees, while the *Bundesvereinigung der Deutschen Arbeitgeberverbände* (BDA), the Confederation of German Employers' Associations, represents the interests of German employers.

⁶² The impact of the public tripartite discourse on technological change on actual technological development should not be overestimated for a number of reasons: many factors might be out of the hands of the tripartite partners (e.g. global economic developments) and parts of the communication might be strategic (see for instance my discussion of the “man in the middle” phrase below). This applies to the policy discourse, too, as actual policy making can be affected by election cycles, changing power constellations within the Federal government and the relative clout of different ministries (e.g. the Federal Ministry of Labour and Social Affairs versus the Federal Ministry for Economic Affairs and Energy).

trade unions as well as employers' associations of specific branches of the economy (such as the industrial employers' association *Gesammetall* or the German Metalworkers' Union *IG Metall*) are active on a national level too and conflicts of interest between, for instance, the employers' association of *Gesammetall* and *BITKOM*, representing companies of the IT-sector, cannot be ruled out. At the same time, the perspectives of individual employers or ordinary workers can of course differ from that of their representatives, too (cf. Müller-Jentsch 2009; Nachtwey 2016: 39; Schaupp 2021: 70–71). Yet, to gain a grasp of the broad trends of the policy debate regarding automation on an aggregate level, limiting myself to the final results produced by the BDA and the DGB through their internal negotiation processes in-between the various employers' association and trade unions seemed pragmatic.

My research situates itself within the broader debate on a hermeneutical extension of TA (Grunwald 2014, 2015), which argues that engaging with societal debates on possible futures is a meaningful hermeneutical tool to lay bare the ideological predispositions and social and political interests of actors in today's society, thereby allowing for a more enlightened democratic debate on issues of sociotechnical change (cf. Grunwald 2018c). Accordingly, the term "future" is used in the sense of "present futures", unless stated otherwise. "Present futures" are generally understood to be contemporary imaginations of future states of affairs that, rather than perfectly anticipating „the future“ (in this lingo: "future present"), are important insofar as they help shape social processes in today's present – and, in effect, the eventual future present (Adam 2011; see Lösch et al. 2019). Therefore, engaging with the Industry 4.0, which dominated the contemporary debate on automation in my investigation period, allows me to contextualise the findings of my document analysis and to connect with the scientific debate on the Industry 4.0 which serves as a productive point of departure for reflecting the limitations of the dominant policy discourse on automation in Germany. This reflection is inspired by the early Frankfurt School as the general theoretical framework of this dissertation and by more contemporary critics of both corporatism and the Industry 4.0.⁶³

Since my interpretation is theoretically motivated and informed, it cannot be simply verified by the empirical material since its reflection is meant to provide findings that transcend the immediate data to hand and concern the oftentimes implicit interests and convictions of the

⁶³ As such, this reflection follows a perspective that might, as any contribution to scientific debate, be contested and whose validity is predicated in turn on the validity of previous research which cannot be reproduced comprehensively in the context of my exposition. Accordingly, linguistic constructions employing such particles as "might", "can be understood" or "seems" are intended to highlight the fact that alternative interpretations of the material are possible, although I am convinced the one presented in the following is reasonable.

actors involved. The capacity to explicate the implicit has been highlighted as a key virtue of hermeneutic approaches to futures (Grunwald 2012b: 283), but it invites the criticism frequently raised against any theoretically-informed empirical research that, in the end, theoretical convictions are forced upon the empirical material to confirm the bias of the researchers. This risk exists, of course, but in light of the fact that I had to reconsider my theoretical approach to the empirical material several times throughout my research, I hope that I was able to avert an all too dogmatic interpretation.⁶⁴ Accordingly, I hope to have redeemed the claim to open-mindedness frequently demanded in the methodological debates on empirical research of the early Frankfurt School (Adorno 1972a, 1972b).

Collection and Selection of Data

The core of my material consists of written sources (predominantly grey literature such as policy papers, position papers and annual reports) published by the *Sozialpartner* and the German Federal Government in the years 2007-2016. The sources were identified by research on the homepages of DGB, BDA and the Federal Government as well as bibliographical research. Furthermore, I contacted all three organisations inquiring what material of theirs they considered central and exemplary in regards to the discussion of the automation of work. These informal inquiries were supplemented by a Freedom of Information Act request to the Press Office of the Federal Government regarding the numbers of downloads of various brochures and information material as well as the respective orders of physical copies to identify particularly relevant documents. All three institutions responded. These initial compilations were collated with existing research literature.⁶⁵

Despite this thorough approach, universal comprehensiveness of the data cannot be guaranteed. Instead, the central criterion for the collection of material then was that of “saturation” – that the core arguments seemed to be apparent and started to repeat themselves. An in-depth study of the material was preceded by a preliminary scan using 17 different keywords (from technology related ones such as robot* and automation to specific policies such as

⁶⁴ To avoid giving away too much at this point, just one short example: For instance, I had initially assumed that techno-determinist statements would be much more virulent in the debates on automation, as deterministic arguments can be considered a common ideological tool in technopolitical conflicts (Grunwald (2019a: 155–156)) – its lack, alongside a relative lack of explicit conflicts between the *Sozialpartner*, motivated me to engage more actively with Herbert Marcuse’s concept of One-Dimensional thinking and to develop a more nuanced understanding of how the preformation of a discourse (e.g. if a focus on competitiveness is shared by all participants) might lead to its partial opening.

⁶⁵ I would also like to thank Alexander Hutzler for his research support during his internship at ITAS.

Grundeinkommen (basic income) or *Arbeitszeitverkürzung* (working time reduction) and fashionable lingo in the context of socioeconomic transformation fundamental economic change (e.g. disrupt*). In a last step, the scope of sources was then reduced back to sources that appeared exemplary for the overall discourse on automation in the evaluation period, both regarding their content and the context they originated in.

3.2 Analysis

The (Non-)Discussion of Automation in Germany 2007-2011

The first result of this research is actually a negative result: in the first five years of the investigation period (2007-2011), there was no significant discussion dealing with automation or the employment effects of technological development discernible at the national level. My initial hope was that choosing a time period coinciding with the start of the worldwide financial crisis of the years from 2007 onwards, and the discursive turmoil that accompanied it, would allow me to gain insight into the importance attached to technological innovation in discussions about the immediate management of the crisis, or even its genesis⁶⁶, and to contrast these debates with those developing around the so-called Industry 4.0.

The lack of discernible discussions on the subject can in part be explained by lack of publication provision continuity due to changing Federal Governments or BDA- and DGB-officials. Furthermore, since existing research literature focuses heavily on the Industry 4.0 period (see below), its usefulness for correcting issues in data collection was limited due to possible selection biases. The annual reports of the DGB and BDA suggest, however, that the years in question were heavily dominated by immediate crisis management: In a socioeconomic and political climate defined by emergency rescues of companies and the fear of recession resulting in mass-unemployment, considerations whether automation might eventually lead to job losses in some distant future might have appeared less urgent, even to those open to discussing this matter at all.

General demands to provide a “positive climate for innovation” – first and foremost implying the reduction of regulation – in order to maintain German competitiveness were issued by the BDA throughout this period however. Since this link between national competitiveness and technological innovation is also constitutive of the discourse that developed around the Industry 4.0 vision, the period of 2007-2011 seems to yield no specific insights into the assessment of the societal implications of automation by the BDA, DGB and Federal Government.

⁶⁶ Ernst Lohoff, Norbert Trenkle and others have tried to explain the increased financialization of the past decades as a response to the crisis of the Fordist accumulation regime driven by a rising organic composition of capital that eroded the employment basis of the manufacturing sector (see for instance Lohoff/Trenkle (2013)). In this sense, the financial crisis might actually be considered a result of a more fundamental contradiction between the prevalent mode of production and its sociotechnical basis. For a brief discussion of this line of argument, see chapter 4.2. It is hardly surprising, however, that since the immediate trigger of the crisis was situated in the circulation sphere, such aloof considerations played no role in the publications of the societal actors at hand. Furthermore, their debates can be characterised by a general lack of radical reflexivity regarding the societal conditions which drive and shape technological and economic development (see my discussion of the absence of the term capitalism in the context of the Industry 4.0 discourse).

Accordingly, I will use the debate around the Industry 4.0 to illustrate central sentiments of these actors regarding automation and its labour market effects.

Introducing the Industry 4.0

The story of the development of the Industry 4.0 has been well-documented in research: after initial discussions in the context of a task force of the World Economic Forum on the “Future of Manufacturing” had brought together representatives of several major German corporations, Industry 4.0 was first presented to the public in the context of the *Hannover Messe 2011*, one of the world’s largest industrial trade fairs, by acatech’s Henning Kagermann,⁶⁷ artificial intelligence researcher Wolfgang Wahlster and Wolf-Dieter Lucas, a senior ministerial official (cf. Pfeiffer 2017: 107–113). Subsequently, the term quickly proliferated in German public discourse and policy debates. These policy debates were flanked and structured by the establishment of various national and regional dialogue platforms, working groups and initiatives. The proponents of Industry 4.0 assume that “the introduction of the Internet of Things and Services into the manufacturing environment is ushering in a fourth industrial revolution” (Kagermann et al. 2013: 5), thus warranting the by now fashionable particle “4.0”. The prevalent call for a technologically implemented integration of value chains, smart factories and products into global business networks correlates with a vision of increased control of highly complex and production processes which is also combined with the expectation for a (partial) reshoring of production capacities. Other technologies frequently discussed as forming the technological basis of the Industry 4.0 are adaptive, mobile or smart robotics, 3D-printing and job-related wearables that are all slated to contribute to productivity increases (see Pfeiffer 2017: 107–111).

The state was instrumental in facilitating Industry 4.0 discourse in Germany: A national “Industrie 4.0 Working Group“ was established rather quickly as part of a strategic initiative, bringing together engineers, software scientists, representatives of the DGB and of IT and technology companies as well as the German Federal Ministries of Research and of the Economy (Hirsch-Kreinsen 2016: 8). In its wake, a plethora of initiatives and platforms as well as ministerial research programs have been initiated. The Plattform Industrie 4.0, sponsored by

⁶⁷ Before becoming the chair of acatech, Germany’s National Academy of Science and Engineering, Kagermann served as the chairman of the Executive Board of SAP SE, Europe’s largest software corporation, whose headquarter is situated in the Southwest of Germany (see Wikipedia (2020a)).

the Federal Ministry for Economic Affairs and Energy (BMWi) and the Federal Ministry of Education and Research (BMBF) and the dialogue process Work 4.0 of the Federal Ministry of Labour and Social Affairs (BMAS) can be considered among the most prominent ones (cf. Hirsch-Kreinsen 2016; Pfeiffer 2017; Kalff 2019; Meyer 2019a).

An early key document, the “Recommendations for implementing the strategic initiative INDUSTRIE 4.0”, was first presented to the public in 2012,⁶⁸ with acatech taking a lead role in compiling the report. The roughly 80 pages long report is divided into seven chapters. An introduction is followed by two chapters which introduce the Industry 4.0 vision and the economic strategy informing it. Next, concrete research requirements and “areas for action” are introduced. The report concludes with a chapter comparing the German economy with the rest of the world to further highlight the relevance of this strategic vision for world-market competitiveness and an outlook further emphasising the promises of the Industry 4.0 and the need for its implementation. The report is set out to provide the basis for the further development of this vision and its implementation in the related Industry 4.0 platform (Kagermann et al. 2013: 77).

The Industry 4.0 working group, whose output the report constitutes, comprised primarily of representatives of German software and capital goods companies (e.g. ABB, SAP, Siemens, Bosch) and industrial corporations (e.g. ThyssenKrupp, BMW, Daimler), in addition to industry associations (e.g. BITKOM, Federation of German Industries), members of the scientific community and representatives of the BMBF and BMWi. To make sure that the unions as a central stakeholder group would also be involved in the debate from the get-go, a union representative – Ingrid Sehrbrock, at the time deputy head of the Christian Democratic Employees’ Association, the social wing of Germany’s conservative party, as well as member of the Federal Executive Board of the DGB (cf. Wikipedia 2020b) – participated. The disproportional representation of employer and business representatives is also reflected in the core team of authors of the final report, listing nine members of business associations and individual companies, three academic members and only a single trade union representative (Kagermann et al. 2013: 9–10). It also striking that representatives of the ministries did not get involved as authors of the report, which illustrates that although governmental agencies are

⁶⁸ For my analysis, I am using the expanded and more frequently referenced version published in April 2013.

critical in the establishment of these kind of dialogues, they – at least in this case – left the development of concrete proposals to business, science and union actors.

Despite the relative numerical disadvantage of union representatives in the initial Platform Industry 4.0 and its working groups, the document nonetheless can serve as an exemplary document to the early development of the Industry 4.0 discourse, drafted by members of employers' associations and the trade unions in tandem. In it, the German economy is heralded as “one of the most competitive manufacturing industries in the world and [...] a **global leader in the manufacturing equipment sector.**” Given strong national capital, good industries and existing expertise in “embedded systems and automation engineering”, the German economy would be “uniquely positioned to tap into the potential of a new type of industrialisation” (Kagermann et al. 2013: 5, bold in original). Throughout the document, the chief objective of the Industry 4.0 initiative is made abundantly clear: to increase the global competitiveness of the German economy.

This does not mean, however, that other societal issues and concerns would be altogether neglected. In its historical contextualisation, the Industry 4.0 is related to the so-called third industrial revolution, characterised by the employment of IT and electronics to substitute “not only a substantial proportion of the ‘manual labour’ but also some of the ‘brainwork’” (Kagermann et al. 2013: 14). The question is invoked, how “good, safe and fair” jobs might be guaranteed under conditions of increased automation (Kagermann et al. 2013: 52). And job losses (“at least [for] some employee groups”) are labelled as “unacceptable both for the employees themselves and from the wider public’s point of view” and could “hamper the successful implementation of the Industrie 4.0 initiative” (Kagermann et al. 2013: 53).⁶⁹ Automation anxiety is thus recognised, but primarily as an obstacle to accelerated technological development.

Against this backdrop, tribute is paid to trade union-propagated innovation strategies combining „labour-oriented organisational design with enhanced participation rights, co-determination and training opportunities” and technological innovation to create “good and fair jobs and a secure

⁶⁹ In this case, a comparison of the two versions of the report is worthwhile. The term *Beschäftigungseffekte* (employment effects) is in the first version of the report only used in a section that highlights the need for research on the quantitative employment effects of the Industry 4.0 and on its acceptance – implying that job losses are primarily considered a concern insofar fears of such job losses might trigger worker resistance, thereby impeding the implementation of the Industry 4.0. In the second version this segment persists, but the issue of employment effects is discussed at greater length, indicating a subsequently marked increase in importance attributed to this issue.

future for manufacturing sites and their employees”. Thus, creation of good jobs, technological innovation and worker co-determination might be reconciled “under the banner of ‘better not cheaper’”, all the while “securing the future of German industry” by “meeting the demands of global competitiveness and the need for greater flexibility”. The articulation of workers’ interests is thus welcomed in the form of a strategic commitment to increased investment and innovation as a way to secure employment security and quality. In this spirit, the document suggests to establish a regular dialogue between trade unions and employers’ associations and “to enable transparent identification and discussion of the key advances, problems and potential solutions associated with the implementation of Industrie 4.0”. This dialogue should be in particular supplemented by additional research and documentation of “the impact on work and employment (opportunities and risks) together with the actions required to achieve employee-oriented labour and training policies” (Kagermann et al. 2013: 54). Consequently, the next subchapter is dedicated to (re-)qualification strategies for the Industry 4.0 (Kagermann et al. 2013: 55–58).

These basic notions can serve as a summary of the technocorporatist agreement characterising the debates around Industry 4.0 more generally: social concerns and the demand for co-determination are at the very least rhetorically acknowledged, provided they can be reconciled with maintaining and expanding the competitiveness of the German economy. The risk of job losses is addressed, not least because the fear of job loss might be detrimental to the further implementation of the Industry 4.0 initiative,⁷⁰ but quickly rephrased as an issue of economic growth and labour supply elasticity, that should be enabled through (re-)qualification – a topic to which we now turn.

From the Industry 4.0 to Work 4.0

The BMAS’ “Work 4.0” dialogue process can be understood partly as a response to the need for additional dialogue on the impacts of deepening automation on the labour market identified in the recommendation document. It was launched in 2015 to facilitate dialogue both amongst experts and the general public on the future of work in Industry 4.0, bringing together actors from the ministry, trade unions, employers’ associations, socio-political advocacy

⁷⁰ Given the centrality assigned to automation throughout the document (the term is mentioned roughly every two pages), one might consider the all-out omission of this concern unfeasible, provided public preoccupation with fears of technological unemployment in the context of automation.

organisations, the churches, and the general public. Postulating a one-sided focus “on technological innovations, with little attention paid to labour and the impacts of technological development on the world of work”, the Work 4.0 dialogue was set out by the BMAS to “play a part in shaping our future working society’s social conditions and rules” (BMAS 2017: 216). This focus on the whole of the “working society” also indicates a broadening of the debate beyond a rigid fixation on a modernisation of industry (which in Germany is more or less equated with manufacturing).

The BMAS’ own evaluation of the two years long dialogue seems genuinely elated: it lists seven workshops “with more than 200 experts from academia, the practitioner community and the social partners” and a film festival that toured across Germany screening documentaries on “the modern working world” and provided the opportunity to engage with experts at 25 different locations spread over Germany. Additionally, “more than twenty research projects and individual papers” were commissioned (BMAS 2017: 219). At the dialogue’s launch event, Andrea Nahles, the social democratic Minister heading the BMAS, presented a “Green Paper Work 4.0” outlining the “starting point and the Ministry’s aims” and posing questions that were to be discussed throughout the consultation process (BMAS 2017: 216). The Green Paper was followed by the publication of two “Work 4.0 workbooks” that “offered an insight into the state of discussion on the key issues, contributed to the debate and formed an extended platform for the specialised dialogue on the future of work” (BMAS 2017: 218). The results of the process were compiled in the so-called “White Paper Work 4.0”, whose presentation as a draft formed part of the closing conference of the dialogue in November 2016⁷¹ (although two additional smaller publications linked to the process were published in 2017).

Although self-evaluations should be taken with a grain of salt, the dialogue process can be considered an extraordinary exercise in engaging both with experts as well as the general public and various other stakeholder groups. According to the numbers provided by the BMAS, the expert workshops were attended by “more than 200 experts from academia, the practitioner community and the social partners”, while the Futurale film festival attracted over 8.000 visitors. In total, around 12.000 participants in events linked to the dialogue process were recorded. In addition, the homepage of the dialogue process counted over 1.000.000 page views

⁷¹ The White Paper was first presented to the public in late autumn 2016 and thus fell into the period under study, the divergent publication date likely is due to delays in the printing process – I at least was unable to identify differences between the versions of the White Book presented in late 2016 and the final version printed in march 2017.

and the Green Paper was downloaded 11.000 times while it also “flew off the press”, by the end of 2016 reaching “a print run over of [sic] 27,000 copies” (BMAS 2017: 216ff.). Copies were supplied free of charge.

The first thing that is striking regarding the written material is its trendy design: the ministry led by the Social Democratic Party of Germany (SPD) commissioned an advertisement agency to design the key documents of the Work 4.0 process. While the White and the Green Paper vary in extent – with the Green Paper around 90 and the White Paper totalling over 200 pages – both are heavily decorated with illustrations and graphical fillers. The colour palette is centred on green (particularly in the Green Paper), pink and blue. The depictions of persons are similarly unthreatening. People are mostly presented in a work setting (which is the context of the debate after all), and either peacefully cooperating or smiling. These themes also extend to the depiction of technological devices. They are depicted predominately as tools under the mastery of human workers, or as friendly colleagues, as illustrated by a human arm and a robot arm toasting with a mug (BMAS 2017: 42–43). Only very rarely is this theme suggesting cooperation and assurance dispensed, for instance when a surveillance camera is showed peeking into a human head (BMAS 2017: 64), an illustration of privacy concerns, or when substituting Leonardo da Vinci’s Vitruvian Man through a Vitruvian robot (BMAS 2015: 17). The design not only serves as a visual representation of the topics discussed in the texts but also to set a non-threatening ambiance for the written material.

Kicking Things off: The Green Paper “Work 4.0”

The Green Paper welcomes the reader with a word-cloud combining various terms alluding to technological developments (Industry 4.0, Big Data, Digital Transformation, 3D-Printers (robots are noticeably missing, despite being referenced repeatedly in other Industry 4.0 documents) and terms referring to changes in work organisation and other societal implications (Work-Life-Balance, Crowdfunding and Opportunities are featured in big font sizes, although the term ‘polarisation’ can be found too, albeit in much smaller font). The book is divided into five chapters that follow a foreword by Labour Minister Andrea Nahles. While the first one gives an introduction into trends and scenarios of the evolution of “our working society”, the second one is dedicated to “re-imagining work” and the third one introduces “areas of action and “key questions” that are supposed to be addressed through the dialogue process. Chapter four

focuses on the institutional arrangements of “the working world 4.0” and finally the process design of the dialogue process is outlined (BMAS 2015: 5).

In her foreword, Nahles alludes to the discussion of driver-less “taxis and HGVs [heavy goods vehicles]”, robot-surgeons and “houses and estates [...] built using 3D printers” in the media. She also points towards discussions within “[t]he German business community” on how to ensure the attractiveness of Germany and Europe as business locations. She identifies a need for a “debate about the future [...], with people and their needs at its heart.” She brings up the threat to employment that might result from automation (“what place do drivers, doctors, [...] and construction workers have in the digital world (and beyond)?” and advocates “a careful evolution in social affairs” oriented by “a new social compromise which benefits employers and workers alike” (BMAS 2015: 6–9).

Not only is the fear of technological unemployment directly addressed by her, her foreword also implies ways in how to process the challenges of the so-called “digital revolution”: namely through social compromise between the social partners and “careful evolution in social affairs”, i.e. incremental reforms (BMAS 2015: 8). The first sub-chapter of the Green Paper also addresses the employment effects of automation. In line of the Green Paper’s character as an invitation for dialogue, no side is taken at this point. The Green Paper points out that “[i]t remains to be seen what the digital economy’s net effect to employment will be” (BMAS 2015: 16), citing both evidence for increased employment in the information and communications technology sector, but also for job losses particularly “of middle-skilled, routine-intensive occupations”⁷². The connection to an increase in employment polarisation in the recent past is made⁷³ and although historical evidence is quoted that “short-term loss of [...] occupations” has been compensated by job creation “over the long term” in the past, it is also put into question whether this might still be the case today (BMAS 2015: 16–17). It is also at this point where

⁷² Some subtle valuations can be identified however. While the Green Paper states that “[n]ew jobs **are** being created”, evidence for job-losses is quoted as “Labour-market researchers **believe** that [...] automation has resulted in the loss of [...] occupations” (BMAS (2015: 16), bold by me). Thus, the validity of the latter evidence is subtly put into question.

⁷³ This implicit admission of failed labour market politics in the past is softened by the compliant remark that employment polarisation in Germany lead to “no wage polarisation comparable to that in the US” (BMAS (2015: 17)). Not only can the adequacy of this downplay of the urgency of economic polarisation be put into question (see chapter 4.2) – this remark also constitutes a thinly veiled attempt to mobilise popular anti-US resentments to divert attention from the BMAS’, after all a key institution when it comes to labour market policy, own failings in the past.

the Vitruvian robot is presented, a powerful image to illustrate the substitutional effects of technology.

“Areas for Action and Key Questions”

Accordingly, the labour market effects of automation are again addressed as one of the central areas of action and further discussion in the first sub-chapter of chapter three “The Challenges: Areas for Action and Key Questions” under the heading “Securing Participation in Work”. Record high numbers of employment are highlighted and the importance of work to “personal identity and our social relationships” is stressed. “Work for All” is emphasised as “a key aim of employment and labour-market policy” (BMAS 2015: 42–43).

Despite high levels of employment, the Green Paper concedes that “many people are still afraid of losing their job” and livelihoods (BMAS 2015: 43). Furthermore, the Green Paper suggests that the current situation can be characterised as extraordinarily challenging as not just low-skilled occupations might be threatened by technological development, “but increasingly also [...] highly qualified skilled workers and [...] entire companies and sectors.” (BMAS 2015: 43).

Addressing arguments about “the ‘end of work’”, the authors point towards historic development and conclude that “[r]eality has always proved such predictions wrong”, highlighting “new employment opportunities” in the digital economy (BMAS 2015: 44).⁷⁴ The authors contrast these fears with concerns regarding a lack of (skilled) labour and highlight the importance of skills development (e.g. vocational training programmes) to develop and safeguard employability, especially of “low-skilled individuals, women, older people and migrants” (BMAS 2015: 45). The chapter concludes by identifying key areas for further debate which reinforce the link between high levels of employment, a successful adaptation to technological change and skills.⁷⁵ The focus on (re-)qualification is quite dominant and any distributional issues which are mentioned, at least in passing (BMAS 2015: 44), are side-lined. The most interventionist field of inquiry pertains possible job creation in the public sector and

⁷⁴ For a critique of both inductive arguments regarding technological unemployment and the limitations of historical long-term perspectives, see chapter 2.

⁷⁵ E.g.: “What impact will the expected digital structural change have on employment? Which occupations and sectors will be affected in what way and over what period of time? What qualifications will be needed?” BMAS (2015: 47).

possible “state support (infrastructure, research, measures to boost demand, financing, etc.)” (BMAS 2015: 47).

Although there is an incidental reference to measures towards boosting demand which might imply redistributive state intervention, the chapter subtly introduces two limitations on the debate around automation anxiety. For one, the fear of technological unemployment is first recognised but then largely repelled by referring to historic evidence – retracting some of the openness to consider more fundamental challenges to employment that was implied in the opening chapter. Further, in line with this retraction, the responses to these fears are rather limited, largely individualising concerns of structural challenges posed by technological change by reframing them as an issue of employability. This is also reinforced by later discussions in the Green Paper which again highlight the importance of “enhancing individuals’ employability”, e.g. through “continuing vocational education and training” as the central tool of employment promotion (BMAS 2015: 79). This is particularly noticeable since the authors recognise that automation might also challenge high-skill employment; despite this recognition, the primary reaction to automation anxiety is seen as an upskilling of the workforce, rather than developing concepts for the active management of the labour supply and demand, e.g. through collective working time reduction.⁷⁶

This is all the more noteworthy as the following sub-chapter (3.2) is indeed dedicated to the topic of working time. Options for individual working time reduction are discussed but it is also observed that these are “very rarely used.” The authors identify two main reasons for this: Loss of income and the perception that “part-time work can lead to a professional dead-end”, with fewer chances for career advancement and issues at increasing hours again (BMAS 2015: 50). Rather than discussing *collective* working time reduction, that could cushion both the risk of income losses (if they would take place with no reduction in pay), and the fear of a “professional dead-end” (if anyone is working shorter hours, it no longer constitutes an individual competitive disadvantage), the authors double-down on the perspective of a “new flexibility compromise [...] based on a life-phase approach”. This includes, for instance, family working-time models that provide “parents the chance to work less when their children are young” by partly subsidizing temporary losses of pay (BMAS 2015: 51). As such, working time policy is understood in the Green Paper mainly as a way to allow for better “work-life balance” through further flexibilizations “that take into account the interests of both businesses and employees”

⁷⁶ For a more detailed critique of this focus on qualification, see below.

and schemes based on conditional income support which aim to enable temporary individual working time reduction. Thus, the connection between productivity gains and shorter working hours is raised, but only in a very limited way (BMAS 2015: 51–52).

The final area of action and inquiry that seems relevant in the context of the management of automation is headlined “The Social Market Economy reloaded?”⁷⁷ (chapter 3.3) and deals directly with the regulation of wages and social security policy (BMAS 2015: 54ff.). The chapter starts out with a eulogy of the “social market economy”, setting out “social equity, prosperity and a good quality of life for the general public” as “its guiding principle”. The importance of social policy in its implementation is highlighted by pointing towards the importance of social policy as stabilizing factor in crises, the importance of state support for training that “lays the foundation for ensuring the availability of the skilled labour needed by companies” and its contribution to “confidence in the market and its institutions” more generally.⁷⁸

Despite this cheery opening, the authors state that „[t]he original **promise of prosperity for all** has become **less comprehensive**” (BMAS 2015: 55), pointing to increases in wealth and income inequality. The growth of a low-wage sector, disproportionately affecting women, is lamented and rising income inequality is linked to slower economic growth. Growing income inequality is linked to an erosion of “collective bargaining coverage” – accordingly, the Green Paper continues, state intervention might be needed “to either ensure that the system of free collective bargaining remains functional, or to offset the differences in market incomes”, e.g. through minimum wage policy, a reform of taxation (particularly in respect to international businesses (BMAS 2015: 57), or income support (BMAS 2015: 55–56). The chapter concludes by suggesting more detailed discussion on how workers’ “fair” participation in economic growth can be ensured – “even in times of dynamic change”. Attention is also drawn to the question how income-based social systems might be made more resilient in the face of demographic change and “new forms of work” (BMAS 2015: 58–59).⁷⁹ Challenges to wage labour-based social security schemes are therefore identified. No attention is given to the possible role automation might play in eroding social security contributions however,

⁷⁷ The term *Soziale Marktwirtschaft* (social market economy) is an idealizing designation for the mix of a corporatist market economy and a more or less generous welfare state that defined the post-second World War consensus in Western Germany.

⁷⁸ There is a striking disproportion between the highlight of normative arguments for a strong welfare state and the discussion of its functional utility for business.

⁷⁹ “New forms of work” likely refers to freelance work that is not covered by pension and unemployment insurance schemes that cover regular wage labour.

reinforcing the perception that this issue is largely disregarded and marginalised throughout the Green Paper, i.e. from the very outset of the Work 4.0 dialogue.

Another question put forth addresses how “the social partnership [can] be preserved in a changing world of work” (BMAS 2015: 58). The term preservation is key here: although the importance of the so-called social partnership and economic co-determination is highlighted throughout the document, it is mostly accompanied by rather defensive vocabulary inquiring how it might be preserved (see above) or safeguarded (BMAS 2015: 77) – and they are mostly justified in functional terms, e.g. as “a vital locational advantage” (BMAS 2015: 78), suggesting that after decades of weakening coverage of collective bargaining agreements and eroding wage levels, one has to continuously highlight the appeal of corporatist dialogue for the “business location” (i.e. the employers).

The Social Partners React

How did these social partners react to the invitation to talks by the Federal Government? Both the DGB and the BDA were quick to react by publishing extensive statements (13 and 14 pages long respectively). Both organisations welcomed the publication of the Green Paper, considering it an indication of the importance ascribed to technological change by the Federal Government (BDA 2015b: 42; DGB 2015a: 1), and both reinforce the emphasis put on education in managing the labour market impacts of automation (BDA 2015a: 3–5; DGB 2015a: 10–11). The statements however also allow for a reconstruction of key issues in contestation in the context of the management of technological change.

The BDA’s statement, for instance, sets out by arguing that although the Green Paper identifies a number of questions, they are too strongly centred on the perspective of employees; in contrast, employers’ and consumers’ demands, as well as issues of competitiveness, would be discussed too little. In response, the BDA demands a more “balanced” approach and puts forward its own demands (BDA 2015a: 1).⁸⁰ These are formulated not just as demands by

⁸⁰ This criticism might seem needless in light of the constant appeal to competitiveness and economic advantages in the Green Paper. On the other hand, it should perhaps be unsurprising that a lobbying group is claiming that its interests have not been represented sufficiently; furthermore, the Green Paper indeed deals more explicitly with possible challenges to employees and less on economic opportunities compared to other Industry 4.0 publications such as Kagermann et al. (2013).

employers however, but at least partly as inherent necessities of technological change.⁸¹ For the most part, a discourse of chances and opportunities (and to a much lesser degree challenges) defines the papers of the BDA however.

Realizing these opportunities, namely potentials for economic growth and growth in employment as well as boosts for global competitiveness and security of existing jobs, should be the shared goal of tripartite initiatives of policy-makers, employers and trade unions according to the BDA. The Confederation of Employers' Associations suggests to review existing labour law but connects this demand to a review of existing labour law with a vocal opposition to "premature legal regulations", suggesting an overall goal of deregulation (BDA 2015a: 2). And indeed, the BDA demands a weakening of labour time regulation via moving from a model which allows for a maximum of ten hours of work per day and 48 hours within a week to one that focus solely on weekly maximum working hours. At the same time, rest periods should be opened up to interruptions (e.g. to allow for workers to do some work from home in the late evening without violating legally required minimum periods of rest). The BDA argues that this would allow employees to take advantage of the opportunities for better Work-Life-Balance, for instance to carry out some work once the kids are in bed. By referencing changes in customer demand in the context of Internet trading, they call for an erosion of the protections for bank holidays and Sundays,⁸² combining this demand with a thinly veiled threat of job relocation, e.g. in the call centre industry (BDA 2015a: 6–7). This call for working time deregulation is combined with a general endorsement of non-standard employment (e.g. by arguing against the regulation of "crowdwork" and against a push back against service contracts) (BDA 2015a: 7–8).

Although the BDA concedes that co-determination within businesses should not be fundamentally undermined in the process of digitalisation, it again presents it as a fact that digitalisation would lead to changes in co-determination processes and highlights the importance of honouring the established balance between "entrepreneurial freedom" and co-determination rights. The employers also suggest that co-determination might inhibit innovation if, rather than focusing on the introduction of altogether new technological systems

⁸¹ One key paragraph for instance starts by stating that "The digitalisation of the economy and the world of work **will** [emphasis added] lead to more differentiation, flexibilization and specialisation" (BDA (2015a: 1)), another one is headlined "Digitalisation demands and supports flexibilization" (BDA (2015a: 5)). For a critique of such techno-fetishism, see below.

⁸² With the exception of certain sectors such as gastronomy or the care-sector, most businesses in Germany are required by law to close down on Sundays.

in the workplace, they would extend to updates in established software systems (BDA 2015a: 8–9).⁸³ The statement concludes with another warning against government regulation: The BDA argues that if the federal government were to introduce too many regulations, the system of collective bargaining would be weakened further, as less and less decision could be taken on the level of collective bargaining. Instead, they demand for an expansion of flexibility clauses that would allow to override state regulation if both representatives of the workforce and the employers would agree on divergent terms (BDA 2015a: 13). The distinction this demand is given as the final chapter of the statement suggests a strategic importance, implying an offer by the BDA for a possible deal: continued support for Germany’s collective bargaining system in exchange for a partial undermining of state regulation.

Negative labour market effects of technological change are deemed unlikely – on the contrary, the BDA states that not understanding digitalisation as an opportunity for economic growth would be the safest way to destroy jobs (BDA 2015a: 3). The BDA also points to the coincidence of digitalisation and increased employment (BDA 2015a: 2), thereafter shifting the debate to a call for accelerated digitalisation, investment into infrastructure and new business fields and most importantly: education (BDA 2015a: 3–5).⁸⁴ Accordingly, the BDA rejects the notion of “deserted factories”, highlighting the importance of well-trained personnel in managing ever shorter innovation cycles (BDA 2015a: 11). Particular attention is paid to the need for continuous training of employees and the demand that employees should be contributing more themselves, for instance by undergoing training in their spare time. The BDA at the same time rejects that the state should take a more active stance in this area, for instance by passing general laws regulating (the right to) continuous training or by providing support through social security agencies (BDA 2015a: 5). This position is in line with the BDA’s general rejection of state intervention and its promotion of shifting responsibilities to the business level in the sources that I have reviewed. Curiously, this position precludes a potential 'easy way out' – i.e. externalizing costs of training to social security agencies who could, for

⁸³ While speedy software updates seem essential for instance in case of security fixes that do not change the basic functionality of a given software system, other updates might of course introduce new features that affect workers’ rights, for instance if new surveillance options are introduced. The BDA’s phrasing is very general however and does not distinguish between these cases.

⁸⁴ The BDA appears to recognize the importance to address concerns of possible job losses, for instance by reproducing the key paragraph on the subject of its statement in its annual report (BDA (2015b: 43)).

instance, subsidise individual working time reductions, thereby reducing costs both for employers and employees.⁸⁵

The BDA's position on the Green Paper largely echoes an earlier paper from the organisation, dedicated to using the opportunities of digitalisation, published roughly half a year before the statement on the Green Paper (BDA 2015c). The paper is slightly shorter and more aggressively worded, frequently warning that the employment opportunities of digitalisation would go wasted if more regulation would be forced upon employers and demanding a moratorium on regulation of "flexible employment forms" (BDA 2015c: 2). This statement triggered a reaction by the DGB, allowing for a reconstruction of central contentious issues between DGB and BDA aside from the statements provided for the Green Paper. The DGB condemns the original statement of the BDA as a "Naysayer-Paper with a neoliberal tinge", criticising that the BDA would prefer to leave everything to "the market" by rejecting political regulation (DGB 2015b: 1). At the same time, the DGB claims that it would be 'obvious' that the BDA would be using digitalisation as a pretence to declare "flexibilization the key locational factor" and to externalise economic risks to employees and the welfare state. Furthermore, they argue that the BDA would "discredit" social and labour legislation (DGB 2015b: 1).

The DGB summarises its perspective by stating that "[now would be a] defining phase for the long-term setting of the course regarding the future of work" and that the digitalisation would need to be shaped politically (DGB 2015b: 3). Five main contentious issues emerge:

- 1) the regulation of non-standard employment forms (i.e. crowdwork, service contracts, subcontracted labour, fixed-term employment, pseudo self-employment etc. (DGB 2015b: 2–4)),
- 2) the future of co-determination (with the DGB highlighting that the BDA apparently is trying to shift the focus from co-determination on the level of sectoral collective bargaining agreements to the company level; furthermore, the DGB demands that co-determination rights should be updated to also apply in the context of "Cloud-Working", mobile work and the setting of performance targets for workers (DGB 2015b: 2; 4),

⁸⁵ The BDA gives no indication why it is taking this position – it could however be explained both ideologically (for instance through a neoliberal preference of the BDA for a "lean state") or economically (i.e. the BDA could be worried that increased spending by social security agencies might eventually lead to increases in social security contributions to refinance the expenditure, driving up labour costs, whereas the costs of temporary lower wages in the case of working time reduction for continuous training are borne by workers only).

- 3) the regulation of working time (with the DGB arguing for limits to the flexibilization of working times (DGB 2015b: 2; 4)),
- 4) the regulation and financing of education (while BDA and DGB both agree on the importance of education and particularly continuous training, the DGB criticises the BDA for trying to shift the burden to individual workers and sees the qualification of its work force largely as a responsibility of companies (DGB 2015b: 1; 4-5)),
- 5) and lastly the assessment of the employment effects of technological change (with the DGB stating that digitalisation might lead both to a humanisation of work and its precarisation and substitution, demanding technology assessment to provide knowledge that might help shape sociotechnical development in a co-determined manner in a way that actually benefits employment levels and promotes decent work (DGB 2015b: 3–4)).

While the initial reaction of the DGB is very much defined by its critique of the BDA's publication, the DGB's statement on the Green Paper allows for further insights into the DGB's own ambitions in the context of digitalisation. Unsurprisingly, the DGB welcomes the focus of the Green Paper on employment issues and the perspective of employees, suggesting that these dimensions of the Industry 4.0 had been neglected before. It welcomes, too, that the Green Paper identifies a need to politically shape the implementation of digitalisation particularly in terms of employment and social policy (DGB 2015a: 1–2).

The trade unionists state that the goal of a new “flexibility compromise”, whose establishment is openly pursued through the Work 4.0 process, would however be “ambitious”, provided the extensive demands pushed by the BDA (DGB 2015a: 2–3). They also point out that research by both the Federal Institute for Occupational Safety and Health as well as their own would suggest that working times are already quite flexible in Germany,⁸⁶ leading to overtime work and stress. The DGB therefore argues that further flexibilization should only happen on the grounds of strong co-determination by employees and works councils and should not be used as an unilateral tool to increase efficiency at the cost of workers' private lives (DGB 2015a: 7–8). The DGB also suggests that finding a compromise might be particularly difficult, in light of the propagation of increased use of robotics and software to lower costs and to automate

⁸⁶ The DGB for instance points out that according to a recent survey conducted by the Federal Institute for Occupational Safety and Health, as many as 13,8% of workers would regularly work on Sundays. Additionally, 74% of respondents in a large-scale DGB survey reported that they would be under strain by their job even in their official time off (DGB (2015a: 7–8)).

(implying a conflict of interests). The Green Paper in general is criticised for ignoring conflicts of interests such as this and for instead highlighting opportunities afforded by digitalisation in a lopsided manner (DGB 2015a: 2–3). The DGB demands that an overarching transformation strategy should put co-determination and participation of employees front and centre in order to make use of their innovation potential (DGB 2015a: 3), rather than considering technological potentials the driving force that should define future development (DGB 2015a: 4). To support such an employee-driven innovation model, the DGB suggests expanding co-determination rights, for instance by granting works councils additional information rights on technologies that are considered for implementation in their respective companies and by providing them with the legal right for expert counselling on the impacts of technological change (DGB 2015a: 13).

The DGB argues that the BMAS' rather optimistic view on the potentials of technological development in its Green Paper ought not lead it to trivialise the risks of automation. In contrast to the statements of the BDA (and the DGB's reaction), the DGB's own statement on the Green Paper utilises scientific references and highlights further need for research (DGB 2015a: 2; 4–5). The DGB is particularly vocal in demanding that possible options for short to medium term job creation and job security should be developed, despite reassuring arguments about the long term. It also admonishes the federal government to reflect its own role in creating the conditions for past job polarisation (especially the expansion of the low-wage sector) and the possible societal impacts that might ensue if progressing job polarisation and automation would coincide (DGB 2015a: 4). The DGB is particularly concerned about the job prospects of low- and medium-skilled workers working in jobs with high level of routine tasks and refers to C. Frey/Osborne 2013 to highlight the vulnerability of these groups of workers. The statements states that they would need to be safeguarded by providing continuous training, alternative employment, protection from rationalisation and social security support (DGB 2015a: 5–6). The DGB stipulates a need to further develop existing social security systems to allow to them to better provide support for career disruptions and professional reorientations (DGB 2015a: 9), ascribing a more active role to the unemployment insurance system to support the (re-)qualification of the unemployed and arguing for a more active role in state agencies in providing funding for continuous training. This could take the form of both wage subsidies for workers who reduce their working hours in order to take part in continuous training (DGB 2015a: 11) and of a more general movement towards a (at least temporarily) shorter work week (DGB 2015a: 9).

To summarise the DGB's initial position on the Green Paper, it is noticeable that it exhibits a strong focus on the need for regulation and political intervention into the design and implementation of technological change. The "flexibility compromise" suggested in the Green Paper is met with suspicion and additional regulation is demanded, particularly in the context of non-regular forms of employment but also in setting limits to the blurring between work and private life. The DGB stands out by highlighting the importance of acknowledging conflicts of interests in innovation processes (rather than following the "win-win" rhetoric of the BMAS or the – at least at times – techno-fetishist rhetoric of the BDA) and, in comparison to the BDA, by its frequent references to scientific sources and demands for additional research. The DGB is also active in demanding an expansion of democratic participation in the shaping of technological change and of structures of the welfare state, particularly in terms of unemployment insurance and support for training. What is lacking however are extensive demands for more active redistributive policies (other than providing decent unemployment support) or collective working time reduction (shorter working times are mostly discussed on an individual basis, although governmental wage subsidies are mentioned in this context). The DGB also refrains from developing an alternative strategy or at least rhetoric to transcend the fundamental focus on economic competitiveness of the Industry 4.0 discourse, leading to the impression that while its position on technological change is distinct from that of the Federal Government or the BDA, it is mostly developed reactively, at least initially.

The DGB's position was further refined in a statement published in the run-up to the publication of the White Paper Work 4.0, setting out an updated set of basic demands from the perspective of the trade unions in light of the negotiations that took place throughout the Work 4.0 process.⁸⁷ While the statement largely reinforces the initial statements by the DGB and develops them in further detail (for instance quoting specific paragraphs of the Works Constitution Act that ought to be reformed), several subtle shifts in emphasis are recognizable: Although the risks of employment losses are still highlighted, the main emphasis is shifted to discussing requirements for a successful implementation of digitalisation from the point of view of the trade unions. The DGB presents itself as a modernizing force and scolds the BDA as a retrograde institution peddling the same old demands for deregulation and for dismantling economic co-determination, tracing their roots back to as early as 2004 (DGB 2016: 6). The DGB positions itself and co-determination more generally as enabler of successful technological development,

⁸⁷ The publication of this statement illustrates the continuous active engagement of the DGB in the dialogue process. The DGB also underscores the importance it assigned to the Work 4.0 dialogue process and other debates around the Industry 4.0 in its report on its activities in the years 2014-2017 (DGB (2017a: 47–48)).

highlighting both the importance of confidence building through regulation and strengthened co-determination to reduce the risk of workers' resistance against the implementation of digitalisation (DGB 2016: 1–2) and the innovative potential of co-determination (DGB 2016: 6). While the DGB takes a more offensive stance by proactively publishing a statement attacking the BDA and stating that it will not accept being “relegated to the side table” (DGB 2016: 6),⁸⁸ this confidence comes at a price: rather than arguing for co-determination on normative grounds, it is increasingly justified in functional terms, much like in the BMAS' Green Paper, for instance via its capacity to ensure acceptance for new technologies on the job floor (DGB 2016: 6).

The DGB expands on its earlier demands regarding the financing of education with a call for a new legal framework that would hold employers responsible for continuous training, would introduce a right to attend continuous training during working hours and for works councils to take the initiative on continuous training measures in their companies. At the same time, unemployed and people in non-standard employment should be covered through new state subsidies for continuous training (DGB 2016: 3). The DGB also demands additional state support for other forms of “socially necessary” working time flexibility, introducing a term that could potentially imply a broadening of state subsidies for working time reduction beyond support for continuous training and possibly care obligations, although these are still given as examples (DGB 2016: 5).

This greater detail – and to some extent greater ambition – in terms of policy comes at the price of diminished attention to more general, socio-political questions however, although these are still mentioned in passing (e.g. the issue of technological unemployment but also the role of social innovations and ways to use increased productivity to better match societal needs (DGB 2016: 3)). This is also noticeable on a rhetoric level: the term automation for instance does not get mentioned throughout the 14 pages long document, implying a shift away from visionary debates on the future of work to the nitty-gritty of managing the implementation of technological change. Rather than following up on questions such as the societal ends towards which technology is employed, the DGB therefore focuses on its role as a partner in an attempt to socio-technically (as it is quite vocal that technological innovation has to be combined with increased co-determination) advance the German economy in global competition.

⁸⁸ The DGB uses the colloquial term *Katzentisch* (cat's table).

But what exactly followed out of the initial corporatist discussions in the Plattform Industrie 4.0, the initial statements on the Green Paper and the dialogue process that ensued? The White Paper Work 4.0 documenting the result of the dialogue process does not purport that a full consensus has been reached. Rather, points of contention are documented throughout the White Paper by offering commentaries by individual organisations (with the BDA and DGB featured prominently among them) in a side column alongside its running text. It does draw conclusions however from the point of view of the BMAS.

Although the White Paper is much more extensive than the Green Paper, we have already learned about many of the central issues discussed in the Work 4.0 dialogue process, so I will skim over much of it. The White Paper is organised in the following manner:

- A foreword by Andrea Nahles
- A summary of the paper's findings
- Chapter One looks at “drivers and trends” shaping the future of work
- Chapter Two looks at key challenges arising in the context of Work 4.0
- Chapter Three considers “a vision for quality jobs in the digital age”
- Chapter Four looks at policy options
- Chapter Five is headed “Re-imagining work: identifying trends, testing innovations, strengthening social partnership”
- Finally, there is an Annex documenting the dialogue process.

With regards to the issue of (de-)regulation of non-standard employment, the White Paper avoids taking a strong stance. Although it accepts that “the line between employment and self-employment is blurring”, it does not indicate any intention of ambitious policy initiatives, for instance by implementing policies that would equate crowdworkers and other forms of platform workers to standard employment, forcing platforms to pay social security contributions. Rather, it vaguely postulates the need to “determine to what extent specific types of workers are in need of protection and include them in the protection afforded by labour and social law in line with their specific situation.” It also identifies the goal that “[f]or all persons in work, including self-employed individuals, gaps in social protection should be avoided” and indicates that “in principle”, “it would be appropriate to include self-employed individuals [...] in the statutory pension insurance system.” (BMAS 2017: 176) Other forms of non-standard employment are even lauded as a potential “bridge to permanent full-time employment” and helpful “if freely

chosen” “to balance work and family responsibilities” (BMAS 2017: 50). By highlighting the potential advantages of non-standard employment and offering little in terms of concrete policies, the White Paper largely sidesteps the demands for increased regulation of non-standard employment levelled by the DGB.

With regards to the future of co-determination, the BMAS accepts that corporatist arrangements need to be stabilised, accepting both the DGB calls for “adequate **rights and resources** for works and staff councils” and the BDA’s demand for “greater flexibility in applying the general legislative frameworks contingent on the existence of collective agreements.” (BMAS 2017: 11–12). These flexibility clauses are exemplified for instance in the discussion on working time flexibilization (see below). Regarding the support for works and staff councils, the ministry announces that it wants to simplify the electoral procedures for works councils and to better safeguard them from “prevention and obstruction”, in order to “foster the **establishment of works councils.**” (BMAS 2017: 158) Additionally, established works councils should be strengthened by simplifying access to experts on technological development, both within companies as well as via external consulting (BMAS 2017: 159).

In terms of the flexibilization of working time, the BMAS’s interpretation of a new flexibility compromise builds on the assessment that an increased demand for “time sovereignty” would necessitate a stronger focus on working time negotiations (BMAS 2017: 127). To facilitate them, the BMAS endorses flexibility clauses based on collective agreements as they were suggested by the BDA, adding some limitations to them (e.g. that employees must consent to the relaxation of the law and that risks assessments must be conducted). More importantly, it indicates that these relaxations of the Working Time Act should be evaluated to serve as experiments, possibly informing a more general reform of the Working Time Act (BMAS 2017: 125–126). Aside from fostering these flexibility compromises brokered on sectoral and company level, the BMAS announces that it will pursue a “general right to temporary part-time work” and the strengthening of “life-phase approach” based working time flexibility. It also indicates that in the future a Working Time Choice Act might become a possibility. This act should combine increased flexibility for workers “in relation to working time and location” and “a conditional possibility to derogate from certain provisions of the Working Time Act” on the basis of aforementioned flexibility clauses. The BMAS states that “[t]his Act should initially be introduced for a two-year period and trialled in experimental spaces”, reinforcing that the

flexibility compromises propagated by the BMAS and the BDA are to serve as a trial-run for a more general restructuring of working time regulation (BMAS 2017: 125–127).⁸⁹

With regards to the issue of technological unemployment and labour market policy, Frey and Osborne (2013) are again brought up in order to motivate the discussion on technological unemployment in the White Paper. Several issues are raised with their approach: they would assume that “everything that theoretically can will in fact be automated” – which is a fair point (see chapter 2) – “and that all activities required in certain occupations can be automated.” (BMAS 2017: 47). But in light of the fact that “only specific individual activities [...], not necessarily entire occupations” might be automated, the risk of automation might actually be much lower. This point remains underdeveloped in the White Paper. The BMAS however quotes a study it commissioned by a team around Holger Bonin of the ZEW – Leibniz Centre for European Economic Research (2015), which found automation risks to be significantly lower when basing assessment on individual tasks and particularly when taking variations of job profiles within occupational profiles into account (Bonin et al. 2015: 14). Bonin et al. do not provide a detailed sensitivity analysis on which effect is the stronger one, but since an assessment of individual tasks also informs the model of Frey and Osborne, it seems reasonable to assume that it is the presence of automation-resilient tasks exercised by individual workers, in variance to the standardised job profiles stored in O*NET, that is key in understanding why overall automatability could be much lower.⁹⁰

It is unclear, however, why the presence of individual automation resistant tasks should safeguard from substitution altogether: after all, provided that the workforce is large enough, even small increases in productivity enabled by the automation of only a small set of tasks might lead to a partial substitution of the workforce. Furthermore, work might be reorganised by reshuffling and concentrating automation resistant tasks or by omitted them through simplification of work settings etc. (see chapter 2), rendering the argument that many occupations also encompass tasks that might be automation resistant (and thus would be altogether automation resistant) less persuasive.

⁸⁹ The fact that flexibility clauses are prominently promoted throughout the White Paper implies a concession to the BDA’s central demand that future commitment to the system of collective bargaining should be incentivised through concessions in terms of regulation, reinforcing an already existing trend to regulatory erosion (Boewe (2016)).

⁹⁰ Bonin et al. indicate that only 12% of jobs would be at high risk of automation according to their methodology, compared to 42% in their own occupation-based application of Frey & Osborne to the German labour market (Bonin et al. 2015: 14).

The White Paper goes on to also highlight “**legal, societal and economic limits on automation**” and the fact that workers are “taking on more complex tasks” (BMAS 2017: 47). The BMAS also points out that already today, around 20 per cent of workers are working in occupations other than the ones “they have been trained” for, implying that constant adaption to the demands of businesses is already a reality for many workers today (BMAS 2017: 47).⁹¹ Furthermore, a whole page of the paper is dedicated to an info-box discussing economic forecasts suggesting increased changes within the employer market but no major net job losses, with IAB/BIBB publications featuring prominently among them (see chapter 2). In addition, views of workers are cited with a vast majority of workers convinced that their jobs should be safe from automation in the next decade (BMAS 2017: 54). Although a discussion of the epistemic limitations of these sources is largely missing, the BMAS does point out that “[w]ith regard to all of the forecasts, however, it should be borne in mind that while they can offer a certain amount of guidance they cannot provide any certainty and are based on past experience.” (BMAS 2017: 53).

Despite this uncertainty, there is a clear commitment to pursue the overarching goal of full employment that is endorsed throughout the White Paper (e.g. BMAS 2017: 100) through increasing employability, rather than reducing work times or public employment schemes. The Policy Chapter dedicated to employment is correspondingly headlined “Employability: From Unemployment to Employment Insurance” and although the importance of labour market policy „in **shaping structural change**“ is emphasised (BMAS 2017: 100–101), this evolution of unemployment insurance largely boils down to mandating the Federal Employment Agency to take a more active role in education and continuous training. Although the turn towards “more preventative support for workers” and forward-looking investment into skills and overall employability might be welcomed as well as the BMAS’ promotion of a more active stance of the state in managing the digital transformation and the aspiration to introduce “a legal right to continuing vocational education and training”, the BMAS’ approach remains firmly confined to a strategy that is informed by the belief that “Germany’s future as an attractive location for business depends to a crucial extent on its workers being well-educated and skilled” and that unemployment might be prevented from becoming a larger social issue through raising

⁹¹ Of course this remark serves the purpose to suggest that the challenges of automation and digitalisation are not insurmountable: indeed, it would not demand much more of the working population than what has been demanded before. In doing so, however, it also implies a form of positivism based on the assumption that “business-as-usual” conditions should be uncritically taken for granted and that the demand for further adaptations are thus not to be questioned or even criticised as a further imposition.

individual employability (BMAS 2017: 114). This approach is also extended by the BMAS with regards to the fear of labour market polarisation rather than of all out unemployment: here, too, the White Paper emphasises “new opportunities in the structural change which lies ahead” and the importance to “enhance their [workers’] ability to adapt” (BMAS 2017: 53). The option to also push for job creation in the public sector, as suggested here at least in passing in the Green Paper, is not refreshed.

Perhaps the most ambitious policy proposal discussed is the introduction of a so-called personal activity account, a grant for young workers to invest into their own “skills development, starting a business, or career breaks for personal reasons” – or even a vehicle for long-term saving (BMAS 2017: 181–182). By framing the personal activity account as a tool to increase social justice and to introduce a form of “social inheritance”, the BMAS introduces a redistributive dimension into the debate on the future of work and digitalisation (BMAS 2017: 181). The BMAS also addresses the need to secure long-term financing of the welfare state, mentioning both the inclusion of “broader groups in the social insurance systems” (for instance well-earning self-employed) and a number of ways to reform taxation by introducing “taxation of digital companies which focuses on data flows” and changing the way employers’ contributions are calculated. In addition, even changes to the “ownership structures in the digital economy”, for instance by making citizens “owners of their data” who would need to be “paid for its use” or by making employees shareholders of their respective companies, are briefly mentioned (BMAS 2017: 179). The option of a universal basic income (UBI) is also discussed in the White Paper, although not very favourably (see my detailed discussion below), concluding that “there is no need, or support within society, for such a fundamental change of system” (BMAS 2017: 180). Instead, the White Paper highlights the “path dependency of the development of the German welfare state”, once more endorsing a strategy of careful incrementalism in adapting it, rather than socio-political radicalism (BMAS 2017: 180).

The grand scheme of things regarding the management of the impacts of automation thus becomes clear: rather than demanding ambitious social and labour market policy, it is conceded that technological development, which is understood as a non-negotiable necessity to stay economically competitive, will lead to more or less extensive changes in the labour market, but the burden to adapt to these changes is mostly put on individual workers, substituting the debate on the employment effects of automation with a debate focused on employability. While this interpretation of the challenges of automation and the way to manage them has been

championed by the BDA from the beginning, and is the dominant perspective in the White Paper, the DGB adopts this perspective more cautiously.

A trend of convergence towards employability as the defining issue of the debate is noticeable however, with DGB-president Reiner Hoffmann highlighting qualification as the central tool to prevent labour market polarisation and unemployment in his opening remarks at a DGB-conference on digitalisation (Hoffmann 2015: 4).⁹² This convergence is accompanied by an increased focus on concrete questions of implementing technological innovation, rather than grand debates on chances and risks of technological development (see above).⁹³ Despite occasional, sharply phrased disagreements, the basic premises and requirements of the Industry 4.0 discourse are largely adopted by the DGB. This is particularly evident in a paper published by Hoffmann and Oliver Suchy (2016), director of a research unit of the DGB on the future of work and digitalisation and corresponding author of several statements of the DGB regarding innovation politics. In it, they accept that technological change is inevitable (Hoffmann/Suchy 2016: 4) and suggest overcoming the antagonisms defining the debate on digitalisation. In particular, they suggest that regarding central questions of the future, employers and employees, management and trade unions would be “in the same boat” (Hoffmann/Suchy 2016: 5).⁹⁴ This contrasts starkly with the initial statement of the DGB in the Work 4.0 process, chastising the BMAS for not addressing conflicts of interests appropriately (see above). They, too, cite both economic and cultural barriers to automation and refer to research by the IAB to reinforce the importance of labour market transformations rather than technological unemployment and thus qualification (Hoffmann/Suchy 2016: 16–17). Thus, the issue of technological unemployment

⁹² Hoffmann goes on to hand the floor to Andrea Nahles who gave a keynote at the conference. Hoffmann also happens to be a fellow party member of Nahles, which might also help explain a certain convergence of political perspectives particularly at the very top of the DGB.

⁹³ A similar shift of focus is also pursued by the BMAS: In a contribution to the first workbook of the Work 4.0 process, Thorben Albrecht, at the time state secretary in the BMAS, and Andreas Ammermüller, a researcher employed in the General Policy Division of the BMAS, accept the “undeniable intellectual appeal” of macro-debates on the end of work as they would offer a big picture perspective and “a new framing regarding essential issues such as growth, (re-)distribution and the purpose of work” (Albrecht/Ammermüller (2016: 40)). They continue, however, that a more sober approach would be required and, inevitably, end up discussing strategies for (re-)qualification. In 2018, Albrecht went on to become the federal manager for the SPD and then to lead the political department of the IG Metall, further illustrating the close connections between the elite of the SPD and the trade unions. Before the start of the Work 4.0 dialogue process, Albrecht had already contributed to debates within the trade union movement on digitalisation, see for instance Albrecht (2016).

⁹⁴ The phrase invokes images of the German economy as a ‘community of destiny’, withering the storms of global competition together. The paper ends on a critique of the BDA for delaying progress by irresponsibly forcing debates on working time regulation, concluding that “Germany cannot afford political blockade”, that “the game might only be won together” and that it would need more collective effort to bring the German economy into “the offensive” (Hoffmann/Suchy (2016: 30)).

remains present in the discussion at the top of the DGB, but appears to become less important throughout the Work 4.0 dialogue process, while employability gains in importance.

To sum up the key findings: There seems to exist a shared consensus amongst the social partners and the federal government to welcome automation as a way to raise productivity, thereby reconciling increased competitiveness with stable and good employment. It is hoped that if the upgrade of the technological base of the economy associated with the Industry 4.0 or Economy 4.0 might be implemented successfully, it might actually lead to higher employment in high-value manufacturing industries and IT development, as German companies might increase their global market shares. And indeed, the German annual export surplus soared from 158.7 to 248.9 billion euros between 2011 and 2016, more than making up for the losses incurred in the context of the financial crisis (Destatis 2021b).⁹⁵ The general assessment presented here is that if the Industry 4.0 is implemented and marketed successfully, unemployment might be exported to countries that buy German capital goods such as robots or IoT technologies or that cannot match its high levels of productivity. Such an assessment is supported by studies such as Wolter et al., which project a negligible loss of employment or even positive effects of the Industry 4.0 (see chapter 2). Thus, the framing of increased automation as a national winning strategy amidst fierce global competition in the Industry 4.0 seems warranted to a certain degree.

This framing applies to the federal government, the BDA and the DGB alike. In this sense, the discourse revolving around Industry 4.0 can be understood as a successful transfer of German corporatism from the realm of collective bargaining to the level of the national innovation regime that is stabilised by Industry 4.0 platforms and dialogue processes (see Harmony 4.0 below). This is also marked by a rejection of old imaginaries of automation that conjured the image of empty job floors towards a rhetoric that continuously highlights the importance of human-centred innovation processes. Judged by the publicly accessible material, actual conflicts do exist, but are discussed within a larger framework of consensus: all three actor groups portray themselves as being concerned with the interests of the German *Standort* (economic location) – in other words to providing the best possible conditions to attract investment and enable capital accumulation. Correspondingly, demands for policies that could be considered linked to offensive class politics are all but entirely missing in the documents of the DGB. The only real dissent seems to exist regarding a possible further flexibilization of work and the question of who pays for the costs for the necessary re-qualification of workers.

⁹⁵ This growth cannot be directly attributed to the Industry 4.0 discourse, of course, but it illustrates that the macroeconomic strategy it refers to was implemented with some success.

The issue of technological unemployment is ultimately largely marginalised by the BDA, government and DGB alike, with employability advancing to the most discussed issue with regards to managing the societal impacts of automation.

In the next section, I will engage with existing research on futures and their societal impact to reflect on how the social processes, the results of which are documented in the material I have analysed, were influenced by the dominance of the vision of an Industry 4.0. I will also explore the extent to which it functioned as a facilitator of democratic debate on the societal implications of automation and to what extent it limited such a debate.

Reflecting the Industry 4.0

In recent decades, a lively debate has emerged within the social sciences on the importance of techno-futures - that is, imaginations of future states of affairs that revolve around technologies. In an early contribution, Dierkes and others (1996) coined the concept of '*Leitbild*' or 'vision', emphasising its guiding function. As a collective projection, it brings together the knowledge and intuitions of different people about what seems technologically possible and desirable to them. Thus, the vision always describes a future technology, something not yet existing. At the same time, however, Dierkes and others point out that the *Leitbild* has a tangible function in material technology development. This perspective has been further developed by, among others, Patrick McCray (2013), who uses the term 'visioneers' – a fusion of visionary and engineer – to show how technology developers are spreading their vision of future technologies, paving the way for their implementation. It has also been supplemented by extensive analyses of the central role of expectations attributed to technologies, which may crystallise into the form of techno-futures, in enabling and orienting processes of innovation (van Lente/Rip 1998; Brown et al. 2000; Borup et al. 2006).

Focused on a national level, Sheila Jasanoff and Sang-Hyun Kim highlighted the significance of techno-futures, coining the concept of 'sociotechnical imaginaries' as "collectively imagined forms of social life and social order reflected in the design and fulfillment of nationspecific scientific and / or technological projects" (Jasanoff/Kim 2009: 120). While the concept of the technological *Leitbild* focuses on concrete technology and its developers, the concept of imaginaries addresses a far more abstract level: it deals with the (re-)production of the social order on the scale of entire nation states.

Although the Industry 4.0 label is supposed to describe a transformation of the economy on a national level, and even though the hopes for the ‘revolutionary’ achievements of a forthcoming fourth industrial revolution are often formulated in superlatives, social conditions are largely only considered insofar as they need to be reformed in order to productively support the desired push for increased competitiveness. The promises made therefore lie between those of the *Leitbild* for a concrete technology and those of a sociotechnical imaginary for an overall normative order. What the label Industry 4.0, and associate terms such as Economy 4.0, communicate is no more and no less than a radical modernisation of the technological basis of production that promises immense productivity leaps, but stays within the confines of the dominant normative order (cf. Frey/Schaupp 2020b).

Industry 4.0 as a Political Tool

As recent research has shown, techno-futures do not only quasi-spontaneously emerge out of processes of socio-technical innovation. Rather, they have been identified as tools to shape and orient innovations of socio-technical innovation deemed desirable (cf. Pfeiffer 2017). This seems to be particularly relevant for the Industry 4.0 vision: set out as a deliberate strategic initiative to boost national competitiveness, it contributed to a largely accepting discourse revolving around the economic potentials of technological development and its sponsorship by the state. Further, it was instrumental in implementing a variety of societal processes that helped to coordinate the activities of various social actors and to facilitate dialogue, all the while orientating said dialogue with an overarching normative orientation. Of key importance in this respect was the establishment of national as well as regional platforms (cf. Hirsch-Kreinsen 2016; Meyer 2019a), connecting private companies, the trade unions and governmental institutions, which I mentioned above.

In general, these platforms and dialogical processes served and continue to serve as a social space for a variety of actors to pursue and push their specific agendas. Hirsch-Kreinsen (2016) identifies three groups in particular who engaged in these platforms to shape the further development of Industry 4.0: Scientists, who use the vision to facilitate a further increase in appreciation and legitimation for their research; innovation-policy actors (for instance the Federal Ministry for Research and Education) who are interested in establishing “lighthouse projects”; and lastly, enterprises – particularly from the capital goods industry, who are interested in the developments subsumed under the Industry 4.0 vision to boost their economic

position (Hirsch-Kreinsen 2016: 7). Additionally, as we have seen, the role of the trade unions might have been less pronounced than those of actors from the government, business and science in the beginning, but should nonetheless not be underestimated.

Overall, coordinated activity around Industry 4.0 by a wide variety of heterogeneous actors can be observed in Germany. What is more, as the vision grew increasingly socially accepted, it started developing a “normative behavioural pressure” (Hirsch-Kreinsen 2016, 11). This normative pressure – a vague, but rather strong impulse to welcome innovation as a means in global competition – can be considered a central and desired effect of this strategic project for the development of the national economy.⁹⁶ Industry 4.0 can therefore be understood as a largely successful attempt⁹⁷ to reorient scientific, corporatist and policy discourse and to some degree public debate on economic development towards a future- and technology-oriented project that draws on one of the perceived key strengths of the German economy: its relatively high share of value creation from manufacturing. Realizing that less deindustrialised economies fared better in the crisis, “the old economy” was suddenly rediscovered as a chief advantage in world market competition, with the Industry 4.0 vision heavily focusing on manufacturing sectors and particularly the capital goods industries such as machine construction and automation technologies (cf. Pfeiffer 2015, 2017).⁹⁸

Although its strong discursive presence has accordingly been analysed by critical social scientists as “first and foremost the result of professionally managed agenda setting” (Pfeiffer

⁹⁶ In light of this strategic dimension of the Industry 4.0 discourse, the critique that the quality of technological change is oftentimes exaggerated in it or that its technological core remains largely unclear (cf. Pfeiffer (2017: 108); Brödner (2018: 238–239); Fuchs (2018: 281)) is correct but beside the point: it is precisely the vagueness of the Industry 4.0 that allows for its broad adaption to different economic, technological and social preconditions. In other words: its vagueness is key to the effectiveness of the Industry 4.0 vision (Meyer (2019b: 129ff.)) as it enables it to serve as a cipher that can be mobilised flexibly (Grunwald (2012b: 121)).

⁹⁷ Although it is difficult to quantify the material effects of a discourse, the Industry 4.0 discourse coincided with a growing appreciation of the importance of digitalisation amongst German companies. While in 2016 the management of 48% of polled companies deemed digitalisation unnecessary, that number fell to 29% in 2018 (BMW (2018: 6)).

⁹⁸ For empirical data on this and a materialist explanation as to why despite the subsequent broadening of the debate beyond the core-branches of manufacturing industries, the Industry 4.0 discourse largely stays focused on the manufacturing sector, see Fuchs (2018: 281–283). Fuchs highlights that manufacturing contributes almost 25% of value-added in Germany, whereas the US and UK economies only feature value-added shares for manufacturing of around 10%. For non-native speakers, it might furthermore be noteworthy that, as indicated earlier, the term “Industry” in Germany refers almost exclusively to the manufacturing sector (e.g. the hospitality industry would usually not be called an industry in Germany). I would agree with Fuchs that this material basis of the Industry 4.0 vision was more relevant for its success than its “catchiness”, resulting for instance from the fashionable use of versioning – although its importance should not be neglected altogether (Meyer (2019b: 125)).

2017: 112), this does not refute its effectiveness.⁹⁹ Furthermore, the growing debate around Industry 4.0 invited social actors other than government and business elites to inject their agenda into the debate: the widening of the debate beyond the original field of Industry 4.0 into a more general debate on the future of the economy and technological development throughout the BMAS' Work 4.0 dialogue is a case in point. The appropriation of the 4.0 particle for a multitude of contexts is an indication both of the diffusion of this discourse into society and also its reinterpretation.¹⁰⁰ At the same time, the proliferation of the Industry 4.0 vision coincided with increased discussions of the societal implications of technological development whose less-desirable aspects needed to be managed. Rising automation anxiety, which was problematised early on as a possible obstacle to the implementation of initiatives linked to the Industry 4.0 by Kagermann et al. (2013), can be considered the most prominent concern in this context.

It would thus be correct to point out that the vision facilitates a broader discourse on technological change, particularly by being open to adaptation by social actors such as politicians dealing with social policy or trade unionists, who could thereby mobilise some of its appeal to innovation and modernity in the interest of a discussion on labour relations and innovation in the field of welfare policies. Nonetheless, where the label "4.0" dominates and the Industry 4.0 vision remains the central point of reference, the primacy of global competitiveness (particularly in comparison with China and the USA) as a policy orientation is almost never put into question (cf. Pfeiffer 2017: 112). The assertion of this ultimate goal of technological development and economic policy has far reaching implications (see below). Discursively, it contributes to a situation in which critical analysis of working conditions are eclipsed by talk about possible increases in productivity, and discussions on technological unemployment are side-lined within policy discourse, lest risk that a crucial national strategic initiative be weakened.

⁹⁹ The importance for instance of political actors in the development and dissemination of the Industry 4.0 is highlighted even by researchers sceptical of overstating their importance such as Hirsch-Kreinsen (2016), who is correct in pointing out that the practical impact of the Industry 4.0 vision should be understood as an emergent result of heterogeneous actors linking their strategic interests to the propagation of the Industry 4.0 rather than "the result of a master-plan of a controlling agency".

¹⁰⁰ Even the Rosa-Luxemburg-Foundation felt compelled to publish a, albeit sceptical, brochure titled "Industrie 4.0, Arbeit 4.0 – Gesellschaft 4.0?" (Industry 4.0, Work 4.0 – Society 4.0?) on the implications of technological change (Matuschek (2016)).

Industry 4.0 as a Form of One-Dimensional Thinking

The question as to what ultimate ends are pursued through Industry 4.0 is thus discussed remarkably little. This is understandable to some degree as the Industry 4.0 has been conceptualised as an answer to a shared challenge: finding a way to frame a renegotiation of economic priorities to manage the national economy in the wake of the global financial crisis (Pfeiffer 2017). Nonetheless, it is important to note that the discourse around the Industry 4.0 not only facilitates democratic debate around technological development but also severely limits it, as it helps stabilise an economic primacy, an unquestioned dedication to improve competitiveness on a global scale; all other needs and interests have to adapt to this central demand. State-led mediation processes such as the Work 4.0 Dialogue Process can be understood as a central tool for this adaptation, consolidating positions of employers and trade unions alike into a White Paper, which has been accepted by most social actors (Kalff 2019). It would thus seem appropriate to speak of a “Harmony 4.0” that is being formed around the Industry 4.0 (cf. Arlt et al. 2017: 83–90).

By helping to side-line concerns regarding technological and societal developments or the expression of desires that are incompatible with the ultimate goal of competitiveness, the discourse around the vision of an Industry 4.0 thus helps to stabilise and perpetuate existing social relations, rendering it structurally conservative at its core. Rather than enabling an open, democratic, societal debate on political, social and economic possibilities, it limits societal discussion on socio-technical innovation to an extremely restricted question (how best to increase national competitiveness in global competition) whose pursuit can then, indeed, be openly discussed. In this respect, the relationship to the future in the Industry 4.0 discourse bears strong resemblance to that of neo-conservative futurology criticised by Flechtheim (1972) in which references to “the future” distract from social and political change in the here and now. Instead of discussing possible social and political innovations that could address contemporary challenges, this kind of futurology, according to Flechtheim, tends to relegate the solution of societal problems to the future and technological innovation, rather than social change.¹⁰¹ As such, the Industry 4.0 discourse nicely illustrates the observation of Moishe Postone, that “[capitalist] society [is] marked by a temporal duality – an ongoing, accelerating flow of history, on the one hand, and an ongoing conversion of this movement of time into a constant present,

¹⁰¹ In contemporary research, this diverting dimension of innovation discourses is being discussed under the term of solutionism (see for instance Nachtwey/Seidl (2017)).

on the other.” (Postone 1993: 300). While technology continues to advance, it is ever subjected to the same old economic imperatives.

The limiting effect, and the dominance of this core-orientation, is illustrated by the failure of trade union interventions into the discourse to transcend the confines of the larger goals defined by this vision and to articulate a radical alternative. Calls for co-determination, workers’ autonomy, good and decent jobs are all acceptable – as long as they contribute to a wider acceptance of technological development in the spirit of Industry 4.0 and do not restrict competitiveness. In this sense, the Industry 4.0 discourse might serve as a textbook example of one-dimensional thinking: the greatest of deliberative freedom is afforded, a general air of radicalism and fundamental change is promoted – as long as it is compatible with the success of German corporations on the world market. Thus, the Industry 4.0 discourse contributes to “a pattern of *one-dimensional thought and behavior* in which ideas, aspirations, and objectives that, by their content, transcend the established universe of discourse and action are either repelled or reduced to terms of this universe” (Marcuse 2007: 14). The successes celebrated by the unions (being involved as dialogue partners regarding technological development, having placed “man in the middle” of these innovation discourses (DGB 2017a: 2) etc.) are thus precarious ones: they might quickly be put into question once considerable conflicts of interest arise and the interests of workers are labelled as obstacles to national economic success, as they were only accepted insofar they were subordinated to this overarching goal.

One could also question what the “man in the middle” phrase actually means. Coming from the DGB, it is meant to differentiate such an approach from technology-centred innovation discourses (DGB 2017a: 2), but the phrase does not address the perhaps more important question: who these humans exactly are and what they are doing in this “middle”. After all, technology has so far always been developed and employed by humans, but the questions remain: in whose interest has it been developed? In whose interest has it been employed? (cf. Grunwald 2019a: 155–156) Furthermore, humans, or more precisely workers, have always been at the heart of capitalist economies, albeit as objects of exploitation, and we can predict confidently that they will continue to be so for the foreseeable future. The question is whether establishing this mere fact can be considered as a win for working class interests (although it might contribute to more sensible technological development).¹⁰² The fact that the talk of

¹⁰² There is indication that the DGB leadership actually has grown disillusioned with the adoption of the phrase in broad discourse, criticising that although the government has adopted the slogan as its mantra, it failed to win over people because it failed to implement concrete policies supporting the interests of the working population to actually comply with the slogan (DGB (2019)). In the end, the acceptance of the slogan might

putting “man in the middle” could reach such prominence is however an excellent semantic representation of the corporatist form of the Industry 4.0 discourse. It is not the only one, however. For instance, the term “disruption” is only very seldomly used in the documents produced by the tripartite partners – despite playing a key role in other writings on Industry 4.0 (e.g. Schwab 2017).

This is understandable, as the term conjures up images of radical transformation that, despite all the talk about a technological revolution, does not sit well with the incrementalism represented within Industry 4.0 discourse in particular and Germany’s system of industrial relations more generally. Another term virtually absent from the documents is capitalism, which might tempt discourse participants to question the socioeconomic foundations of competition and its imperatives, rather than accepting it as a quasi-objective necessity (see below). Perhaps the most remarkable semantic effect of the Industry 4.0 discourse is the depoliticization of the term automation however: in 1964 Pollock cautioned the trade unions in particular of accepting the neutralisation of the term, warning that they would lose a powerful ideological weapon in the fight for radical reforms (Pollock 1964: 19). The weapon today seems to have lost its sharp edge indeed. Rather than being discussed as a challenge to the established regime of labour, an understanding of automation has been established that presents it as a common-sense, business-as-usual process that rather than far-reaching societal reform only requires individuals to make sure their employability is not eroded.

The one-dimensionality of the Industry 4.0 discourse is also manifested on the policy level through the unquestioned focus on employability by both the federal government, the BDA and the DGB as a means to prevent technological unemployment. Although an increased focus on education can certainly be welcomed morally (insofar as it contributes to human flourishing) and economically (insofar as it increases labour productivity), it is doubtful that this focus on employability would either satisfy a holistic ideal of education or might be a sufficient policy response to possible labour market polarisation deepened by automation. Even leaving aside thought experiments assuming more or less full automation – in which case it would be correct to point out that the “the option of a human worker’s learning new skills for jobs that humans won’t be doing becomes, of course, a moot point” (Clark 2017: 38) – today there is already a huge mismatch between the number of open positions and the number of unemployed persons. Even in 2019 in Germany, a year that can be characterised by the coincidence of a high level

have only superficially covered up that the ultimate goal for employers remains automation to reduce labour costs too (Grunwald (2019a: 73); Roose (2019)).

of open positions being advertised and a very low number of people being unemployed – there were three unemployed for every open position in the German economy. This ratio gets even worsened if you take the “hidden reserves” of the German labour market into account, bringing the ratio to more than four unemployed persons for every job.¹⁰³ Even without further job destruction caused by automation, it is clear that an exclusive focus on “employability” is not a sufficient answer to the threat of unemployment. Even with maximum flexibility in terms of the skill and geographical location of the unemployed, more than three in four unemployed persons would still be unable to find a job.

Taking into account that geographical mobility might be limited due to personal attachments and a possible deterioration of the labour market situation due to increased automation, it should be evident that simply investing into qualification without supplementing policies such as collective working time reduction might work out for many workers, but might still lead into a dead-end for many millions more. Furthermore, one might question whether it is reasonable to demand of elderly blue collar workers that they train themselves to, for instance, program industrial robots, moving from a direct role in manufacturing to a supervisory one (Sitte/Scheele 2017).

But I would argue that it is precisely this imposition of training and individual development that constitutes the appeal of a focus on employability for employers: rather than being forced into a debate on the future of work in society, including discussion on alternative measures such as collective working time reduction or of an expanded welfare state, paid for through taxation and social security contributions, a focus on qualification poses no threats to employers’ position of power. Employability is also a rather cheap conversation to be had, especially if (re-)qualification costs can be shifted onto the workers, as the BDA demanded in the Work 4.0 dialogue process.

Moreover, a general upskilling of the workforce can also help to increase competition around higher-qualified positions, eroding possible skill premiums that might today be realised, for instance, by IT professionals; such erosion is, of course, in the economic interest of employers

¹⁰³ The Federal Employment Agency recorded an average of 774.345 job vacancies in 2019 Destatis (2021a). 2.27 million people were registered as unemployed, while the hidden reserve (people who are unemployed but not covered in the statistics for instance due to not registering or because they accepted so-called “one-Euro-jobs” (extremely low paid jobs that have a reputation for being mostly used by the employment agency to keep people busy and to improve the statistics)) compromised almost another million people (see IAQ (2021)).

and their wage bills.¹⁰⁴ This is not to deny that support for (re-)qualification is a relevant and necessary policy in managing labour market transformation – but we have good grounds to consider it insufficient and prone to the individualisation of structural problems. It affords the option to blame individuals for failing to meet the demands of a changing world of work, even if under the most optimistic assumptions millions would still be condemned to fail in their efforts.¹⁰⁵ In this vein, renowned poverty researcher Christoph Butterwegge scolds the focus on education and employability as the ideological focal point of a policy focused on “equal opportunity”, distracting from more fundamental discussions around social conditions (Butterwegge 2020).

The inability for Industry 4.0 to move beyond the scope of established policies is illustrated further by the BMAS’ focus on incremental reforms and in particular the way it discusses the idea of a Universal Basic Income (UBI): although the concept is traced back to Thomas More’s Utopia, highlighting its rich utopian heritage, the only modern advocate of a UBI referenced by the BMAS is Milton Friedman. Consequently, the UBI advocates in general are represented as hoping for “a lean state” (BMAS 2017: 180). This borders on intentional misrepresentation, as a more detailed discussion on the UBI in one of the Work 4.0 workbooks clearly states that an egalitarian-emancipatory strand of the UBI debate would also exist which would aspire to introduce a UBI in addition to the existing welfare state, rather than using its introduction to downsizing it substantially (Ebert/Rahner 2017: 175).¹⁰⁶ The BMAS mentions two further motivations for introducing a UBI however: freeing people from their material dependence on employment and from “social security administrations”. These purported advantages are immediately reversed into disadvantages as they would imply a departure from a state policy aimed at full employment and at offering the unemployed “support and assistance in a spirit of solidarity” (BMAS 2017: 180). In the workbook, this argument is substantiated further by

¹⁰⁴ The continuous complaint of employers that there would be a lack of specialists in the German economy can be relativized against this background: as long as there is no excess of qualified candidates for any given job that can be used to depress wages, there is always a relative scarcity of qualified labour from the point of view of employers. Their laments might also be challenged in light of the lack of willingness to increase employers’ investment into qualification that the BDA displays.

¹⁰⁵ This one-sidedness is even problematised in a paper published by the party foundation of the SPD, which particularly criticises the lack of working time reduction and public employment programs or jobs guarantee (Schwemmler/Wedde (2018: 70–71)).

¹⁰⁶ The workbooks were additional publications by the BMAS that were published throughout the dialogue process and that “offered an insight into the state of discussion on the key issues, contributed to the debate and formed an extended platform for the specialised dialogue on the future of work” (BMAS (2017: 218)). The BMAS is keen to emphasise that contributions to these workbooks do not represent the perspective of the ministry itself, even if they are written by employees of the ministry. A strong overlap between texts written by BMAS members in the workbooks and the White Paper is observable however – with this being a politically relevant deviation.

stating that such a departure from existing welfare provisions might turn out to be to the disadvantage for those, who would require needs-oriented support rather than monetary transfers (Ebert/Rahner 2017: 179). While it makes sense that state support should not be limited to financial transfers but should also, for instance, encompass consultancy and qualification support, it is not immediately evident why the introduction of a UBI could (and should) not be combined with active employment policies (e.g. consulting unemployed people, supporting their placement and qualification and subsidizing jobs for the unemployed).¹⁰⁷

The later objection – that the introduction of a UBI might weaken the caring character of the welfare state seems even more tenuous. After all, the SPD-led reforms of the German social security systems have been subject of vicious criticism in the past. These reforms for instance introduced benefit reductions of up to 100% for recipients failing to ‘cooperate’ with the social security administration, for instance, by refusing to take up a job below their qualification level. In effect, welfare recipients were effectively threatened with deprivation, including hunger and homelessness (Jäger et al. 2017: 43ff.). The reforms not only lead to a secession of substantial parts of the SPD’s left wing, but also to reprimands by the United Nations’ Economic and Social Council (ECOSOC), which urged the Federal Government of Germany “to review the sanctions regime in order to ensure that the subsistence minimum” is always maintained (ECOSOC 2018: 7). This criticism was compounded when a ruling by Germany’s Federal Constitutional Court (BVerfG) judged that large parts of “the design of benefit reductions does not satisfy constitutional requirements” (BVerfG 2019: 24). This unconstitutional brand of „solidarity” distributed towards the unemployed by the German state reportedly left people starving, in some cases to their death, while others lost their homes or were forced to prostitute themselves in order to sustain themselves (SG Gotha 2016). The fiction of a caring character of the contemporary German welfare state is contradicted even further by the fact that according to social associations, the risk of being sanctioned is significantly increased for people suffering from mental illness (Jäger et al. 2017: 62–63). This phenomenon is understandable, as they might have a particularly difficult time living up to the demands of the welfare administration, but it belies the thesis that people would receive support according to their needs and illustrates

¹⁰⁷ In the absence of material force, these might have to shift their focus from coercing people to take up employment to working with them on the basis of voluntariness. Ebert and Rahner seem to imply that this “either, or” logic can be justified by the high costs of a UBI that would not allow for much additional spending on employment policies (Ebert/Rahner (2017: 179)). Since the total costs for active employment policies amounted to only around 11.2 billion euro in 2019 (Weber et al. (2020)) - a rather low amount of money in comparison to today’s overall spending on unemployment and certainly in comparison to the costs of a UBI – this argument seems rather tenuous.

that the existing welfare bureaucracy might at times exacerbate rather than alleviate social vulnerabilities.¹⁰⁸

The explicit refusal to discuss the option of a UBI in the context of the Work 4.0 dialogue process (BMAS 2017: 180) further reinforces its anti-utopian one-dimensionality. More than that, its dismissal, with the help of an uncharitable representation of the demand bordering on distortion, betrays a decidedly anti-utopian impulse, rejecting any radical challenge to dominant social relations. This dismissal by the government is supported by the social partners. Tacitly by the DGB (2017b: 6) who welcomes the general approach of the BMAS to further development of the welfare state (i.e. incrementalism)¹⁰⁹ and agrees with the BMAS that wage labour should remain key to social integration (DGB 2017b: 1). The BDA on the other hand is aggressive in its dismissal of a UBI, criticising the idea as impossible to finance. The BDA furthermore argues that proponents of a UBI neglect the positive effects of work (social recognition, mobility and participation) and would allow people to forgo tolerable employment, allowing them to exploit social solidarity (BDA 2016). There seems to be a tension in its argument that is not reconciled however: in light of the ostensible benefits of wage labour to individuals, why should they then – with a UBI – choose to forgo such an amazing opportunity, condemning themselves to a frugal lifestyle and choose to become a social outcast? Perhaps this tension might be resolved in the form of a “well-meaning coercion”, documenting a repressive and infantilizing understanding of human beings who would need to be forced to their own good.¹¹⁰

The concern that their enthusiasm for wage labour might not be as widely shared by the population as suggested in much of their own discussions also seems to be on the mind of BMAS officials, who are worried that a generous UBI might increase the risk of people deciding not to work, thereby eroding the tax base that would be needed to pay for a UBI (Ebert/Rahner 2017: 178). This concern is revealing not just regarding the distrust towards the working

¹⁰⁸ That is not to deny that historically speaking the existing system of unemployment support is an enormous accomplishment. But criticising well-meaning activists that want to overcome deficiencies in the established provision of social support by idealizing an unconstitutional and degrading social policy regime, rather than reflecting on its critique with some humility, borders on Orwellian newspeak.

¹⁰⁹ Individual high-ranking trade unionists such as Reiner Hoffmann or the head of the powerful IG Metall Jörg Hofmann have been known for explicitly speaking out against a UBI in the past (Spiegel (2018)).

¹¹⁰ Or one might draw the conclusion that the eulogy on the ostensible benefits of wage labour is actually a rhetorical tool to dismiss a policy that might entail massive redistribution and drastically reduce the leverage of employers (a substantial number of which have been basing their profit margins on depressed wages in a booming low-wage sector and have a vested interest of not having the bar raised on what constitutes acceptable employment conditions).

population on the part of the political administration directing the welfare bureaucracy,¹¹¹ but also another limitation of the dominant Industry 4.0 discourse: the utter inconceivability of robust, economic redistribution. The concept that at least modest losses in income taxes might be compensated through wealth taxation and increased taxation of capital incomes seems to be alien to the ministries' officials. As such, the dismal of UBI should not simply be understood in terms of shared cultural values that unite BDA, DGB and the government. Rather, it also represents a dismissal of a redistributive policy that is fairly prominent in the larger discourse on automation, which promises to also directly benefit societal stakeholder groups other than workers, including retired or unemployed people (who would not profit from company-based profit sharing). All this is not to say that a UBI could easily be implemented overnight or to deny that it indeed represents a radical proposal, whose implications are multi-faceted and difficult to project. For example, the argument that it might be difficult to finance in the short term seems to me to be broadly correct. However, the refusal of an open debate on the subject signals a general unwillingness to even consider more radical policies to safeguard human dignity in times of rapid societal change; such a willingness might in fact be key to effectively address automation anxiety.

Industry 4.0 and its Hold on German Scientific Debate

The pervasive effect of the Industry 4.0 discourse was not just defining for much of the public and policy debate on technological innovation in the evaluation period – it dominated most of scientific research on technological innovation in Germany in the past years, too. Although there have been some critical interventions (see above), most of the research has been focused on helping develop the notion of Industry 4.0 and work towards its implementation. This holds particularly true for research in the applied technical sciences, but also for much of the social sciences. In a telling example of how societal demand and scientific research converge, social scientists strived to provide orientation in the ongoing innovation process. With the orientation towards the Industry 4.0 vision, however, research runs the risk of being “contaminated” by the normativity pregnant within Industry 4.0. This takes us back to the assessment of the contemporary state of research on the labour market effects of automation in chapter 2.4 and the conclusion of Wolter et al. (2016): “There ultimately is no other way – if Germany's unable to implement Economy 4.0, other countries will still do so. And the assumptions which have a

¹¹¹ This distrust might be a motivating factor behind the SPD's continued commitment to the sanction regime to this day, despite talks about overcoming “Hartz IV” (the colloquial term for the current system of unemployment support) and abolishing particularly harsh sanctions (cf. SPD (2021: 33)).

positive effect on Germany in the above scenario (pioneer, additional demand abroad, competitive edge) will then count against Germany as a business location. Decreases in production and further unemployment will result“ (Wolter et al. 2016: 61). Clearly, the study affirms the larger normative framework provided by the Industry 4.0, itself becoming an epistemic resource to be mobilised in the debates about future developments.

As we saw, studies like these are then quoted in turn to alleviate fears of technological unemployment, which is considered a powerful dystopian motive impeding the acceptance of technology by the general public. The discussion of automation anxiety in the aforementioned Federal Ministry of Labour and Social Affairs’ White Paper “Work 4.0” is a case in point: invoking the debate on technological unemployment, these concerns are largely discarded by referencing a number of long-term forecasts projecting little to no losses due to technological development. Despite acknowledging their uncertainty and epistemic limitations (BMAS 2017: 43–54), these forecasts nonetheless seem to be accepted as the scientific foundation of the BMAS’ assessment that radical changes to the social security system need not be discussed (BMAS 2017: 180). To a large degree, such a political determination is understandable: after all, in situations “ridden with uncertainty and ambiguity, science can hardly ever provide clear and unambiguous knowledge to solve policy controversies.” (Bauer/Kastenhofer 2019: 32) Faced with a plethora of different interpretations,¹¹² it seems sensible for policy-makers to reduce complexity by committing to a favourite scenario and doing their best to contribute to the corresponding societal development required to get there. A certain level of confidence seems necessary in implementing policy to shape societal development, even if, in theory, epistemic uncertainty is accepted, endowing an implicit “voluntarist” tendency of policy making with some legitimacy. Nonetheless, the risk of “cherry picking” a favoured scenario out of a range of possible outcomes should be clear: while it may be politically justified to some degree, it is not necessarily epistemically justified and entails the risk of simply taking up research that suits one’s political agenda (Betz 2016: 13), prioritizing political fit over epistemic quality. This seems to be particularly true in the context of Industry 4.0 discourse as scientists were both instrumental in establishing this discourse (think of the role of acatech described above) – muddling research agendas, funding imperatives and national political and economic interests – and because even larger parts of the scientific community submitted to the basic

¹¹² The epistemic precarity of this research environment is additionally aggravated by the fact that policy papers oftentimes lack formal peer review, due to being commissioned under great time constraints.

premises of the Industry 4.0, providing expertise axiomatically biased to conforming to the political assumptions of policy-makers (cf. chapter 2).

At the risk of offering a crooked analogy: imagine a policy discourse on the management of nuclear power production which would exclude discussions on both the risk of disasters occurring at power plants and possible evacuations and containment strategies. It would also omit long-term issues such as long-term repositories for nuclear waste because policy-makers would follow their (more or less informed intuition) that in the end, nuclear power might turn out to be a godsend to counteract global warming and human ingenuity would eventually, maybe even soon, find a solution to recycle waste as fuel for a new generation of reactors. They might even find some scientists that would suggest that the existing risks might be technologically resolved in the near future (provided enough funding is channelled into the research field that those scientists dedicated their professional lives to). The policy-makers in this hypothetical case would most likely be – despite being able to mobilise scientific literature to substantiate their strategy – quite correctly criticised for basing their decision-making solely on such an optimistic scenario and for not taking precautions for unintended consequences of the implanting the technology in question.

Such a precautionary approach is virtually absent from the policy documents of the federal government in the context of the Industry 4.0. This would not have been necessary however: the involved ministries could easily have encouraged and commissioned studies providing a variety of possible scenarios which could then have been used as a basis for developing policy responses to various outcomes of technological change. Such an approach would not have ruled out prioritising a preferred scenario which could inform practical policy, but it would have provided a more substantiated approach to the frequently referenced automation anxiety, rather than simply taking it up rhetorically in order to immediately disregard it afterwards. In the light of the absence of such an approach, it appears that political agenda-setting was prioritised over a more comprehensive management of societal risks of technological development.

Industry 4.0 as Ideology?

Can the Industry 4.0 initiative then meaningfully be characterised as ultimately an ideological endeavour whose sole purpose is to help management legitimise measures of rationalisation to boost global competitiveness (Fuchs 2018)? Highlighting this aspect certainly is important, but at the same time, it runs the risk of standing in a way of a more comprehensive materialist

understanding of the Industry 4.0 phenomenon. Focusing exclusively on the legitimizing dimension of Industry 4.0 discourse for pre-existing rationalization purposes, one might for instance underestimate the functional role it played in triggering genuine innovation processes, both in terms of the organisation of work and in terms of technological innovation on the job floor, stimulated by the very real normative pressure exercised by this discourse. Furthermore, such a focus should not distract from a remarkable shift in the way the role of the state is conceptualised in large scale innovation processes.

Following the worldwide economic crisis of 2008, visions like the Industry 4.0 globally became an important discursive strategy of statesmanship. In the US for instance, the “Advanced Manufacturing Partnership 2.0” initiative was announced, China launched the “Made in China 2025” program, etc. All these visions are examples of state politics in the mode of the propagation and systemic implementation of technological visions. This reorientation has been summed up nicely in the BMWi’s *National Industrial Strategy 2030*: “Industrial policy strategies are experiencing a renaissance in many parts of the world. Hardly a successful country exists that relies exclusively and without exception on market forces to manage the tasks at hand” (2019: 8). Visions such as the Industry 4.0 can be understood as a key tool to these “active policy strategies”. As such, one could say that imaginations of “the future”, or futures, have been weaponised as a means to manage and mobilise national economies in world market competition. Thus, it can serve as an example of a vision that was developed rather shortly after the worldwide financial crisis, empowering state actors to assert a more active role in the management of the economy and contributing to a partial break with “free market” fundamentalism.

It should be noted that this “break” however remains committed to provide best-possible conditions for capital accumulation in Germany and should not be confused with a fundamental shift towards more progressive economic policy or even a radical transformation of capitalist relations more generally.¹¹³ Instead, Industry 4.0 discourse provides ample material that its basic motive – competitiveness in global competition – is motivated by a narrow understanding of reality, whose basic axioms are determined and warped by capitalist economic demands

¹¹³ The limitation of this new state interventionism was illustrated by the refusal of Peter Altmaier’s – who headed the BMWi during the drafting of the National Strategy – to accept a more active role of the state in the management of companies saved by state support during the Covid19-pandemic, claiming that the government knew “that the state is not the superior entrepreneur” (ZDF (2020)). For a more nuanced assessment of whether this new state interventionism marks a real shift in the role of state, see Fazlovic (2019); Fisahn (2019); Horn (2019).

(Horkheimer 1978; Marx 2008b). But why should a clear commitment to world market competition, and an accompanying dedication to pursue a specific strategy of technological innovation that – in the case of success – promises to maintain high levels of employment at least nationally, be considered problematic in the first place? After all, the pressures of global competition have not been dreamed up by sinister government officials or even captains of industry – market competition seems to be, and is, a simple fact of life under capitalism. This insight also apparently informs the position of the trade unions within the Industry 4.0 discourse. Faced with fierce international competition for markets shares (and thus jobs) and the strong export dependency of the German economy that exacerbates this focus on global competition, as well as the constant threat of relocation of operations and the withdrawal of investment by companies, the trade unions are forced to reconcile their fight for workers’ interests with the demands of capital. As such, their commitment to a “better, not cheaper” strategy of high-tech investment, accompanied by an increased focus on (re-)qualification and employability, seems perfectly reasonable: although it is unlikely to lead to full employment or an all-out humanisation of work, it might at least prevent drastic regresses and might even provide some openings to argue for strengthening economic co-determination or worker rights (which explains the extent of commitment of the DGB to the Work 4.0 dialogue process).

Of course this approach to tripartite negotiations is nothing new: Germany has a strong and long-running corporatist tradition, or *Sozialpartnerschaft* (Panitch 1981; Hirsch 1995; Streeck 1999). This tradition seems to have been reinvigorated to some extent in the aftermath of the financial crisis, as disillusionment towards a strongly financialised accumulation regime grew and Germany’s relatively strong industrial base was rediscovered as a competitive advantage, leading to the Industry 4.0 strategic initiative (see above). This dynamic has since been analysed under the term of a revitalised crisis corporatism (Urban 2012; Dörre 2016). Already two decades earlier, Joachim Hirsch (1995) carefully reconstructed the role corporatism acquired under the conditions of international competition: faced with the reality of competing national economies and the fragmentation of both the working class and capital into national fraction, successful corporatism would achieve the formation of cross-class coalitions in the interest of securing competitive advantages in global competition. Hirsch explicitly gives the example of the state providing subsidies for technological development to safeguard the competitiveness of national competition (and the attractiveness as a business location) while forcing workers to accept the societal consequences of technological rationalisation (Hirsch 1995: 32–33).

Indeed, it seems as if the corporatist negotiations of the Industry 4.0 discourse redeems something that has been discussed in German-speaking discourse since the 1980s: an update of the corporatist framework in order to reflect the increased importance of technological change in economic affairs (Weber 1986). Citing the contested but popular thesis that the German economy would face the risk of being relegated to a third-class position in global competition (Weber 1986: 278), Hajo Weber draws attention to the technological and economic leadership of Japan and the US. While China may have by now substituted Japan in the worries that motivate the Industry 4.0 discourse, the key concern appears the same.¹¹⁴ These worries can also apparently not be assuaged by a high ranking in macroeconomic stability, innovation capability and business dynamism when it comes to global competitiveness rankings (e.g. Schwab 2018). To the contrary: the ritual incantation that the German economy might fall behind obfuscates the fact that it outclasses the vast majority of other national economies, that are hit by economic depressions, increased unemployment and political unrest – with the German economy effectively exporting unemployment and societal instability on a mass-scale (Arlt et al. 2017: 99–100). This is only logical in an economic system in which the (market share) gains of the few are the losses of the rest. In this sense, the juxtaposition of continued economic successes and narratives of decline is not inconsistent but rather logically consequent: it expresses that under capitalist competition, the only way not to be declassified as a national economy is to declassify others. With innovation being a central factor in securing competitiveness, the appeal to innovate, which is constitutive for the Industry 4.0 discourse, thus merely expresses an “objective” necessity.¹¹⁵

Nonetheless, this necessity has to be accepted, put into practice and managed by the social partners – and it is precisely in this respect that Weber highlights the competitive advantage of Japanese “technocorporatism”. Weber goes on to posit that by now competition would not only require classical instruments of industrial and innovation policy (such as law making and state funding) but also an optimisation of the governance of technological change that would require additional coordination, negotiation, integration and management to secure successful and legitimised implementation of technological change (Weber 1986: 283). The Industry 4.0 discourse can be understood as a successful implementation of a technocorporatist process in this sense – and indeed, it has been celebrated as a revival of corporatist social market economy (Schroeder 2017), a conservative member of parliament turned chief BDA official proclaimed

¹¹⁴ At times, reading policy documents from the discourse can feel like reading war reporting (e.g. “China has also redoubled its efforts on the exports front” (Kagermann et al. (2013: 69))).

¹¹⁵ The quotation marks are meant to imply that this objectivity is preconditioned on capitalist social relations.

a Social Partnership 4.0 (Kampeter 2019) and internationally has been used as an example on how to manage technological change in a corporatist manner (Breimaier 2017).¹¹⁶

But again: So what? Not only are the pressures the Industry 4.0 tries to address non-imaginary, but technocorporatism seems to be considered a fairly effective and relatively inclusive way to manage them – are these aforementioned politicians and social researchers not correct in welcoming and even celebrating the Industry 4.0 discourse, even if it might be somewhat reductive in a few respects? From the perspective that aims at a technocratic management of social affairs, informed by common sense, this objection certainly seems valid. But such a dedication to technocratic management comes at substantial costs, which shall be noted in the final section.

Industry 4.0, Work 4.0 – TINA 4.0?¹¹⁷

For one, as I have highlighted, such a discourse fails to take precautions to face the socio-political challenges that might arise from technological development, violating even a soft understanding of the precautionary principle. When managing the implementation of far-reaching innovation, it can reasonably be demanded however to also consider a variety of possible outcomes, rather than just the most preferable one (Grunwald 2019a: 66) – particularly in light of wide-ranging automation anxiety amongst the population (cf. Special Eurobarometer 2017; Technikradar 2018; Gür-Şeker 2021). What is more, the unquestioned focus on economic growth to create new jobs even threatens to exacerbate the climate crisis facing humanity (see chapter 4.2).

Furthermore, as we could see in the Work 4.0 dialogue process, power dynamics and societal conflicts of interests tend to be obfuscated. In its most extreme, this tendency can take a form which I would – following Marx discussion of the fetishism of the commodity – refer to as a fetishism of technology: if the BDA for instance argues that digitalisation would “demand” this

¹¹⁶ The important role played by the trade unions, scientists and policy-makers corroborates Bob Jessop’s observation that tailoring national economic strategies to “prevailing accumulation possibilities” and mobilising the necessary political support requires an involvement of broader stakeholder groups than just employer associations Jessop (1983: 160). As we saw, the DGB even actively asserts this role by claiming that it would know best how to provide optimal conditions for capital accumulation in Germany (although these claims might to some extent represent a rhetorical strategy to endow its demands with additional normative clout by appealing to some supposed general interests).

¹¹⁷ TINA refers to a slogan frequently used by Margaret Thatcher (“There is no alternative”), condensing the aggressive exclusion of alternatives to neoliberal, market-based approaches to solving societal problems.

or that, it endows technologies – a product of human practice – “with a life of their own” (Marx 1982: 165). And while in the case of the BDA the suspicion that such a techno-fetishist rhetoric is used as a deliberate tool to masquerade the interests of its members as objective necessities might be well warranted,¹¹⁸ such an interpretation of techno-fetishism fails to take into account everyday talk about how “robots are coming for our jobs” etc. Clearly, “the robots” could not care less about anyone’s jobs (including their “own”) and it would be more precise to articulate the fear that one’s employer might endeavour to reduce its wage costs through the introduction of new technologies. I would argue however that these expressions reflect a genuine misconception within the public discourse on automation, which is rooted in the social conditions that shape people’s lives and consciousnesses: largely powerless to influence the actions of the companies they work for, and even more powerless to shape the socioeconomic structures that drive these companies, the imperatives of capitalist production indeed seem to obtain characteristics of a (quasi-)natural power which are then, just as in the fetishism of commodities, reinterpreted as qualities of material objects, providing the basis of the problematic talk of technological change as a “tsunami” (Grunwald 2019a: 155–156). Very much in this line of thinking, Jürgen Habermas has pointed out that as basic socioeconomic conditions are excluded from discussion, pressures resulting from capitalist social relations get transformed into “objective exigencies, which must be obeyed by any politics oriented toward functional needs.” At the same time, technological development would increasingly appear “as an independent variable”, a “quasi-autonomous progress [...] on which the most important single system variable, namely economic growth, depends.” (Habermas 1970: 105) As a result, there is a tendency to read “[t]he iron necessity of natural law [...] into the process of technological development and through it into society as a whole.” (Feenberg 2002: 139) This (mis-)understanding of the nature of technological change has far-reaching implications, obfuscating economic interests and power relations and perpetuating a condition of socioeconomic powerlessness when it comes to democratically shaping technological development – and the economic conditions that drive it. And it should not be understood merely as an intellectual mistake, but as a reflection of the very real powerlessness, the lack of agency, that defines the situation of most individuals in our society when it comes to far-reaching technological change.

¹¹⁸ After all, the link between the technological properties of digital technologies and the demands raised by the BDA is weak at best (cf. Boewe (2016: 2)) and technological determinism has a longstanding tradition of serving as an ideological tool of those in power of shaping technological development (Grunwald (2019a: 155–156)). While this certainly applies to economic elites, the rhetoric of technological determinism can be used by politicians, too, to justify unpopular policies, effectively using technology as a scapegoat (Ruschig (2016)).

As a consequence, I would argue that this ideological misconception of technological change (that it would be an autonomous power, rather than a product of human practice, shaped by (capitalist) power relations) can ultimately not be meaningfully transcended through theoretical critique alone; rather, as it emerges on the grounds of the way societal reproduction is organised, its *Aufhebung* (sublation), too, must take place on the level of a reorganisation of political economy.¹¹⁹ Fighting the relentless processes of capitalist political economy might indeed feel as hopeless and pointless as isolatedly fighting a thunder storm, or some other natural catastrophe, by hand. Nevertheless, the theoretical insight that technological development *can* be socially shaped is a necessary precondition to a non-one-dimensional approach to technopolitics, although it is not sufficient by itself. Rather, this insight can only be fully realised practically: by denouncing the economic interests and normative limitations of the Industry 4.0 discourse, and even more crucially by contributing to the formulation and implementation of a progressive, alternative technopolitical project. To do so implies not to be content with a few roundtables on how to best pursue prescribed ends, but rather to democratise the setting of the objectives of technical change, implying a radical break with existing socioeconomic structures and the corresponding power relations.

Although it might be a moot point to criticise the BDA or a centrist government for not pursuing an anti-capitalist agenda, the relative tameness of the DGB has drawn more explicit criticism. Part of the criticism has focused on the fact that the primacy of providing ideal conditions for capital accumulation has not been questioned by the DGB and that its strategy would be too strongly based on optimistic projections of future economic development (Butollo/Engel 2015). Other critics have focused on the lack of a more ambitious policy agenda, particularly the demand for collective working time reduction (Boewe 2016) and economic democracy (Bontrup 2016; Martens 2020).¹²⁰ In essence, these contemporary critics echo Marx's famous reservation that although "Trade Unions work well as centers of resistance against the encroachments of capital", they would run at risk to limit themselves "to a guerrilla war against the effects of the existing system, instead of simultaneously trying to change it, instead of using their organised forces as a lever for the final emancipation of the working class, that is to say, the ultimate abolition of the wages system." (Marx 1910: 127–128) The brunt of the charge is

¹¹⁹ Borrowing liberally from Marx's critique of ideology: Thus, the struggle against the Industry 4.0 is indirectly the struggle against that world of which the Industry 4.0 is the ideological aroma. Its critique is the critique in embryo of the economic imperatives of which the Industry 4.0 is the halo (cf. Marx (1970)).

¹²⁰ It has been pointed out that this lack of more ambitious policy agenda also coincides with the lack of a more autonomous, progressive narrative and semantics that would be able to condense alternative normative orientations of innovation (Mikfeld (2017: 109–110)).

clear: although resisting the worst impositions of capital (such as the BDA's demand for deregulation) is a necessity and welcomed, the trade unions as key institutions of working class power ought to at the same time strive for a more fundamental reorganisation of the economy with the ultimate goal to transcend the capitalist labour regime altogether. At worst, given that increased automation can be considered a successful strategy to protect national employment at the expense of workers elsewhere (Arlt et al. 2017: 99f; Benanav 2019: 30), one might even consider the DGB commitment to contribute to the implementation of the Industry 4.0 as tacit consent to the deepening, or at least stabilisation, of income disparities within the global working class (Hirsch 1995: 147ff.).¹²¹

While it is indeed sobering that despite a recent, far-reaching economic crisis, the trade unions should adopt such a conciliatory approach to the management of technological change and refrain from revitalising more radical demands such as collective working time reduction or a substantial expansion of economic democracy, one should on the other hand not underestimate the successes this “embracing solution” (Haipeter 2020: 243) has yielded. As Hans-Jürgen Urban, a member of the IG Metall's Executive Committee and a prolific critic of established corporatist practices in Germany, pointed out, in light of the power relations at play during the post-crisis years, employment could only be secured at the price of concessions by the trade unions (Urban 2012: 224). Nonetheless, these concessions proved more efficient a strategy than much more confrontative and militant strategies for instance in the south of Europe (Urban 2010: 448–449). Some trade unionists have consequently resorted to disregarding criticism of the revitalised form of corporatism as overly normatively charged and mostly put forward by social scientists who would project their personal beliefs, i.e. the need for offensive class struggle, onto trade unions (Wendl 2012).

Klaus Dörre, one of the social scientists targeted by this (counter-)critique, has reacted by pointing to widely shared anti-capitalist sentiments among German workers both in the west and the east and the need to formulate a credible transformational economic strategy both for social and for ecological reasons (Dörre 2013, 2019a). Eventually, it could be argued, the ‘constructive’ course adopted by the DGB leadership in the Industry 4.0 discourse might exacerbate tensions with parts of the trade union basis that support a more confrontational approach and more radical policy demands (Schaupp 2021: 111–112). It remains to be seen

¹²¹ It also deepens the dependence of German employment on exports and thus leaves it particularly exposed to international disturbances such as trade wars – which in turn might be fuelled by escalating competition (not least in the form of technopolitical strategic initiatives) leading to increased international tension (as one for instance could see in the case of China and the US (Schneider-Petsinger et al. (2019)).

whether trade unions might be willing to assert a more offensive role in progressive politics. In light of the erosion of the class compromise that formed the core of the cooperative corporatism of the early Federal Republic (FRG), and the challenges of a socioecological transformation of the economy (Hoffmann 2018; Hofmann 2019; Werneke 2019), a window of opportunity might open up for a fundamental reorientation of the trade union leadership that might realign it with the more progressive parts of its membership. Whether it will be exploited remains to be seen.

At the same time, the development of a progressive project for the management of automation is still pending. In order to contribute to such a goal, I will devote the next chapter to addressing some of the key shortcomings of the Industry 4.0 discourse by a) discussing how today's automation, and technological development more generally, is driven by capitalist political economy, by b) discussing some of the societal challenges that might arise from an increased automation and by c) developing basic features of a progressive use of automation.

4 Technology, Crisis and Emancipation

As I have reconstructed in the previous chapter, one of the key effects of Industry 4.0 is both the naturalisation of economic imperatives characteristic for the capitalist mode of production and the effective marginalisation of any discussion of the fundamental societal challenges that automation may pose. In the first part of this chapter, I will discuss how automation and technological development more broadly are connected to the capitalist mode of production and how automation may exacerbate societal tensions. In the second part of the chapter, I will explore how this bleak outlook could serve as a starting point for developing a progressive technopolitical project to *utilise* automation. I will do so by connecting to the understanding of the concept of progress as it was developed by Adorno in light of the “total calamity” facing humanity. From then on, I will examine the role of technology in the thinking on societal emancipation within Critical Theory in general and will concretise this understanding for automation in particular.

4.1 The Political Economy of Automation

Competition, Profit and the Development of the Productive Forces

Both critics as well as apologists of capitalism agree on one thing: that is, as Marx and Engels put it in the Communist Manifesto, that capitalist modernity differs from previous epochs by a “[c]onstant revolutionising of production” (Marx/Engels 2017: 54). The bourgeoisie, they argued, would not be able to “exist without constantly revolutionising the instruments of production, and thereby the relations of production, and with them the whole relations of society” (Marx/Engels 2017: 54). But where does this drive for innovation stem from? Rather than trying to explain it through cultural factors¹²² or contingencies, Marx identifies the capitalist mode of production, that is the political economy of our era, as the key driver. To recapitulate very briefly (for more elaborate reconstructions, see Postone 1993; Fuchs 2017): according to Marx, capitalists exploit workers by extracting surplus-value from their work. By this, Marx means that the capitalists pay their workers less in wages than the value they produce during a working day. For example, workers might take four hours of their workday to produce the equivalent of what they are paid. If they work an eight-hour day, the value generated in the other four hours would be appropriated by the employer.

Profits might be bolstered in several ways: for instance, the employer might try to force workers to work longer hours for the same pay. Assuming they could be compelled to work ten hours instead of eight (and assuming there is no fall in labour productivity as a result), the employer might be able to extract the value of six additional working hours instead of four. This is what Marx calls absolute surplus-value. But there is another way: one can alter the relative “lengths of the two components of the working day” (Marx 1982: 432). If an employer would succeed in raising labour productivity substantially but keep wages roughly the same, they might increase what Marx calls relative surplus-value extraction. Marx provides the example of a capitalist who manages “to double the productivity of labour”, producing “twenty-four instead of twelve articles in the course of a working day of 12 hours” but continues to pay the same wages (Marx 1982: 434). By substantially increasing productivity above the societal average, this capitalist is afforded with the option to undercut their competitors and still generate an “extra surplus-value”, as even his lower prices are higher than his actual production costs (Marx 1982: 434). But this extra surplus-value is only temporary, as the “coercive law of competition

¹²² To the contrary, as indicated in the quote before, technological innovation is also understood to be accompanied by changes in the “relations of society”, which according to Marx and Engels also implies massive cultural upheaval: “All fixed, fast-frozen relations, with their train of ancient and venerable prejudices and opinions, are swept away [...]. All that is solid melts into air” (Marx/Engels (2017: 54)).

[forces] his competitors to adopt the new method.” (Marx 1982: 436) After some time, average productivity will have increased and the competitive advantage and with it the extra surplus-value will be lost, incentivising capitalists to seek out new innovations and so on and so forth. The quest for productivity increases is thus, according to Marx, primarily motivated by the pursuit of profit.¹²³

It is not so much that the profit-motive for innovation would be denied in most of the contemporary debates on automation and technological change. Rather, it is not made a subject of discussion at all, at least in tripartite dialogue. This illustrates, and forms part of, the dominance of capitalist social relations that is constitutive of Industry 4.0 discourse, as discussed above. In contrast, discussing technological development (at least within the economy) as a result of economic structures, as obvious as this perspective should be, allows to draw several preliminary conclusions:

1. If technological change is driven by socioeconomic conditions, it may also take other forms, display different dynamics and have other impacts under other, alternative, socioeconomic conditions.¹²⁴
2. Although technologies might be open to their appropriation for emancipatory purposes (e.g. to enable working time reduction), productivity increases in capitalism do not automatically serve this purpose; rather, this appropriation requires social struggles over control of said technologies (see below).
3. As productivity increases are not primarily driven by some ideological belief but are a tool to maximise profits, capitalism not only facilitates unprecedented productivity growth but also massively confines it.

Let us stay with this last conclusion for a moment as it is important for the contemporary debate on automation and how to manage it.

¹²³ This is not to deny that at times, automation might also be deliberately used as a threat in class struggle (“if you do not comply, we will substitute you through machines”, cf. Marx (1982: 562ff.)) or might be pursued due to a mixture of PR-extravagance and ideological commitment rather than immediate profit-seeking (PAQ (1987: 27)). But eventually, this investment also has to make sense economically, lest investors might feel the urge to withdraw from a company wasting money on new technologies, as was demonstrated by Elon Musk who was eventually forced to concede that “excessive automation” at Tesla was a mistake to assuage investors more interested in the bottom line than the aesthetic and ideological appeal of robotics (Matousek (2018)).

¹²⁴ The relative standstill of technological development before the rise of capitalist modernity attests to this. This is not to say that those would have been happier times (to the contrary), but it at least illustrates that technological development is no transhistorical constant, but rather dependent on social conditions (and thus can be stimulated, shaped and directed through social interventions).

Speculation, Profit and the Hampering of Technological Development

If it is the quest for profit that ultimately motivates most productivity increases within the economy, it stands to reason that automation might lose its appeal if profits would actually be hampered by it, for instance if the costs of these new technologies outweigh the labour costs that they help save. Marx is keenly aware of this and is outspoken regarding the primacy of profit over other factors in driving innovation: “No capitalist voluntarily applies a new method of production, no matter how much more productive it may be or how much it might raise the rate of surplus-value, if it reduces the rate of profit.” (Marx 1991: 373) Not only is it not the search for productivity improvements per se that motivates capitalists – it also is not simply the rate of surplus-value (i.e. the share of the total product they can keep to themselves) but overall *profitability*.

This insight is echoed in both academic and policy discourse with frequent references to the high relative costs of automation to soothe fears of technological unemployment. It indeed would be poor business sense to invest millions into advanced technologies in a context in which a vast low wage sector affords plenty of opportunities to hire workers for extremely competitive, i.e. depressed, wages. While this point is usually raised to reassure workers that the future might not be as bleak as they might fear, from the point of view of a theory that deplors the waste of human lifetime and considers the development of the productive forces and technology in particular to form the objective basis of a better society, this “reassuring” fact morphs into a scathing critique of capitalism: not only is it in many respects an inhumane way to organise the economy – it even underperforms in one of the key capacities attributed to it: technological innovation.

The first – to my knowledge – to systematically develop this critique was the second notable economist of the first generation of the Frankfurt School, today even less remembered than Friedrich Pollock: Henryk Grossmann.¹²⁵ He theorised that since technologies in capitalism would be employed to seek profits, the application of the productive forces would substantially

¹²⁵ Henryk Grossmann became part of the Frankfurt School already under Carl Grünberg, Max Horkheimer’s predecessor. After growing increasingly estranged from the rest of the Frankfurt School during their exile in the US, he decided to return to the East, rather than the West, of Germany, dying there just one year after his return to Germany. The estrangement from his colleagues and his earlier death might have contributed to an unsympathetic reception, in which Grossmann only is mentioned, if at all, as a straw puppet for a deterministic understanding of the formation of capitalist crisis. This is in spite of the fact that his central book *The Law of Accumulation and Breakdown of the Capitalist System*, the first book published by the Institute for Social Research, offers a much more nuanced reconstruction of Marxian theory of crisis and original research than one might expect based on his caricaturesque contemporary representation.

lack behind technological feasibility. Grossmann points to the capitalist periphery where wages would be so low that it would not be worthwhile for employers to invest in machinery. Although machinery could be used “to substitute, that is to save human labour, it [human labour] is in fact MASSIVELY WASTED and the development of the productive forces is hampered” (Grossmann 1929: 257). But Grossmann does not stop there, pointing out that the retardation of new production methods would not only limit productivity growth in low-income countries but even the capitalist centre such as the US and Germany, concluding that it is precisely “capitalist profitability considerations” that would cause the waste of human labour (Grossmann 1929: 258; see also Srnicek/Williams 2015: 112 for a more contemporary discussion of this issue).¹²⁶

But it is not just the relative costs of automation that hamper technological development. The urge to prevent competitors using the latest technologies in order to preserve a competitive advantage has led to a “proprietary model of innovation that locks up knowledge-intensive products of innovation and research into an increasingly impenetrable thicket of mutually exclusive claims of ownership” (Tyfield et al. 2017: 7). This is particularly true in the case of digitalisation where not only the latest algorithms have to be guarded as trade secrets but also scarcity of digital goods has to be systematically, and with extreme efforts, be produced and enforced (Mason 2016; Dörre 2020). An obvious example here would be the case of 20 year old music titles and films whose copyright continues to be enforced through an industry of lawyers.

Last but not least, it is not only the relative costs of automation when faced with low wages or the tendency to exclude competitors or non-paying consumers from access to commodities and new technologies that hamper productivity increases under capitalism. Investment in new technologies might also be curtailed when other investments promise higher profits at an acceptable risk: after all, why should one spend their money on machines and wages to produce some commodity with a meagre profit if buying up assets such as real estate or stocks offers substantial higher returns?

This fact has oftentimes been neglected in the debate on technological change and productivity development. Take for instance Carl Frey’s discussion of the temporal delay of the impact of technologies: he starts with the observation that it would be “well known” that productivity

¹²⁶ Low wages not only increase the relative costs of automation, they also contribute to uncertainty for investors – after all, depressed wages translate into lower purchasing power and thus lower demand for additional commodities that might be produced in even more productive factories (Stirling (2019)).

growth has been slow lately, especially since 2005 (C. Frey 2019: 329). He traces this back to upcoming technologies, such as AI, being “at an experimental stage” where high investment would be needed without seeing an immediate return. He concludes: “During this phase, history tells us, the economy goes through an adjustment process with slow productivity growth.” (C. Frey 2019: 329)

While it seems reasonable to argue that new technologies require up-front investment to be developed and further investment to be implemented, I would argue that the question as to what extent this investment actually takes place should not be merely put down to transhistorical temporal delays associated with innovation cycles. Rather, these delays can be reasonably explained through economic analysis. For instance, Frey might have considered drawing a connection between the financial crisis that erupted shortly after the year 2005 and the economic policies that were developed in response to it, quantitative easing (QE) in particular. QE has been dubbed “the boldest policy experiment in the modern history of central banking” (Roach 2018). Through it, central banks tried to stabilise the financial system by massively buying up securities (public debt as well as other assets) to pump additional money into the economy. This added liquidity was then supposed to translate into additional investment, thereby boosting economic growth. Between 2008 and 2017, the G4 (Eurozone, US, UK and Japan) central banks were estimated to have pumped around 11 trillion US-dollars into their respective economies (Tily 2017).

In light of this remarkable number, one might expect investment to have sky-rocketed in those years. And in a way it has, just not in the form of investment into new infrastructure, factories and so on. Instead, stock markets and real estate prices reached ever new heights in a growing disconnect between financial markets and the general economic development (for instance measured by the GDP). It turns out that if the rate of profit is highest when speculating, capitalists will speculate. Or as Marxist economist Michael Roberts puts it: “A fall in the rate of profit promotes speculation. If the capitalists cannot make enough profit producing commodities they will try making money betting on the stock exchange or buying various other financial instruments.” (Roberts 2014: 13) The provision of additional liquidity helped to keep interest rates low and thus private, corporate and state debt more sustainable, but added additional fuel to the inflation of non-productive assets (thus making them even more attractive for further investment).¹²⁷

¹²⁷ As Roberts points out, this exacerbates an already existing, destabilizing trend: as investors flock into the stock exchange since they are collectively faced with low profits, they end up inflating asset prices. “But

The following graph illustrates that indeed investment (measured in the share of gross income reinvested into fixed assets such as machines, factories etc.), and in turn productivity growth, has been at a historic low in recent years in Germany:¹²⁸

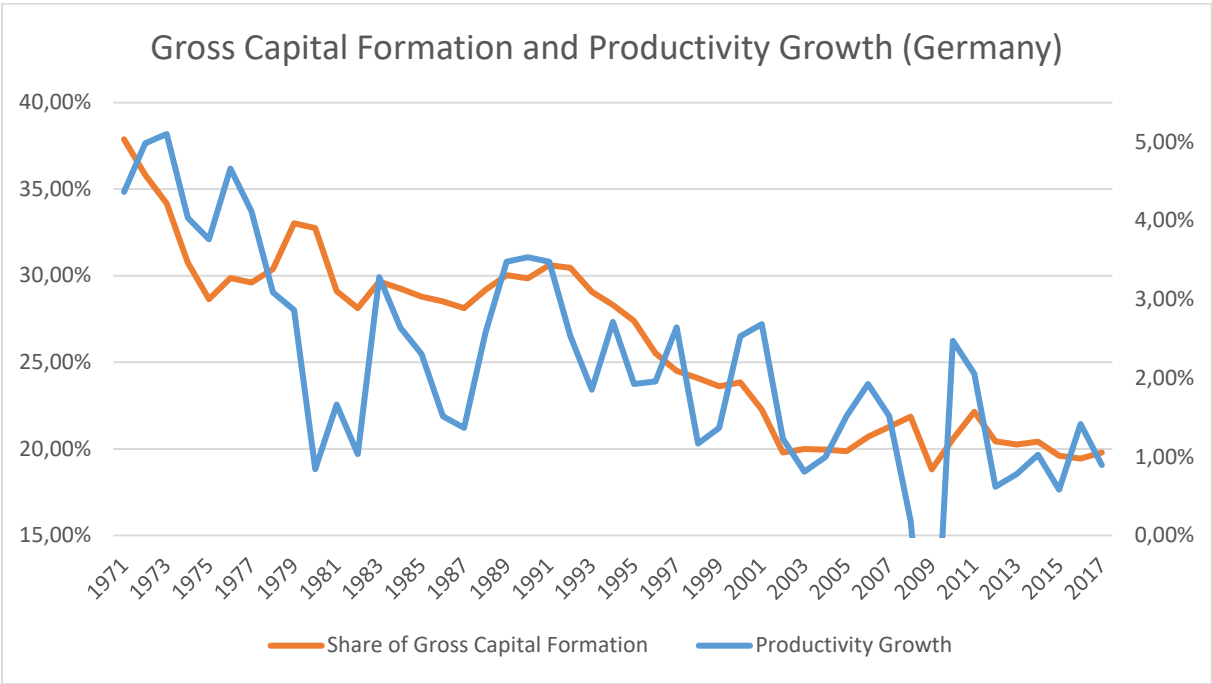


Figure 3: Gross Capital Formation and Productivity Growth (Germany)

As is evident, investment in capital formation was high in the early FRG (nearly 38%), it reached medium levels between 1970 and 1990 and started to decline considerably from the 1990s on, stagnating at a very low level of around 20% since 2002. And as it turns out, productivity growth matched this development rather closely: it was very high in the early years of the FRG, saw a gradual slowing down and has reached ever new lows since the early 2000s. Investment and productivity growth are strongly correlated – the thesis that if you invest in new production methods, productivity increases and if you do not, it does not, thus seems to have some empirical validity (cf. Goldin et al. 2021).

These empirical interdependencies are not entirely unknown either (cf. for instance Roberts 2021a, who corroborates my findings based on US data). And what is worse, the obstructive effect of financialization does not end there: it is not just private investors who have increasingly opted to invest into the stock markets but also corporations themselves: since reinvesting their profits into their company offers less of a return than speculating,

when stocks and assets prices are rising everybody wants to buy them – this is the beginning of bubble on exactly the lines which we have seen them again and again since the Tulip Crisis of 1637.” (Roberts (2014: 13)).
¹²⁸ The chart is based on data on productivity provided by the OECD (2019) and on Gross Capital Formation provided by Feenstra et al. (2015).

managements increasingly build up corporate savings to invest in the financial markets to boost the bottom line instead of reinvesting profits which might expand commodity production, increase productivity and boost economic growth (Redeker 2019). In addition, the shareholder-orientation of corporate governance has greatly increased in the last decades, with companies wooing their shareholders with buyback programs to boost stock prices and by distributing generous dividends, leaving less and less money for investments into new technologies (Lawrence et al. 2020). This illustrates that the popular juxtaposition between “productive” and “speculative” capital is somewhat tenuous: not only was financialization introduced as a reaction to overaccumulation within “productive” industries (i.e. a lack of profitable investment opportunities in the “productive” economy, cf. Lohoff/Trenkle 2013; Streeck 2017; Nachtwey 2018: 45–50; Schaupp 2021: 35ff.), but “productive capital” increasingly engages in the same investment practices.¹²⁹

That is not to deny that other factors might not also contribute to the recent decrease in productivity growth,¹³⁰ but the academic disinterest for changes in investment patterns appears negligent. This is particularly true as substantial productivity gaps exist within developed economies, indicating that the easiest way to realise productivity increases would be to generalise technologies that have been trialled and tested by industry pioneers (see chapter 5.4).

While the eulogy of capitalism’s propensity to promote productivity growth thus comes with important caveats, with the profit motive not only driving but also hampering societal potentials for innovation, there can however be little doubt that modernity saw an unparalleled increase in productivity that, while slowing, continues to this day.¹³¹ And the economic environment for

¹²⁹ In light of all this, one has to at least appreciate the Industry 4.0’s intention to boost investment into (fixed) capital formation – although it is noticeable it lacks any attention for disincentivising speculation in return.

¹³⁰ A popular example includes the difficulty to measure the productivity impact of digital technologies: Most often, (labour) productivity is measured in how much economic value is generated per hour worked (e.g. GDP/hour). But this way to measure productivity fails to take into account additional use values that are provided free of charge, for instance in the form of digital services. To the contrary: As Paul Mason argues, hardly anyone would deny that the Wikipedia vastly simplified access to information – it is the most frequented webpage in the world and its use value as a global knowledge resource can hardly be overstated. At the same time, it can be considered a machine of destruction in terms of (economic) value as it not only for many substituted the products of the encyclopaedia industry but also is provided free of advertisement, with Mason estimating the advertisement revenue not realised alone as high as \$3 billion a year (Mason (2016: 10)). Other examples could include the provision of music and videos free or charge or the substitution of dedicated electrical appliances such as navigation devices through smartphone apps etc. Studies evaluating the explanatory power of different approaches to explain the recent slowdown of productivity growth do conclude however that the dominant factor is lack of investment (Niebel (2019); Goldin et al. (2021)).

¹³¹ And this productivity growth ought not be accredited to other factors – e.g. the intensification of work through algorithmic management (cf. Schaupp (2021)) – exclusively. Investment in automation continues to take place. To give just one example, the International Federation of Robotics (IFR) reported in December 2021 that the number of industrial robots per 10,000 workers nearly doubled within half a decade, surging from 66

profit-seeking can change quickly, as illustrated by the rapid interest rate hikes in the year 2022. Furthermore, even slower productivity growth might prove a challenge to socioeconomic stability in the context of “postgrowth capitalism” (Nachtwey 2018). And finally, government support and various forms of normative pressure, e.g. through strategic initiatives such as the Industry 4.0, could lead companies to reinvest greater shares of their profits, prioritising long-term competitiveness over short-term profits. As such, the desideratum of a more fundamental assessment of automation’s possible societal impacts persists, despite the limitations of capitalist innovation discussed above. The next section is therefore dedicated to exploring the intertwined tensions associated with automation from a socioeconomic, political and environmental perspective.

to 126 robots globally. Robot density is particularly high in the German economy, which boasts 371 robots per 10,000 workers or “38% of Europe’s operational stock” (IFR (2022)).

4.2 Automation and Crisis

Socioeconomic Crises

The first dimension I will address is the one most often discussed in relation to automation: the potential that technological development might lead to economic destabilisation and social hardships. In particular, I will discuss three crisis diagnoses: The first diagnosis posits that automation might lead to the long-term erosion of the rate of profit and thus could end up undermining the very foundations of capitalist economy. The second focuses on increased technological unemployment, or a surge in so-called “surplus populations”, i.e. people who are more or less permanently excluded from both work and most consumption, leading to a collapse in (solvent) demand for commodities and thus to economic crisis. And lastly, a weaker version of this diagnosis, positing that continued technological development might lead to an increased polarisation in the labour market between “winners” (people profiting from technological development, i.e. predominantly the owners of the means of production but also workers whose skills are in high demand) and “losers” (predominantly workers who face the devaluation of their skills and their displacement into low-wage jobs).

Organic Composition of Capital and the Law of Falling Rates of Profit

The first, most far-reaching and also most abstract crisis diagnosis is rooted in an analysis of the very fundament of capitalism. We have learned already that, according to Marx, technological development can be understood as being driven by the pursuit of profit and that the extraction of profit enabled by technology is enabled through the appropriation of so-called relative surplus-value – reducing the share of the work day required to produce their wages by increasing the productivity of workers. As this process progresses, investment into constant capital (machines etc.) gains a preponderance over the spending on wages (so-called variable capital), leading to what Marx calls a change in the organic composition of capital (cf. Marx 1982: 762ff.). In other words: as investment in technology grows and grows, the relative quantity of human labour involved in production shrinks: the work process becomes more “capital-intense”. But why should that be a problem? After all, the investment would not take place if it would not facilitate the appropriation of extra surplus-value.

To answer this question, we have to introduce another tenet of Marx’s critique of political economy: The labour theory of value. In his reconstruction of how economic value is created in capitalist economies (Marx 1982: 247ff.), Marx follows his predecessors in the study of

political economy, Adam Smith and David Ricardo, in emphasising that ultimately surplus-value can only be extracted from living labour (i.e. the work done by human workers whose compensation is measured in variable capital), not dead labour (i.e. constant capital such as machines, resources and the likes, themselves product of living labour): it is “[l]abor, and labor alone, [that] according to Marx, has the capacity to produce value beyond that which is necessary for its own reproduction.” (Zwolinski/Wertheimer 2016)

While the price of all other commodities (including machines) could not sustainably fall below the costs of producing them, a worker, as we already saw above, has the ability to produce more value in a work day than the costs to reproduce his labour – hence, surplus-value is created, which in turn can be appropriated by capitalists (their employers). As the organic composition of capital increases and more and more living labour is substituted by machines in the pursuit of temporary, extra relative surplus-value, behind the scenes, the very foundation of surplus-value extraction erodes. In chapter 13 of *Capital* Volume III, Marx reconstructs the law of the tendential fall in the rate of profit (Marx 1991: 317ff.) precisely on this basis. But this counterintuitive relationship, that the rate of profit actually falls not “because labour becomes less productive but rather because it becomes more productive [thereby reducing the relative share of living labour]”¹³² (Marx 1991: 346) had been reconstructed by Marx as a central contradiction of capitalism already much earlier in *Capital*'s predecessor, the *Grundrisse*:

“Capital itself is the moving contradiction, [in] that it presses to reduce labour time to a minimum, while it posits labour time, on the other side, as sole measure and source of wealth. [...] On the one side then, it calls to life all the powers of science and of nature, as of social combination and of social intercourse, in order to make the creation of wealth independent (relatively) of the labour time employed on it. On the other side, it wants to use labour time as the measuring rod for the giant social forces thereby created, and to confine them within the limits required to maintain the already created value as value. [...] Forces of production and social relations - two different sides of the development of the social individual - appear to capital as mere means, and are merely means for it to produce on its limited foundation. In fact, however, they are the material conditions to blow this foundation sky-high.” (Marx 1993: 706)

The tendency to, on the one hand, save human labour time, while on the other hand not being able to suspend the labour theory of value, is, to Marx, the defining contradiction of capital. And as technological development progresses so does, thus, a potential – and necessity –

¹³² This relationship is particularly counterintuitive as increasing productivity is, as we already learned, a way for individual entrepreneurs to snap up extra relative surplus-value, i.e. a way to increase profits (Kosmoprolet (2009)). This illustrates a general point of Marx's critique of capitalism: that oftentimes, behaviour that is perfectly rational from the point of view of the individual leads to unintended and destabilizing side-effects.

develops to radically transcend (“blow sky-high”) the existing mode of production. To Marx and Engels, “[m]odern bourgeois society” is bound to end up “like the sorcerer who is no longer able to control the powers of the nether world whom he has called up by his spells” (Marx/Engels 2017: 58). Marx is also quite clear that this process “is completely intendent of the capitalists’ will” as competition enforces technological development in disregard of individual propensities (Marx 1991: 374)

The gradual fall in the general rate of profit has infatuated Marxists ever since. Karl Kautsky, a tireless disseminator of Marx’s critical theory and thought leader of early social democracy in Germany, dedicated a whole series of articles in the SPD’s leading theoretical journal to theories of crisis, with the falling profit rate serving as headliner (Kautsky 1902). While touching on a number of interesting other points, Grossmann’s (1929) opus magnum was in essence dedicated to working out Marx’s law in greater detail – and Grossmann and Kautsky have been followed by ever new generations of critical theorists, trying to theoretically prove the necessity of the eventual demise of capitalism, suffocating under its own productivity (Kurz 1986; Postone 1993; Roberts 2009; Lohoff/Trenkle 2013; Konicz 2016).¹³³

The issue is, of course, that this diagnosis rests on the labour theory of value, whose validity – despite Marx’s extensive argument on its behalf – might be put into question. Luckily for the proponents of the law of the tendential fall in the rate of profit, there is some empirical evidence to support their position (see for instance Carchedi/Roberts 2018). As Roberts has shown, the global rate of profit has dramatically fallen between 1869 and 2007, declining from more than 40% in the early 1870s to below 20% in the early 2000s (Maito 2018; Roberts 2020b). This trend has not stopped in the period after the second world war either, as can be shown using Germany as an example in this figure:¹³⁴

¹³³ In part, the revival of discussions around the rate of profit of course represents a reaction to the Financial Crisis. Then again, many elements of these analyses have been developed previously in the context of the *Neue Marx-Lektüre* – the attempt to develop an understanding of Marx’s critical theory distinct from both Marxism-Leninism and reformist readings of Marx – which in turns owes much to the Frankfurt School. Not only were Grossmann and Postone employees of the Frankfurt School’s Institute for Social Research, but second generation scholars such as Alfred Schmidt, Hans-Georg Backhaus or Helmut Reichelt were instrumental in facilitating a debate on Marxian theory in the early FRG after the disruption of the Third Reich. Several of their contributions can be considered predecessors to later strands of Marxist theory dedicated to theories of crisis in general and the discussion of the declining rate of profit in particular, such as value criticism (cf. Elbe (2008: 66–87)).

¹³⁴ The chart is based on data for the real internal rate of return provided by Feenstra et al. (2015).

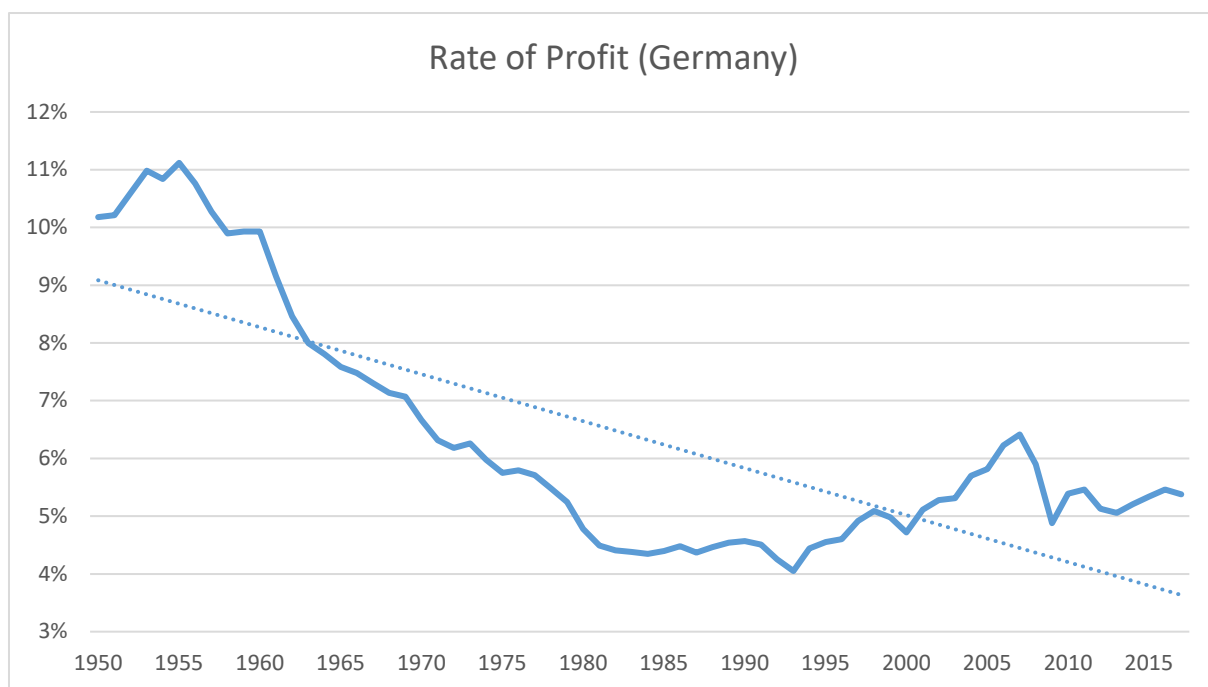


Figure 4: Rate of Profit (Germany)

One can see well that the rate of profit was substantially higher during the post-world war II economic expansion which was followed by a profitability crisis. Following the reunification with the less technologically advanced GDR and neoliberal labour market reforms, the rate of profit stabilised, although at a substantially lower level than during the immediate post-war period. What is more, as Roberts has shown for the G20 economies, the development of the organic composition of capital and the rate of profit run contrary to each other, i.e. as the organic composition of capital increases, the rate of profit falls (Roberts 2020c).¹³⁵ While the validity of these observations of course depend on the quality of the data provided by macroeconomic datasets such as the Penn World Table of Feenstra et al. (2015), there seems to be an empiric case that there is indeed a tendency for the rate of profit to fall in the long term. The graph above indicates however that there are ways to, at least temporarily, restore the rate of profit, for instance by depressing wage levels through economic reforms.¹³⁶

Another way the rate of profit might be restored is through a decrease of the organic composition of capital – either by disaster¹³⁷ or by decreasing the costs of constant capital (for

¹³⁵ As documented in the comment section of Roberts (2020a), I had tried to approximate an index for the organic composition of capital to relate it with the rate of profit at the beginning of September 2020, using a quotient of capital stock and output-side GDP. I am thankful that Michael Roberts made good on his promise to dedicate himself to a more elaborate discussion of the rate of profit in a posting later in September 2020, although he does not document in Roberts (2020c) how he derives the index for the organic composition of capital.

¹³⁶ Effectively, cutting down wages ensures that the rate of surplus-value extraction outpaces the rising organic composition of capital.

¹³⁷ The classical example here would be, of course, wars.

instance if new software that allow for a substantial increase in productivity can be made accessible at relatively low cost or if productivity increases in the capital good industries contributes to falling prices of capital goods). Aside from discussing such counteracting factors (Marx 1991: 339–348), Marx is eager to highlight that as more and more people are integrated into the wage labour regime, the absolute mass of profit might still grow, despite a sinking rate of profit (Marx 1991: 324). This, however, presupposes enough economic growth to integrate more and more people into the labour process despite increasing productivity (Benjamin 2021: 43). And in the context of a global competition in which growth often means snapping up market shares to the detriment of competing capitals and national economies, it often simply means exporting unemployment to other parts of the world.¹³⁸ These counteracting factors imply that individual companies and even national economies might find ways to maintain profitability at a level that allows for continued capital accumulation, at least for an indeterminate period.

Thus, the jury is still out as to whether the theoreticians arguing for an eventual collapse of the capitalist economy overstretch the explanatory power and importance of the law of the tendential fall in the rate of profit (cf. Harvey 2021; Roberts 2021b). But more importantly, the question remains as to what relevance it would have, if the accuracy of Marx’s law could be demonstrated conclusively. After all, it might take centuries before capitalism suffocates under its own productivity – and what might follow after its agonizing breakdown might be even less pleasant than the status quo (see chapter 4.3 for a discussion of how societal progress and crisis diagnoses might be reconciled non-deterministically).

Nonetheless, for an economic model that at its core is motivated by the pursuit of profit, these preliminary insights do not bode well. They highlight a fundamental tension: that the means to pursue increased profits for individual entrepreneurs, to save human labour, undermines the very foundation of capital accumulation. Or to put it differently: “That which is both rational and necessary from the perspective of the individual capital reveals itself to be suicidal from the perspective of capital as a whole.” (Benjamin 2021: 46)

But there exist also more immediate and tangible concerns in regards to automation: namely fear of technological unemployment and/or of a further polarisation of the labour market.

¹³⁸ Aside from Grossmann, Marcuse stands out in the first generation of the Frankfurt School by not only discussing the connection between the rising organic composition of capital and the decline in the rate of profit, but also linking it to the increase in international tensions as competition for new markets increases (Marcuse (1955: 310–311)).

Automation anxiety is such a strong feature of the popular discourse on automation that it appears to demand little explanation: if productivity increases are not compensated by economic growth (whether through the expansion of existing industries or the creation of new), people might be left unemployed. The concern is time-honoured (Marx 1993: 708), with Marx arguing that as the organic composition of capital rises, “a relatively redundant working population, i.e. a population which is superfluous to capital’s average requirements for its own valorization” (Marx 1982: 782) is created. Against the background of increased debate on automation progresses, this issue has received increased attention lately (Autor 2015a; Srnicek/Williams 2015: 85–105). The key insight is that as productivity increases, more and more people might not be needed anymore as workers, condemning them to material deprivation.

While this might seem “natural” in capitalism, it is anything but: after all, increases in productivity imply that a better satisfaction of human needs can be realised with less work than before. That the fact that we can meet our demands with less work should constitute a catastrophe for humans betrays a profound irrationality of capitalism. This irrationality has been portrayed starkly by Nobel laureate Wassily Leontief:

"Adam and Eve enjoyed, before they were expelled from Paradise, a high standard of living without working. After their expulsion they and their successors were condemned to eke out a miserable existence, working from dawn to dusk. The history of technological progress over the past 200 years is essentially the story of the human species working its way slowly back into Paradise. What would happen, however, if we suddenly found ourselves in it? With all goods and services provided without work, no one would be gainfully employed. Being unemployed means receiving no wages. As a result until appropriate new income policies were formulated to fit the changed technological conditions everyone would starve in Paradise." (Leontief 1986: 372)

But Leontief is not quite correct. Not “everyone” is threatened to face material deprivation if technological unemployment were to actually manifest. There are people who are not gainfully employed and whose incomes nonetheless outshine the wages of even the best paid trustees of capital: Capitalists themselves. As long as you own the companies that utilise robots and employ the few guardians of the productive process that are still required, your “capital income” (i.e. the relative surplus-value appropriated from your workers) might yet swell. Technological unemployment, insofar as it threatens the capacity to make a living, is thus a class issue. It constitutes one aspect of what can be called the proletarian condition.

Although the term "working class" and even more so the term "proletarian" is often understood to refer to men wearing overalls wielding some preferably blunt tools to produce commodities (Samol 2007), this is not how classical Marxist theory understands class: Rather than defining the proletariat through a distinct culture or a specific field of work (i.e. manufacturing), Marx suggests a class divide based on ownership of the means of production (Marx 1982: 272–273). Broadly speaking (for more nuanced contributions, see Candeias 2021), if you have to depend on selling your labour to make a living, you are a proletarian. If you do not, you are not.¹³⁹ In the context of automation, this understanding of class in general and the proletarian condition in particular which identifies a shared socioeconomic predicament as the defining feature of the working class, seems highly relevant. Rather than losing itself in the minutiae of social stratification, it highlights a shared feature that the majority of people in modern society have in common: their dependency on wage labour which leads to a fundamental asymmetry in power relations and is constitutive of capitalist political economy. Losing one's job to automation very directly impacts the life of people who have to rely on their wages to make a living, no matter whatever other social, cultural, gender etc. differences there might be. While automation can constitute a threat to the socioeconomic well-being of workers, it is a means by which capital owners can increase their "capital income" through the pursuit of extra surplus-value, creating an antagonism of material interests in which the interests of capital owners are opposed to those of members of the working class.¹⁴⁰

But there is yet another aspect of technological unemployment that constitutes a threat not just to workers but the overall stability of the economic system: The economic deprivation forced upon workers also implies a drop in affluent demand. Thus, it might become harder and harder for companies to actually sell their commodities as people lose their jobs and an underconsumption crisis erupts (Marx 1993: 708). But this, of course, is no necessity: even if economic growth is relatively low, there are ways to either prevent technological unemployment (for instance through redistributing work) or to mitigate its effects (for instance through economic redistribution via a strong welfare state). Accordingly, for technological

¹³⁹ Of course it is not complicated to point towards more complicated cases such as pensioners or dependent household members.

¹⁴⁰ This is not to say that wealthy people could not possibly show solidarity with the working class. To be sure, emancipatory thinking would be much poorer, had not Marx profited from Engels' support. Even the establishment of the Frankfurt School would have been impossible without the generous support of Felix Weil and his father Hermann Weil, one of the biggest grain tycoons of his time. Nor should one confuse the existence of a shared predicament with a guarantee for progressive thinking. The discussion of the distinction of "class in itself" (defined by their shared relation to the means of production) and "class for itself" (consisting of people that politicize this shared feature and act in their specific class interest) has filled books by themselves (see for instance Lukács (1971); Marcuse (2007)).

unemployment to happen and for it to lead to an underconsumption crisis, several factors need to coincide: economic growth too low to outweigh productivity increases and an unwillingness of policy-makers to implement progressive policies in response to automation (Srniczek 2015). As such, the earlier observation from chapter 2 is reinforced that there exists no technological unemployment; insofar as one might speak of technological unemployment, one should discuss it as a result of a deeply irrational economic management of technological development and a failure of policy (Grossmann 1929: 128–130).

This also holds true for probably the least spectacular but nonetheless harmful tendency of automation: its potential to contribute to labour market polarisation.

Automation and Labour Market Polarisation

Even if widespread technological unemployment is prevented, this does not necessarily imply an equitable distribution of the benefits of productivity increases. To the contrary: a growing body of research suggests that the way the fruits of technological change have been shared constitute a key driver of growing income inequality and social polarisation in the last decades, despite record high levels of employment (OECD 2012; Autor/Dorn 2013; Goos et al. 2014; Ugucconi/Sharpe 2016; Dao et al. 2017; Schwellnus et al. 2018). Automation (in conjunction with global competition) lead to losses of middle-skill jobs, displacing workers “to lower-wage occupations” (Dao et al. 2017: 39). Unequal participation in the distributive outcomes of productivity increases (spurred by the wage depression of the neoliberal era) and shifts in labour’s terms of trade¹⁴¹ lead to further growth in inequality.

Consequently, the assumption that labour’s share in overall income is more or less fixed (cf. Ugucconi/Sharpe 2016: 22) has collapsed, as has the close connection between productivity increases and wages. This development has been under way for some time now, as illustrated in this graph, visualizing the historic development of productivity in Germany (before 1990 using FRG data) and real wages:

¹⁴¹ The technical term labour’s term of trade denotes “the ratio of consumption goods prices to producer prices” (Ugucconi/Sharpe (2016: 8)). For instance, in Germany housing costs grew much quicker than investment costs (e.g. the costs of robots), which means that companies were able to invest into new technologies more cheaply whereas workers’ real wages suffered from higher living costs (Ugucconi/Sharpe (2016: 21)).

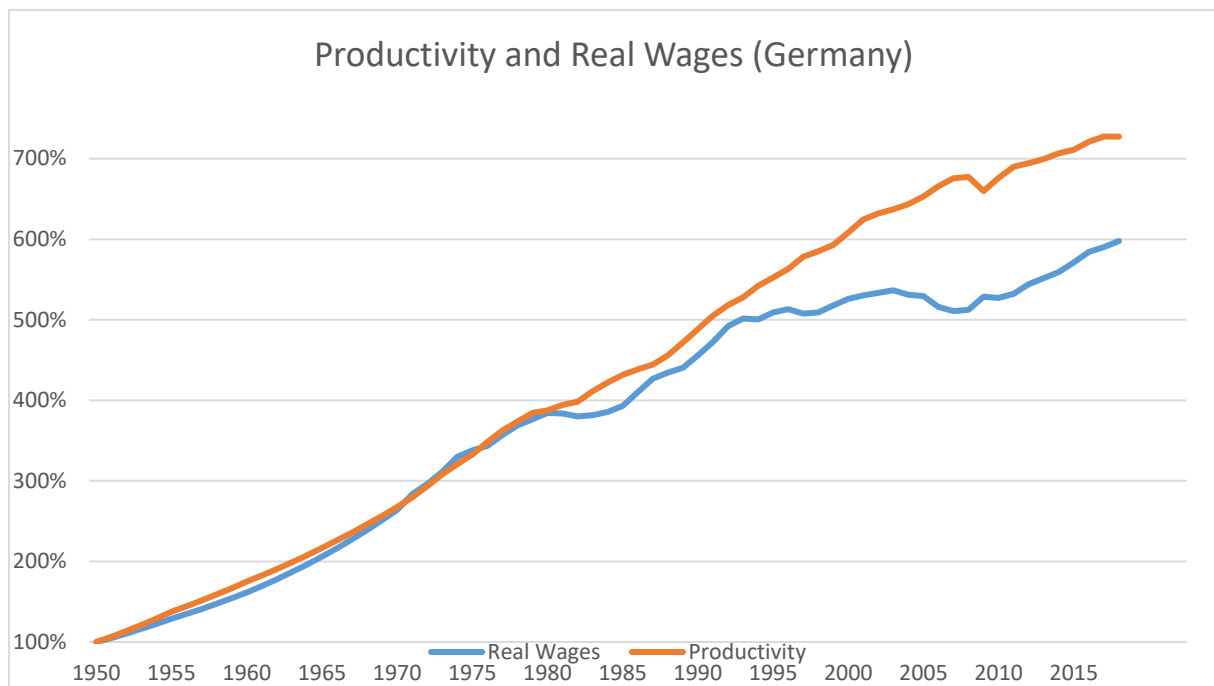


Figure 5: Productivity and Real Wages (Germany)¹⁴²

As can be seen, real wages (before taxes) and productivity develops almost perfectly synchronous for the first three decades of the FRG (cf. Nachtwey 2018: 112–113). From 1980 onwards, a first decoupling of wage and productivity growth takes place, followed by a second one from 1995 onwards. And this graph even underrepresents the extent to which many workers were excluded from the fruits of productivity increases, as the decoupling of productivity increases and real wages coincided with an increase in wage polarisation within the labour market, i.e. higher wage shares going to (oftentimes high-skilled) top earners with the bottom 20% of workers facing actual losses in real wages, particularly in Germany with its mushrooming low-wage sector (Dao et al. 2017; Grabka/Goebel 2018; Grabka/Schröder 2019; IMF 2019). As a matter of fact, Germany, with its combination of increased wage inequality, a falling overall labour share and quickly rising living costs, has the dubious honour to have accrued one of the largest gaps between median real hourly earnings and labour productivity, second only to the United States (Ugucioni/Sharpe 2016: 15). The general tendency towards a decoupling of productivity and wage growth does apply to most developed countries however, as a joint report by the International Labour Organization and the OECD on labour shares in the G20 economies concluded (ILO/OECD 2015: 8).

There is no shortage of studies discussing the grown disconnect between productivity and wages (Dauth et al; Prenner 2018) and this much seems clear: in the last decades, labour has

¹⁴² Data for productivity increases based on Klump (1985) up until 1970, afterwards OECD (2019). Wage data from Klump (1985) and WSI (2020).

failed to secure proportional participation in the benefits accrued from increasing productivity, leading to a decline in the labour share of the national income. As a report for the British Labour party summarised the risk: “labour’s share is progressively cannibalised by capital, the automation of the economy risks entrenching a new form of economic feudalism: those who own the robots will reap the rewards, the rest will struggle as human labour becomes less and less important in the production process.” (Barrott et al. 2017: 9)

This does not bode well for the socioeconomic effects of future productivity increases and automation, particularly as there is little indication that future technological development will not promote the devaluation of existing qualifications and continued displacement from middle-class jobs to lower-paid jobs as well (Wolter et al. 2016; OECD 2017). As a matter of fact, recent studies indicate a growing disillusionment with regards to the effect technological change has had – and will have – on wages (Autor/Salomons 2018; Acemoglu/Restrepo 2020). Perhaps most indicative of this recent pessimism amongst economists is the result of a polling of “leading academic economists” 43 percent of which agreed “that ‘information technology and automation are a central reason why median wages have been stagnant in the U.S. over the past decade, despite rising productivity.’” Maybe even more surprisingly, only a minority of “28 percent disagreed or strongly disagreed.” David H. Autor, one of the leading voices of the economic debate on automation concludes: “I find these poll results stunning because they suggest that a plurality of mainstream economists has accepted – at least tentatively – the proposition that a decade of technological advancement has made the median worker no better off, and possibly worse off.” (Autor 2014: 134)

One ought not too hastily blame technological change itself however. After all, vulgarly speaking, robots care not about who profits from their use – as such, it seems a bit of a stretch to denounce technological change for driving social inequality. It can indeed be considered a contributing factor however, insofar it enabled certain practices (e.g. displacement of workers to save labour costs). More pointedly: presuming present economic conditions, technological development can indeed be considered a factor that almost necessarily exacerbates socioeconomic tensions, as its primary economic purpose is to strengthen capital incomes in comparison to wages, i.e. reducing the labour share (or in Marxian terms: enabling extra surplus-value extraction).

What is more, automation technologies can weaken the position of labour by rendering the work process (quantitatively) less dependent on the work force. Already Pollock raised the concern that automation might erode the effectiveness of labour strikes, as labour becomes a less central

factor (Pollock 1964: 305–306). Lately, the issue of shifting power balances has also increasingly been highlighted (Frase 2016; Schwemmler/Wedde 2018: 42; C. Frey 2019: 201–202).

Automation has also been analysed as being instrumental to the emergence of what has been termed “jobless recoveries”, a particularly insidious way in which managerial innovation strategies can subvert established power balances (Srnicek/Williams 2015: 94). Jobless recoveries denote a constellation in which employment losses during an economic crisis are not fully recovered as economic growth picks back up. The general consensus is that technology is a key contributor to this trend, with companies using the interruption of business as usual, state subsidies and low interest rates for credits to invest into new technologies (Jaimovich/Siu 2012; Srnicek/Williams 2015; Graetz/Michaels 2017; Muro et al. 2020). This should come as little surprise: after all, crises have long been accredited with serving a rejuvenating function within capitalism, leading to the downfall of less productive companies and exerting a pressure on the remaining companies to adopt more effective economic activity (Schumpeter 1942; Marx 1982; Perez 2003). It does introduce a distinct temporal challenge into labour disputes however: while collectively withholding labour to force employers to lay off existing staff is an accepted and established form of labour struggle, striking to prevent the introduction of new technologies which might feasibly increase a company’s competitiveness and thus help secure remaining jobs in the interest of some potential future hires seems tough to communicate and campaign for; it might even be in conflict with the material interests of workers in the present.

This concern should be taken with a grain of salt however: for one, while automation decreases the dependency in terms of the number of human workers required, one could argue that it does actually increase the costs of any interruptions of the labour process (strikes) per worker, too, as every hour of strike means that the costly means of production go unused. Imagine a scenario with a very low organic composition of capital. A company employs a thousand low-skilled workers who by hand craft some commodity with very limited tools. A standstill of production means that mostly the rent for the factory is wasted, but since wages (i.e. variable capital) are the main costs for the company, once the strike starts, the majority of its costs for the company stop as well, making even a lengthy lockout possible. Now imagine a highly productive company in which only 50 workers produce the same number of commodities utilizing the latest means of productions. Millions of euros will be bound up in machines (i.e. constant capital) which cannot continue to produce commodities without workers to feed them new resources, to maintain them and to supervise the production process. Every day of strike means that the

machines do not yield a return – even worse, they depreciate over time as time takes its toll and new, better methods of production are introduced. Save for fictions of full-automation or cases in which companies can easily substitute for striking workers, who in this case will likely be fairly specialised, workers in the later scenario have a greater per capita leverage than in the first.

Secondly, jobless recoveries imply that crises actually lead to a loss of jobs (which are then not filled again as the economy recovers). Many economies (perhaps most famously Germany) by now however have furlough or work retention schemes in place, which enable companies to bring down their labour costs by cutting working hours and outsourcing part of their labour costs to the state, which in turn allows them to quickly ramp-up their business as the crisis ends by simply calling back their pre-crisis staff. These instruments limit the extent of jobless recoveries.

On the other hand, established corporatist practices can be considered to actually enable processes very similar to jobless recoveries, but temporarily even more disconnected: for instance, trade unions in Germany have oftentimes been able to cushion large-scale redundancies by averting indiscriminate redundancies and substituting them with early retirement programmes and recruitment freezes. This can make the restructuring of a company's operations more socially acceptable: rather than any current workers losing their livelihood, the social costs of the transformation of the workforce (whether it is downsizing or a shift of the employment focus from manufacturing to research and development) are spread out over a longer period of time and, so to speak, affect future generations of workers that might face a dearth of medium-skilled jobs (Löw-Beer 1981: 118–119).¹⁴³

Lastly, while jobless recoveries might prove decisive for individual companies, they are unlikely to by themselves entrench technological unemployment in the long run (unless they coincide with low growth and job creation in other parts of the economy). This is to no small degree precisely because of the depressing effects technological change can have on wages, as discussed above. As already introduced, wages are, according to Marx, unique in terms of price formation as they are relatively indeterminate: while the price of commodities are largely defined by the cost of producing them, wages cannot sustainably fall below the costs of reproducing labour, but other than that, the intensity of exploitation is determined through labour struggles and affected by a multitude of factors such as policy making, labour market

¹⁴³ It is a testimony to the keen grasp of Pollock of the societal implication of automation to have identified this issue, at least sketchily, already very early in the debate on automation (Pollock (1964: 219)).

conditions, and so on (Marx 1910). If many workers lose their jobs due to the introduction of new methods of production, the ensuing surplus population plays an important role in depressing the wages: the oversupply in labour exerts a downwards pressure on wages, which in turn increases the relative costs of automation (Suedekum 2018). Accordingly, a (maybe somewhat cynical) commentator might conclude, increased unemployment is not just a threat to workers' socioeconomic existence but at the same time a regulating factor in keeping wages competitive with automation technologies.¹⁴⁴

There are a number of important caveats to this however: this assurance against prolonged technological unemployment comes at the costs of depressed wages particularly for those workers threatened by automation. It therefore does not contradict concerns about increased labour market polarisation but presupposes them; as a matter of fact, it does not even rule out excruciating unemployment since that is a key lever through which wages are balanced. What might seem like an elegant regulation mechanism on paper is put into practice through a multitude of small and big catastrophes in the lives of millions of workers, leading to a situation in which “[t]he worker [...] justifiably regards the development of the productive power of his own labour as hostile to himself” (Marx 1969: 573).

Additionally, although this argument suggests that entrenched technological unemployment is less likely to happen, this does not eliminate the economic risk of an underconsumption crisis which I already introduced above. After all, it matters little to aggregate demand whether it is depressed because average wages are lower or because unemployment is higher.¹⁴⁵ Furthermore, in highlighting this mechanism, one runs at risk of reproducing a dogmatic (unevidenced) claim of a “successful self-regulation of the economy of a free market.” (Pollock 1957: 41) After decades of protracted market failures and in light of the risks even temporary unemployment can pose under current conditions, such consolations do not suffice (cf. Pollock 1964: 348–349).

¹⁴⁴ In his outstanding dissertation *Technopolitik von unten*, Simon Schaupp (2021) describes this mechanism more extensively and provides empirical evidence for its contemporary manifestation, which he analyses under the concept of cybernetic proletarianisation.

¹⁴⁵ Of course any half-way enlightened entrepreneur understands that depressed wage levels are bad for aggregate demand. This is because they consider the vast majority of workers possible consumers of their commodities; at the same time, the imperatives of maximising profits incentivise them to try to keep the wages of their own workers down. The logic of capital accumulation systematically fails to maintain the conditions that it itself relies on: “Of course [every capitalist] would like the workers of *other* capitalists to be the greatest consumers possible of his own commodity. But the relation of *every* capitalist to his own workers is *the relation as such of capital and labour*, the essential relation.” (Marx (1993: 420)).

And finally, one might even question the meaningfulness of such attempts to substantiate that automation might in the end not lead to losses of jobs (although wages might get depressed even further) from a more radical perspective. Marx concludes his discussion of this mechanism as follows: “According to the bourgeoisie the perpetuation of wage-slavery through the application of machinery is a ‘vindication’ of the latter.” (Marx 1969: 573) As the term “wage-slavery” and the use of quotation marks around vindication imply, Critical Theory in the tradition of Marx argues that rather than welcoming the prospect that capitalism will likely find ways to perpetuate the existing regime of wage labour even under conditions of technological change, the development of a broader emancipatory project that transcends the fixation on established social conditions remains vital.¹⁴⁶

If social conditions remain largely the same as in the last decades in the absence of such an emancipatory technopolitical project, both empirical evidence and theoretical insights indicate that automation will contribute to a deeply polarised labour market. The long assumed link between rising productivity and rising wages, which would stabilise the labour share of income that was long simply assumed, needs to be actively enforced – through progressive policies (see chapter 5) and through labour struggles (Bivens/Mishel 2015; Schäfer 2016; Dörre 2019c; Staab/Prediger 2019); there is no quasi-natural connection that can be relied upon otherwise. And while large-scale entrenched technological unemployment seems less likely, there exists very little indication that the displacement of workers currently employed in medium-skilled jobs that are both susceptible to automation and offer high enough wages to make automation economically attractive can be ruled out. Faced with automation threatening their job security and the prospect of either falling victim to a degrading unemployment regime or being displaced into lower-paying jobs, concerns about automation among the working class are understandable. And these concerns, as well as the very real displacements and growing inequality of past decades, contribute to another challenge posed by automation: the danger that parts of the working class might turn towards authoritarian, right-wing politics, as their livelihoods are threatened by the capitalist use of automation.

¹⁴⁶ As I will argue in chapter 5.4, this would entail, among other things, to find ways to stop entrepreneurs from using new technologies and rising productivity as a tool to erode wage levels, thus breaking the vicious cycle I described above (cf. Caffentzis (2008: 71)).

To avoid misunderstandings: in the following, I limit myself to discussing possible connections between automation anxiety, past labour market polarisations that coincided with technological change and the rise of the far right. I leave aside other challenges that automation might present for the established political system that are not rooted directly in economic issues, such as the revived temptation associated with algorithmic governance (discussions of a *machine à gouverner* date back to as early as 1948, cf. Pollock 1957: 248), the role automated profiling might play in targeted political propaganda on social media or the construction of “filter bubbles” (e.g. Pariser 2011; Assibong et al. 2020; Leopoldina et al. 2021) or even changing human-machine-interactions that have by Marcuse in particular been considered as driving people towards social conformity and a loss of oppositional consciousness by reducing them to compliant heelers (Marcuse 1941, 2007: 27ff.).

Instead, I want to draw attention to a growing body of research highlighting how past growth in inequality and labour market polarisation has contributed to the recent rise of the far right. And to the fact that the anticipation of further or at least future job displacements and socioeconomic polarisation might keep on fuelling it. This discussion, too, was anticipated by the early Frankfurt School. Pollock in particular was eager to sensitise that “prolonged mass employment [sic!] is the surest harbinger of totalitarian revolution”¹⁴⁷ (Pollock 1957: 59). And as mentioned in the introduction, Adorno picked up on this research, highlighting automation anxiety as a contributing factor to a resurgence of the far right (Adorno 2019).

Today, this concern is a common place in the more enlightened literature on automation as well as more general diagnosis of increasingly polarised societies (Clark 2017; Grunwald 2019a: 65; Hofmann 2019; Habermas 2020: 8). One can identify two strongly interwoven strands of research in this respect: one which tries to grasp how the socioeconomic impacts of technological change (or at least its implementation under neoliberal conditions) has strengthened political support for the far right. And one which deals with the question how fears of future impacts of automation might likewise bolster the far right.

In their study *We Were the Robots: Automation and Voting Behavior in Western Europe*, Massimo Anelli, Italo Colantone and Piero Stanig (2019) cite the “important distributional consequences” of automation. After reproducing much of the literature on socioeconomic

¹⁴⁷ Of course Pollock is referring to unemployment, not employment (see the German version, Pollock (1964: 190)).

polarisation as a consequence of technological change discussed above, they focus “on the impact of robot adoption in fourteen countries of Western Europe, over the period 1993-2016” has had on the support for parties of the far right, “both at the regional and at the individual level.” (Anelli et al. 2019: 35). They conclude that automation strongly contributed to the resurgence of economic nationalism and the far right. In particular, they demonstrate that higher individual exposure to robots leads to “lower likelihood of having a permanent contract, poorer perceived economic conditions and well-being, lower satisfaction with the government and democracy, and a reduction in perceived political self-efficacy.” (Anelli et al. 2019: 24) This dissatisfaction would in turn then translate into votes for parties that appear to represent discontent with the established system as a whole (Anelli et al. 2019: 6).

Rather than focusing on past introduction of automation technologies, studies focusing on the statistical susceptibility to automation of workers, such as *Political Machinery: Automation Anxiety and the 2016 U.S. Presidential Election* by Carl Benedikt Frey, Thor Berger and Chinchih Chen (2018), return very similar results. They, too, start out by discussing the strong labour market polarisation and falling labour share in incomes of the last decades, linking them to “automation as one of the prime forces driving the shifts in income shares” (C. Frey et al. 2018: 10). Using data on the share of routine jobs throughout the US as a proxy indicator for how susceptible areas might be for automation and compensating for other factors such as ethnicity, “exposure of the workforce to Chinese imports” and others, they conclude that “[a]lthough the estimated magnitude declines when adding these additional controls, a positive and highly statistically significant link between the share of routine jobs and support for Trump persists” (C. Frey et al. 2018: 13). Their paper thus suggests that areas with a higher share of routine jobs (i.e. susceptibility to automation) saw higher support for Trump when compared to areas similarly exposed to international competition and with similar ethnic composition and prior political leanings. They explain this by positing that automation anxiety drove people into resisting “the force of technology through non-market mechanisms, such as political activism” (C. Frey et al. 2018: 4).

Although some methodological reservations are warranted,¹⁴⁸ the studies I was able to review on automation and its connection to rightward politics generally agree that “[i]n whatever way

¹⁴⁸ Not all studies provide the data they worked with and one might at times question the fit of some proxy indicators (e.g. whether robot adoption is actually a sensible proxy indicator of automation more generally). Furthermore, there is a widespread commingling of statements about past automation and future automation. In addition, it can be quite challenging to grasp for non-economists how the author teams would differentiate the effects, e.g., of globalisation and automation, although most papers claim to do so.

we measure exposure to automation, the implications are similar to those of the China shock. That is, a higher exposure to robot adoption pushes voters toward nationalist and radical-right parties and away from mainstream parties on both the left and right sides of the political spectrum.”¹⁴⁹ (Colantone/Stanig 2019: 141)

But there is one problem with this “Luddism by vote” interpretation, which Frey et al. as well as Anelli et al. concede: Trump’s election campaign was not focused on the socioeconomic impacts of automation and neither are the election platforms of European far right parties. Rather, their defining issues seem to centre around an ensemble of nativism and authoritarianism – as a matter of fact, they have been documented to not favour economic redistribution. This is puzzling: the “losers of automation” (or those worried to end up as them) seem to support the radical right “*in spite of its economic conservatism*” (Anelli et al. 2019: 8–9).¹⁵⁰ If automation for instance contributed to the election of Trump, it would be difficult to make a rational case for how a vote for a billionaire promising tax cuts for the rich instead of redistribution could be considered a reasonable way to counteract the distributional effects of automation has had in the last decades and prevent further economic polarisation from taking place. Even Frey et al. have to admit that Trump’s campaign pledge to “bring back jobs” in manufacturing, which they point out “have long been automated away”, would imply limits to automation, would likely have escaped most voters (C. Frey et al. 2018: 12).

So why would voters opt for political parties that ultimately promise not to address one of the core roots of their economic distress and likely even compound it further? Research suggests a multitude of reasons: a protest vote “against the incumbent elites”, the urge “to take back control” in light of the destructions of neoliberal globalisation, and a vote against immigration “which is perceived more as a problem in a situation of economic distress.” (Colantone/Stanig 2019: 141). But this explanation remains somewhat unsatisfactory. While it certainly makes sense that voters who see immigration as an issue would feasibly support parties with an anti-immigration platform, it does not explain why people whose economic situation has been worsened by automation under neoliberalism (or are afraid of this happening) should suddenly

¹⁴⁹ In first-past-the-post electoral systems (e.g. in the US and the UK), this statement focused on the continental European context would need to be adapted somewhat as here such swings translated into the capture of established centrist parties (e.g. the Republicans in the US) by far right forces, promoted by the fact that the establishment of alternative parties is impeded by the lack of proportional representation.

¹⁵⁰ This analysis of Anelli et al. for Europe is corroborated by Julian Jacobs (2021) for the US, who likewise points out the tension between the left-wing economic aspirations of automation susceptible Americans and their right-wing cultural attitudes.

take issue with migration primarily – and not with the way the fruits of productivity increases have been shared over the last decades.

To put the question differently: How is it that it is the far right and not the radical left that is profiting from increased socioeconomic polarisation? Prior research has dealt with this question, too. Prolonged periods of austerity are cited for having made calls for redistribution and social support for “losers” less credible – particularly in light of the “convergence between mainstream left and mainstream right in terms of redistribution and welfare state policies” that lead to a weakened link “between social democratic parties and working class constituencies” (Anelli et al. 2019: 8). In other words: the far right is reaping the benefits of the dilution or negligence of policies that benefit the working class in Europe. This growing disconnect was compounded by the erosion of working class power in the workplace and society at large in the form of trade unions, which were hit hard by neoliberal deregulation and changes in work organisations in the context of technological change and globalisation that disrupted “established patterns of shop-floor organization, making it more difficult for unions to retain their central role” (Anelli et al. 2019: 8; Colantone/Stanig 2019; Rathgeb/Tassinari 2022). As trade unions were instrumental in maintaining the link between workers and left parties, this development weakened the cohesion of left parties further.

The Seeds of an Alternative Technopolitical Response

There are two important caveats to this however: first of all, we should remind ourselves that, as argued above, there is no law of nature that automation has to lead to socioeconomic polarisation – rather, who stands to profit from automation depends on the economic and regulatory conditions under which it is implemented. Since the polarising effects of automation that I have discussed depend on the distributional effects of automation, they are not without alternative (cf. C. Frey 2019: 16–17). Accordingly, talk of “political machinery” or how automation is undermining liberal democracy can provide powerful metaphors, but it would be more precise to, for instance, point out that it is the capitalist use of machinery that is undermining liberal democracy. Furthermore, one should not assume that even if socioeconomic polarisation is to take place, the resurgence of the radical right would be without alternatives: as the success of new challengers from the left in southern Europe (for instance Podemos in Spain or Syriza in Greece), Bernie Sanders in the US and Jeremy Corbyn in the UK has shown, the socioeconomic polarisation of the last decades also affords an opening for

resurgent left challenges to the established status quo. By offensively making the scandalous levels of inequality and decades of redistribution topic of societal debate and putting righting these wrongs front and centre of their agenda, they have been able to inspire millions. As shown in the UK, such developments can also offer a way to revitalise ailing social democratic parties, with Labour membership numbers almost doubling its membership numbers in the first two years of Corbyn's tenure (Wright 2015; Audickas 2018).

Political movements such as these, as well as reinvigorated trade unions, could be key to shifting the debate away from cultural divides and onto a field of debate in which working class organisations can genuinely exert their strengths: economic policy. This is key, too, to clearing away the pervasive ideological effects of decades of austerity and a politics that arranged large-scale redistribution to the top income groups: in short, breaking from austerity economics and mindsets will require the organised political forces of anti-austerity. Enshrining an alternative to the socioeconomic status quo promises to help transcend the political and cultural dogmas of this era – if it is feasible that redistribution might grow the pie of the welfare state and bolster wage levels, thereby implementing a more equitable participation in increased productivity, this alternative might mobilise broad parts of the population. But it will take work to reconstruct any confidence in the feasibility of a more inclusive future after decades of increased competition in the labour market, weak interventionist labour market policy and waning trade union power, demanding greater and greater efforts for people to maintain their socioeconomic status (Nachtwey 2018). This work is necessary, however, to conquer a central feature of technical (and social) change today, which drives large parts of the regressive response to it: the pervasive feeling of powerlessness.

Extensive research has shown for Germany that the feeling of powerlessness in the face of technological change strongly correlates with support for the far right, even among trade unionists (Hilmer et al. 2017; Kohlrausch 2018; Sauer/Detje 2019; Decker/Brähler 2020). In research on authoritarianism (cf. Decker et al. 2020), two psychological mechanisms are used to explain the link between a lack of self-efficacy and a turn towards authoritarianism: Authoritarian submission and authoritarian aggression. Authoritarian submission is defined as the identification with an overpowering authority in light of one's own powerlessness, internalizing their rules and norms; this submission requires the individual to forgo pursuing many of their natural urges, which in turn begets aggressions – but since the authoritarian individual is unable to question the authority it has committed to, it projects these aggressions, oftentimes on marginalised social groups (e.g. the homeless, the unemployed or refugees).

There is an aspect with immediate relevance to the subject of socioeconomic polarisation in the context of automation which I would like to highlight, drawing from Adorno. In a dispute with his conservative antipode Arnold Gehlen, Adorno, after discussing automation anxiety, alludes to “horrific consequences” that might follow when the appearance of happiness that was achieved at immense efforts, collapses (Adorno/Gehlen 1974: 250).

Imagine the case of a worker who accepted the ideological accompaniment of working society, that one’s worth is mostly defined by one’s wage labour and tried to do everything “right” in their life: they got proper training, maybe even in some promising profession (rather than something that might have actually interested them), they always showed up on time and worked hard (and scorned those who did not), always tried to please their boss (even if overtime meant that they could spend less time with their partner and kids, which they would have preferred), and so on. They might have reached some modest affluence, possibly even taking up a long-term mortgage to buy a small house somewhere. And suddenly, it turns out, this all should turn out to have been for naught, as the company’s management opts to invest into new automation technologies. Adorno’s claim that this threat of a devaluation of all prior sacrifices would spawn aggression. And while it might seem more sensible to organise against management to asserts one’s own material interests, this would necessitate a break with the authority that one has followed so far (and to consequently scrutinise one’s whole mode of living and its fundamental societal conditions). Alternatively, the individual might instead stabilise its psyche and understanding of the world by redirecting this aggression to some less threatening and disturbing target.¹⁵¹ Clearly Adorno saw this threat (Adorno 2019), linking it to a psychoanalytic defence mechanism canonised as the “Identification with the Aggressor” by Anna Freud (1936), the daughter of Sigmund Freud, which Adorno links to a psychological constellation in which powerless individuals see no other way than identifying even more actively with the societal conditions they are suffering from, because they see no way to overcoming them (Adorno/Gehlen 1974; Adorno/Bloch 1978).

Fighting the lack of self-efficacy is thus crucial to the fight against the rise of authoritarianism – whether in the form of trade union militancy and revitalised co-determination on the shop-floor and other rights of democratic participation in the economic sphere (Brinkmann/Nachtwey

¹⁵¹ It is a peculiar irony that the demand for a further marginalisation of immigrants that is common for nativist ideologies in the context of managing economic distress can in turn be used by employers to tighten the screws even further, as disenfranchised workers can be forced to accept worse working conditions and thereby undermine for “native” workers – the racist denial of solidarity weakens working class power and thus threatens to haunt even those members of the working class that engage in it (cf. Demirovic (2018: 41))

2013; Decker/Brähler 2020) or through the development of a progressive technopolitical project, aimed at ensuring a more equitable distribution of the fruits of technological development and able to counteract automation anxiety radically by addressing its economic roots¹⁵². This is not to say that such a left-wing challenge would be a certain success – Bernie Sanders lost in the presidential primaries of the Democratic Party twice, Corbynism failed due to internal deficiencies, a hostile media environment and because it was ultimately unable to sidestep the culture wars associated with Brexit – but even those failed attempts show that there is a widespread, popular demand for radical answers to the economic distress felt by many and feared by many more.

This demand might be mobilised by the left (at least as much as the right) and policy programs rooted in working class interests could help bridge cultural divides that in part were exacerbated by recent social polarisation (Anelli et al. 2019: 9f; Dörre 2019b: 18).¹⁵³ This applies particularly in the context of automation as recent studies have shown that workers whose jobs are susceptible to automation and people experiencing economic distress display “preferences for a bigger role for government in reducing inequality” as well as increased “support for redistribution” (Anelli et al. 2019: 7). By opening up a conversation on how past, present and future productivity increases might be shared, the imagination of the public might be captured again by promises of a qualitatively better future, allowing for dammed-up longings to be expressed and addressed (Bischoff 2020). This could also counteract the regressive longing for the return to the Fordist model of post-World War Two prosperity with its blend of cultural conservatism and integration via mass-consumption (Nachtwey 2016), so aptly described in Marcuse’s *One-dimensional man* (Marcuse 2007). Contrary to the liberal fiction of individual autonomy, such a technopolitical project can only be realised collectively, rendering the eventual conquering of automation anxiety not simply an issue of intellectual enlightenment, but rather of enlightened political practice.

As mentioned several times before, the case for the necessity of a radical alternative to the status quo would be less compelling however if we could simply return back to the strong economic

¹⁵² Simply denying the validity of automation anxiety, I would argue, is a rhetorical and political dead end however, as it does not address the material conditions (for instance the very real socioeconomic vulnerability associated with the proletarian condition) that continuously (re-)produce this anxiety (cf. PAQ (1975: 5); Benanav (2019)). At the same time, research has shown that it is not necessary for fears to be objectively justified to have a political impact (Im et al. (2019)).

¹⁵³ It should come as a shock to the apologists of capitalism that in a recent survey, only 12% of respondents in Germany indicated that they agreed to the statement that “the system is working for me” and a majority of respondents (55%) indicated that they more generally thought contemporary capitalism would do more harm than good (Edelman (2020)).

growth of a few decades ago, as this would allow for the rapid reintegration of displaced workers into new and expanding industries and to grow the pie of the welfare state quickly enough to prevent (fear of) economic distress that, as we have just seen, might lead to rising authoritarianism (Pollock 1964: 214). In the final chapter on how automation under current conditions might exacerbate societal tensions, I will quickly discuss why this fixation on economic growth offers at best a short-term solution and will likely lead to even bigger societal devastation in the long run.

Automation in the Capitalocene

One could raise a number of objections against a strategy based on high economic growth: in the German case, strategies such as Industry 4.0 might for instance fail in securing the necessary market shares for export-driven growth; a strategy based on vastly expanding the service sector on the other hand might hit both cultural barriers against the commodification of further spheres of life as well as find that there is simply no sufficient business case for the services provided by dog hairdressers or influencers to base a whole economy on them (Gorz 1989: 127). Even more pressing however are the ecological implications of such a strategy. Let us very briefly recapitulate: if one follows Marx's reconstruction of capitalist political economy, its chief objective is the accumulation of capital. To express it more simply, the logic is to invest money (M) in the production of some commodities or provision of services (C) in order to see the original investment returned with some additional profit (M') – which can then be reinvested again, repeating this process of accumulation (M-C-M') in ever greater proportions (Marx 1982: 247ff.). Economic growth is baked into the very core of capitalist political economy, it is “in fact [...] the general formula for capital” (Marx 1982: 257)

This has important ramifications for the relationship between increased productivity and ecological sustainability under capitalism: Considering that competition exerts pressure on companies to drive down the prices of commodities to win market shares from competitors, thereby passing on parts of productivity increases to customers, ever greater resources are needed to feed capital accumulation, as not only the total amount of capital in circulation increases, but also more resources are needed to realise the same turnover.¹⁵⁴ At the same time,

¹⁵⁴ The falling prices of individual commodities can be explained in terms of the labour theory of value, too (Konicz (2016)). As human labour becomes more and more productive, less and less value “is objectified in each individual commodity, which forces individual capitals to grow in scale, producing a greater mass of commodities in order to increase the mass of value” (Benjamin (2021: 45)). Another way to counter the fall in

unless workers are able to force entrepreneurs to major concessions – such as collective working time reduction – the interests of workers and entrepreneurs converge on the topic of economic growth, as workers’ prospects for securing their jobs or finding new ones depend on economic growth, making their fortunes systematically dependant on economic growth, too (Hoffmann/Paulsen 2020).¹⁵⁵ As Pollock already pointed out in the 1960s: Capitalist economics (and therefore societies) know stability only in the mode of constant expansion (Pollock 1964: 216).

But the most obvious approach to cushion the socioeconomic impacts of automation under current conditions threatens to destabilise the global ecosystem further. This tension can be characterised as a form of *Zangenkrise*, an economic and ecological double crisis in which attempts to stabilise the economic and social sphere lead to a worsening of the ecological crisis. This in turn leads to a backlash onto socioeconomic stability as worsening crop failures, natural disasters and the proliferation of sicknesses related to the deterioration of ecosystems rock human societies (IPCC 2021; UNEP 2021b), lead to economic hardships, increased levels of migration and so on (Dörre 2018, 2019c). While this connection seems fairly evident,¹⁵⁶ its repercussions are fundamental: It implies nothing less than that the central mechanism that helped society cope with automation by stabilizing the labour market and social systems will in the long-term prove devastating, rendering the remedy more deadly than the original ailment, as a destabilised ecosystem threatens to seriously impair the very reproduction of mankind.

prices associated with productivity increases would be to increase the complexity of products to stabilize their prices, but this strategy, too, is often associated with higher resource use, as illustrated for instance by the increased market share of Sport Utility Vehicles, compared to smaller and cheaper cars. The same applies to attempts to reduce the durability of products to increase turnover.

¹⁵⁵ As Richard Smith put it: „Whether as CEOs, investors, workers or governments – *given capitalism*, we all need’ to maximize growth, therefore to consume more resources, and produce ever more pollution in the process – because companies need to satisfy the insatiable demands of investors and because *we all need the jobs*. [...] In short, *so long as we live under capitalism, today, tomorrow, next year and every year thereafter, economic growth will always be the overriding priority until we barrel right off the cliff to collapse.*“ (Smith (2015: 105–106))

¹⁵⁶ As a matter of fact, ecological constraints to expanding automated production endlessly have already been addressed cursorily by J. German (1903). Using the automated production of trains as an example, he argued that the machines to automate production processes would be so costly that there would be a strong incentive for capitalists to ceaselessly produce trains until they would cover all of the earth’s surface and/or deplete the world’s iron ore reserves. Although German seems to have underestimated the falling costs of automation technologies, it is remarkable that the issue of the ecological limits of automated production is introduced in the very first article I could find discussing the term automation (or rather *Automatisierung*), illustrating a remarkable sensitivity for ecological issues within Marxist theory in the very early 20th century. Although the author eventually disregards this concern by pointing towards increases in efficiency (and argues that iron ore might eventually be substituted through other materials), it is unsettling that contemporary debates on automation are largely less aware of ecological concerns than a text penned in 1903.

This dependency on economic growth to stabilise social systems is one of the key material drivers of what has been dubbed a “senseless and suicidal [...] war on nature” (Guterres 2021). It is important to acknowledge this to understand that these auto-destructive tendencies are not simply a transhistorical human characteristic. For the longest time, humanity came nowhere near to transforming the ecosystem on a global scale (cf. Patel/Moore 2017). Only in modernity, after the rise of capitalism led to an explosion in productivity and human capacity, did humankind become a force of such immense power that it might radically reshape the planet. But, as critical theorists have been eager to highlight, humans do not engage in this freely, on their own terms (Marx 1978: 595; Horkheimer 2002; Horkheimer/Adorno 2009). Rather, their practices are deeply embedded and mediated by economic structures, casting some doubt over the accuracy of the term “Anthropocene” (Crutzen 2002) that has become popular to highlight the geochronological gravity of the war waged by humankind against its own basis of existence: As long as the accumulation of capital remains the prime objective of economic activities and as long as the livelihood of workers depends on economic growth, moralistic outrage against the unsustainable conduct of companies and individuals alike might be understandable, but ultimately helpless (Bonneuil/Fressoz 2017).¹⁵⁷ The relentless drive for endless capital accumulation is the materialist foundation of the irrational obsession with “infinite growth in a finite world” that much of ecological discourse is struggling against (Foster 2000; Meadows et al. 2009; Foster 2011; Brand/Wissen 2018), leading a number of authors (Moore 2016; Altwater 2017) to suggest that our current age would be more accurately designated as *Capitalocene* – the age in which capitalist social relations lead to a radical disruption in global ecosystems.¹⁵⁸

The discourse of the Anthropocene also is unjustified and unfair if and insofar it seduces people to abstractly hold mankind as a whole and indiscriminately responsible for climate change and other devastations of the ecosystem. This is not to deny that humans are responsible for climate change – but to posit that they are so in dramatically varying degrees that ought not be forgotten,

¹⁵⁷ In his introduction to the first Volume of *Capital*, Marx formulates the limits of individual morality in the face of overpowering social structures this way: “My standpoint, from which the development of the economic formation of society is viewed as a process of natural history, can less than any other make the individual responsible for relations whose creature he remains, socially speaking, however much he may subjectively raise himself above them.” (Marx (1982: 92)) This already implies that the move towards a more sustainable society requires the radical transformation of existing socioeconomic structures (although normative arguments might play a role in this context, particularly in democratic societies).

¹⁵⁸ Past ecological devastations caused by ostensible non-capitalist countries such as the Soviet Union raise the question whether this designation is comprehensively defensible, of course (unless you subscribe to the notion that the former Soviet Union represented a form of authoritarian, state-run capitalist development (cf. for instance Pollock (1941)). But even then, the insight remains that the analysis of societal structures is key to explain the dynamics driving the ecological crisis.

lest both the understanding of the roots and of possible solutions to the ecological crisis get confused. Even if one were to accept for a moment that it is not some abstract societal structures but concrete individual consumption that is driving climate change, the contributions of individuals are vastly different.

To get an idea of the gap between the world's richest and the world poorest, consider this: according to estimates by Lucas Chancel and Thomas Piketty (2015), the top 1% population in income in places such as the US, Singapore, Luxembourg and Saudi-Arabia emitted between 200 and 318 tons of CO₂ a year in 2013 – an absolute mind-boggling number. On the other hand of the spectrum, the global poor – the bottom 10% in income in countries such as Honduras, Mozambique, Rwanda or Zambia – emitted only fractions of a ton (between 0.09 and 0.16 tons per capita per year). In other words: a member of the rich strata of US-society might easily emit as many emissions annually as 3,500 poor Hondurans (Chancel/Piketty 2015: 29).¹⁵⁹ This evidence of a vast gap between the global rich and the global poor has been corroborated since, with Oxfam, a non-governmental organisation focused on the issue of global poverty, pointing out that “[t]he poorest half of the global population are responsible for only around 10% of global emissions yet live overwhelmingly in the countries most vulnerable to climate change” (Oxfam 2015: 1) and that between 1990 and 2015, the richest 1% of the global population “were responsible for [...] twice as much [of cumulative emissions] as the poorest half of the world’s population” (Oxfam 2020: 2). Global carbon inequality has reached such enormous levels that even if the rest of mankind would reduce their emissions entirely, the global top 10% would deplete the remaining carbon budget “by just a few years later” (Oxfam 2020: 2).¹⁶⁰

This illustrates that the Malthusian obsession with overpopulation that emerges every now and then in public debate and forms a staple of emerging eco-fascism (Konicz 2016; Moore 2020: 15f; Strobl 2021) is factually mistaken, too; even in its most extreme, genocidal form, population control offers no way out of the climate crisis. The issue is not with the number of

¹⁵⁹ This comparison is based on extremes, of course. But even when comparing whole geographic regions (each including their own rich and poor), the inequalities are staggering. Focusing on energy consumption as one form of resource usage, a recent study found that the population of sub-Saharan Africa (excluding outlier South Africa however) of 791 million inhabitants consumes roughly as much energy as New York State with only 19.5 million inhabitants (Sovacool et al. (2016)).

¹⁶⁰ This gap is even widening, with the growth in absolute emissions of the top 1% three times as high as those the poorest 50% (Oxfam (2020: 2)). For a suggestion on how to rein these extreme economic and carbon inequalities, see chapter 5.3.

people, but with the kind of lives they lead (cf. Nye 2006: 108).¹⁶¹ Looking at the sustainability of emission levels – or even, to take up the key worry of historic Malthusianism, food production (Gerten et al. 2020) – the global ecosystem would in all likelihood be able to sustainably accommodate more than ten billion humans, particularly if energy provision can be converted to renewables. Perpetuating the lifestyle of the world’s ultra-rich epitomised through luxury consumption such as private jets and super-yachts and by now even joyrides into space on the other hand seems genuinely unfeasible for the foreseeable future.

And the responsibility of capital owners for climate change is not limited to their individual consumption. Rather, their class interest to protect past investments and not have future business opportunities hampered, systematically encourages the rich whose fortunes are intertwined with fossil fuel use to exert their substantial social and political leverage to impede the struggle against the climate crisis. Past lobbying around issues such as CO₂-prices or emissions limits for the car industry are well documented (UCS 2012; Wagner 2012; Smith 2015: 60ff; InfluenceMap 2021), with fossil fuel, logistics and utility corporations spending the lion’s share of an estimated total of two billion USD that have been spent on “lobbying expenditures related to climate change legislation in the U.S. Congress from 2000 to 2016” alone (Brulle 2018: 289). And the fossil fuel industries have not slowed down ever since, with only a handful of key corporations spending over a billion USD in as little as three years after the adoption of the Paris Agreement – with an estimated yearly budget of nearly 200 million USD for “lobbying designed to control, delay, or block binding climate-motivated policy.” (InfluenceMap 2019: 2). Again, this can be lamented morally, but it is only consistent behaviour in a setting in which environmental regulations and the costs of lobbying on them are merely subordinate appendices to an overarching pursuit for profit. Nonetheless, one should at least take notice of the fact that the understandable interest of the owners of some of the largest and historically most profitable corporations in the world, not to see their property devalued, is in very direct conflict with securing the necessary conditions for a continued, more or less humane reproduction of society.

¹⁶¹ This is not to say that any policies that might reduce population growth are to be rejected out of hand. As suggested by Vollset et al. (2020), meeting the UN Sustainable Development Goals on education and the access to basic healthcare might reduce the global population by an average of 2.5 billion people by the year 2100, thereby avoiding additional stress on ecosystems from growing populations. But while increased education and better access to healthcare (and contraceptives in particular) should certainly be welcomed in their own right, slowing population growth until 2100 will not help to reach net-zero emissions globally within the next 20 or 30 years.

Returning more immediately to the issue of automation, I would argue that it is not technological development and the associated increases in productivity that is to be blamed, either. Of course it is hard to imagine that any species should be able to damage global ecosystems to the extent modern humans are without the use of any sort of technology – but although technology can be considered a necessary condition, it is insufficient to explain the devastations we are facing. As a matter of fact, past innovation attests that even under capitalist conditions, substantial increases in resource efficiency can be realised.¹⁶² Taking CO₂-emissions as a benchmark, innovation in the past three decades has actually lead to a decrease rather than increase in the greenhouse gas intensity,¹⁶³ reducing the CO₂ emitted per dollar of GDP by a third between 1990 and 2018 (World Bank 2021a). Accordingly, it seems as if one might hope that there might indeed be a way to reconcile economic growth and the reduction of CO₂-emissions (i.e. “green growth”).

More specifically, taking productivity growth as an indicator for technological development, the recent past seems to indicate that by now, productivity increases indeed go well hand-in-hand with decreasing carbon intensity, as indicated in Figure 6. On the x-axis, you have the productivity on a scale ranging between 10 USD (2010 PPPS) per hour worked up to over 80 USD per hour. On the y-axis you have the carbon intensity, measured in tons of CO₂eq emitted per 1,000 dollars. In the past quarter of a century, there has been a move towards the bottom right in developed economies, combining increases in productivity with decreases in carbon intensity (a similar point could also be made about other forms of resource productivity (UBA 2020b)).

¹⁶² As a matter of fact, despite the tendency to grow turnover ever larger introduced above, there is also a tendency inherent to capitalist production to increase efficiency insofar reduced resource use can allow for cost saving; this inherent tendency can be spurred on by state regulation, increasing the prices of resources through taxation or by even more interventionist policy such as subsidies for more efficient production methods or bans on particularly harmful industry practices (see chapter 5.4).

¹⁶³ The greenhouse gas intensity of economic activities is measured as kilograms of CO₂ or CO₂-equivalents (if other greenhouse gases are included and converted into CO₂ as a unit of measure) emitted per unit of GDP, adjusted for purchasing power.

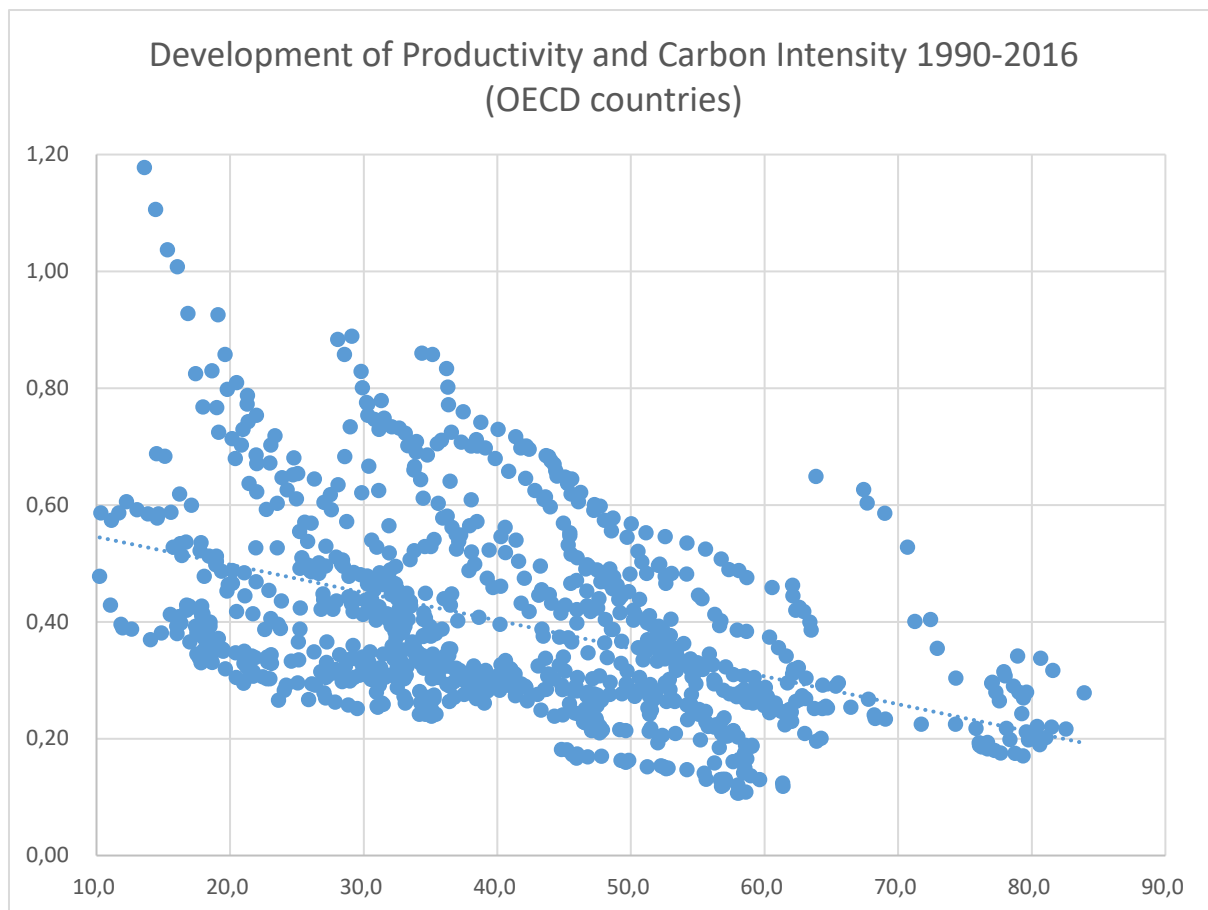


Figure 6: Development of Productivity and Carbon Intensity 1990-2016 (OECD countries)

Of course, this observation also comes with a number of caveats: the mere coincidence of this twin development does not mean that the two are necessarily related. After all, one cannot rule out the possibility that an even greater speed of decarbonisation could have been realised at the cost of slower productivity growth (or even a decline in productivity). And it is also noteworthy that this development took place in developed countries: Past research suggests that countries with a low GDP tend to feature low carbon intensity; carbon intensity then rises “as countries transition from low-to-middle incomes” and then falls again moving up from medium level GDP countries (Ritchie/Roser 2019). This observation has given rise to the so-called *Environmental Kuznets Curve* hypothesis that “postulates an inverted-U-shaped relationship between different pollutants and per capita income, i.e., environmental pressure increases up to a certain level as income goes up; after that, it decreases.” (Dinda 2004: 431) While the accuracy of this hypothesis is still disputed for a number of contexts and pollutants (Stern 2004, 2017), the data on carbon intensity and productivity seems to suggest nonetheless that the technological foundations for a reconciliation of high productivity, ecological sustainability and sustained economic growth exists – as long as, for instance, emission levels at the starting point are sustainable and economic growth does not exceed the rate of efficiency increases.

It is here where such positive success stories of capitalist economics collapses. It is fairly obvious that the level of total emissions of the early 1990s was not sustainable in the long run already and it has grown by over 50% ever since (World Bank 2021c). The reason for this is simple: the GDP (adjusted for purchasing power) has grown to two and a half times its 1990 level (World Bank 2021b). Even significant efficiency increases (in this case a fall of global carbon intensity by a third) help very little if at the same time economic activity more than doubles. Thus, we are witnessing a gigantic, planet-wide rebound effect: the efficiency gains realised through technological development are more than eaten up by economic growth.

As argued above, capitalist economies are fundamentally reliant on economic growth – accordingly it is highly unlikely that they will be able to organise slowing economic growth or even economic degrowth without exacerbating systemic dysfunctionalities. The only way to make pertinent progress towards ecological sustainability would then be to sustainably realise efficiency gains that significantly outpace economic growth – for which there is no empirical indication so far, with research consistently showing that evidence for the decoupling of economic growth and resource use is either inconclusive or, at best, substantiates that it is happening (as I have argued above), but is not taking place nearly as quickly as would be required to save humanity from disaster (Smith 2015: 76ff; Parrique et al. 2019; Haberl et al. 2020; Hickel/Kallis 2020).

Consequently, there are good grounds to consent to the conclusion that limiting climate change to non-catastrophic proportions can only work “if we effect unprecedented transitions in all aspects of society” (IPCC 2019) – and this crucially has to extend to the way our economy works.¹⁶⁴ Relying on some as yet unforeseen technologies that would decouple economic growth from environmental degradation in the short term instead risks to serve “as a distracting fantasy that warrants a (continuously more) destructive path with both the promise of success and demonstration of its impossibility deferred into the future.” (Parrique et al. 2019: 58–59) At the same time, the focus on more ethical consumption characteristic for large parts of sustainability movements in the neoliberal era also failed to deliver sufficient results. Rather than banking everything on individual changes in consumptive behaviour triggered by moral enlightenment, a socioeconomic transformation is needed that should adapt the conditions that frame individual behaviour to the necessities of fighting the climate crisis, so that sustainable

¹⁶⁴ This sentiment seems to be less controversial than one might think. In 2010, for instance, a survey found that in Germany a vast majority of 88% of participants considered the current economic system unable to adequately deliver in terms of social and ecological sustainability (WBGU (2011: 72)).

consumption patterns are systemically enabled – in contrast to an approach which overstrains individual consumers by blaming them for outcomes of an economic system they individually have very little leverage to shape and at best gives them the illusion of self-efficacy (Grunwald 2012a). Humanity would do well to realise that the constraints of nature are binding, whereas the ones of our own economic relations can and should be changed to avoid disaster.

As we shall see, it is this commitment to the conscious design of socioeconomic structures – rather than the blind submission to them – that ultimately constitutes the emancipatory horizon of Marxism in general and Critical Theory in particular. But for the time being, we should pause to appreciate the deadlock that the system-immanent management of automation is presented with: even if one dismisses the more esoteric lines of critique based on the value theory of labour, automation seems likely to, at least in the short to medium term, contribute to further socioeconomic polarisation (in its extreme in the form of technological unemployment, in its more likely form as further income polarisation) which in turn leads to both economic (e.g. through depressed solvent demand) and political destabilisation. Even worse, the magical bullet that has largely pacified social antagonisms in the developed countries – economic growth – seems to eventually lead into an even more fatal crisis: the undermining of the natural fundamentals of societal reproduction. This constitutes a central finding of this dissertation. The third and final section of this chapter will be dedicated to move beyond this bleak prospect by inquiring how the diagnosis of looming disaster might actually, somewhat surprisingly, serve as a conceptual starting point for a project of comprehensive human emancipation.

4.3 Calamity and Progress

Today it is no longer just critical theorists who are haunted by the spectre of looming calamity – one only has to open some random report by the Intergovernmental Panel on Climate Change (IPCC), read the newspapers revealing the terrors of war, appreciate the demonstrations of hundreds of thousands of young people mobilised for climate strikes by the horror of having their future incinerated by fossil capitalism, notice the baleful effects of social polarisations all around us and last but not least observe the authoritarian far right gaining influence in politics around the world to be anxious about the future. And yet, in one of Critical Theory’s dialectical twists, it offers a glimmer of hope, precisely in the face of such gloom.

In one of his late works, Adorno (1998) reflects on the relationship between looming calamity and the notion of progress. The influence of Walter Benjamin, who famously stated in his opaque *Arcades Project* that “[t]he concept of progress must be grounded in the idea of catastrophe” (Benjamin 2002: 473), is strongly evident in the text. More than that, Adorno’s text can be understood as an attempt to reconstruct and flesh out the somewhat puzzling and fragmentary remarks of his late friend. He states that the threat of a regression into barbarism and the question as to whether humanity will be able to prevent calamity could indeed form the starting point of a reappropriation of the notion of progress. This is because any future progress would depend on the survival of the human species – a fact which could no longer be simply postulated (Adorno 1998: 31).¹⁶⁵ Nor could the calamity threatening this survival, according to Adorno, be understood as some exogenous catastrophe disconnected from human actions.

Rather, the catastrophe threatening humanity’s survival is rooted in the contradictions of dominant social relations. This, Adorno notes, implies that historical progress ought to be understood in a holistic sense and would necessitate a qualitative transformation of the totality of society, rather than some isolated advances in specific societal fields. Progress in this sense is either radical or it is no real progress, in the empathic sense, at all. A radical and rational transformation of social conditions in turn would allow individuals to heave a sigh of relief as they realise that society is now set up in such a way that future calamity will be prevented

¹⁶⁵ While today Adorno’s writing seems to lend itself well to a reinterpretation in the light of the deepening ecological crisis – and the discussion of the domination of nature pervading through much of the Frankfurt School’s work (with the *Dialectic of enlightenment* (Horkheimer and Adorno (2009)) as a key example) certainly illustrates a keen sensitivity in this regard – I would argue that Adorno mostly had the threat of a resurgent far right (as illustrated by his discussions of the electoral successes of the Nazi-parties of his time in Adorno (2019)), as well as the threat of mutually assured destruction in mind.

(Adorno 1998: 29-30). Humanity's survival and the need for radical transformation of societal conditions become intertwined in this understanding of progress.

To Adorno it was clear what constituted the crux of modern societies and thereby the key starting point of transforming its totality: capitalist social relations (Adorno 1972a: 209). And he is similarly clear that such a transformation could only be brought about collectively, by the constitution of humanity as a collective subject that consciously shapes its social conditions in a rational way. His intricate argument in the end boils down to a juxtaposition: either humanity constitutes itself as a collective subject or it risks a regression into barbarism (Adorno 1998: 30). This conclusion illustrates Adorno's radical critique of capitalism as well as his continued support for fundamental societal transformation through a project of collective self-emancipation (Freitag 2018: 62). Adorno also fairly explicitly echoes the famous juxtaposition popularised by Rosa Luxemburg of a crossroad between "either transition to socialism or regression into barbarism" (Luxemburg 1919: 6).¹⁶⁶

For Adorno progress therefore is inextricably linked to what Habermas defines as the emancipatory promise of Marxism: after humans succeeded in adapting "the environment to our needs culturally rather than adapting ourselves to external nature", now they should, too, become able to open up "changes of the institutional framework" to "planned purposive-rational action" rather than leaving it to "undirected development" (Habermas 1970: 115). The transformation of social conditions, "to bring under control the structural change of society itself", according to Habermas reconstruction would "complete the self-constitution of mankind" (Habermas 1970: 116).¹⁶⁷ It is this self-constitution, which for Marx marks the end "of the prehistoric stage of human society" (Marx 1904: 13), that according to Adorno is the only way to prevent future disaster. Rather than falling powerless victim to forces unleashed by antagonistic social conditions beyond individual human control, mankind would attain collective agency over its social development and through democratic planning become an

¹⁶⁶ He also shares her gravity, maybe best expressed by Luxemburg's reflection on the choice between socialism and barbarism: "Until now, we have all probably read and repeated these words thoughtlessly, without suspecting their fearsome seriousness." (Luxemburg (1919: 6)) For both, this issue was not a purely theoretical but an eminently pressing political issue, with Luxemburg employing the phrase in her famous *Junius Pamphlet*, written while she was imprisoned for struggling ceaselessly to help end the First World War, whereas Adorno had lost friends and colleagues to the Nazi terror, committing him to a lifelong struggle to prevent another relapse into barbarism (cf. Adorno/Becker (1999)).

¹⁶⁷ Although I am discussing Adorno here, the same could be shown at least for the young Horkheimer. For comparison, Horkheimer characterises Critical Theory by its understanding of "the overall [societal] framework" as being "a function which originates in human action and therefore is a possible object of playful decision and rational determination of goals." (Horkheimer (2002: 207)).

agent that would consciously shape history; a history which only then could truly be called human in a comprehensive sense. Only then, Marx already warned, “will human progress cease to resemble that hideous pagan idol who would not drink the nectar but from the skulls of the slain.” (Marx 1942)

Benjamin’s famous characterisation of progress in his *Theses on the Philosophy of History*¹⁶⁸ echoes this acute awareness for the terrible costs that has accompanied societal “progress” in the past and is inherited by Adorno. I would argue that this specific understanding of key terms of Marx’s critique (of progress for one, but also of revolution as “the emergency brake” of human history rather than its engine (Benjamin 2006: 402)) is implied already in Horkheimer’s critique of the Hegelian project of *Verklärung* – exculpating human misery by explaining through philosophical reflection that it serves a higher purpose (Horkheimer 1988, 2002). Rather than purporting that human suffering might eventually serve societal progress and human emancipation, Critical Theory principally identifies progress with the overcoming of unnecessary misery altogether through a project of collective self-determination.

Autonomy, the ability to set the rules that govern society and individual lives alike, is then at the core of the political and theoretical tradition inspired by Marx’s critique of capitalism. In a reminiscence to Kant (1996), Adorno frames this collective self-empowerment as the end of the immaturity of mankind. This emergence from immaturity in turn requires the construction of a “collective intentionality” and the establishment of processes that allow for it to be formed – in other words, a vast expansion of democratic decision-making structures (Wagner 2016: 138ff.). In connecting the notion of looming calamity with the concept of qualitative progress, Adorno implicitly draws on the original meaning of the term Crisis (κρίσις) which indicates an open – albeit problematic – situation in which a decision needs to be taken (Schubert/Klein 2011: 173). Mankind thus does not face crises – whether economic, social or ecological – in the same sense as a tragic hero does (who is condemned by the gods to ultimately fail) faces their challenges; or rather: it ought not. The degree to which crises are discussed analogously to natural disasters (they happen, they cannot be prevented from happening and one simply has to adapt)¹⁶⁹ illustrates our collective Kantian self-incurred immaturity, i.e. collective lack of

¹⁶⁸ “Where a chain of events appears before us, he [the angel of history] sees one single catastrophe, which keeps piling wreckage upon wreckage and hurls it at his feet. The angel would like to stay, awaken the dead, and make whole what has been smashed. But a storm is blowing from Paradise and has got caught in his wings; it is so strong that the angel can no longer close them. This storm drives him irresistibly into the future [...]. What we call progress is this storm.” (Benjamin (2006: 392))

¹⁶⁹ By now, even the notion that natural disasters „simply happen“ is mostly outdated (cf. IPCC (2021)).

control over the forces that shape our lives. This lack of self-efficacy is particularly unsettling in the context of a continuously intensifying ecological crisis, which renders the question of societal alternatives a matter of life or death for more and more humans.

The understanding of a crisis as a fundamentally open-ended situation is also key in sensitising Critical Theory against the deterministic temptation that the inner contradictions of capitalism would eventually guarantee its demise and substitution with liberated society. Not only has capitalism proven to be remarkably adapt in rejuvenating itself,¹⁷⁰ rendering discussions of his eventual collapse perhaps intellectually uplifting but practically of little importance, but it would also be unclear what kind of system would take its place, with a regression into barbarism continuing to be a constant danger.¹⁷¹ Accordingly, there is little hope in the escalation of capitalist crises acting as a *deus ex machina* for human emancipation (for instance in the form of a renewed immiseration thesis). Looming or actual crises however afford an opportunity to reflect on the rationality of the societal conditions we are exposed to, or in another perspective, it can lead to a crisis of hegemony: triggering a search for alternatives among millions disillusioned with the existing socioeconomic system. Antonio Gramsci famously designated this period of a search for alternatives an Interregnum: the Status Quo has lost legitimacy, but it has not quite emerged yet what might supplant it (Gramsci 1971: 275–276). Although crises thus do not guarantee societal progress, such an Interregnum – and the political turbulences of the last years suggests that the present hegemony has indeed been waning lately – presents alternative socio-political and economic projects with an opening to assert themselves in public debate (Gorz 1985; Solty 2013; Srnicek/Williams 2015). The ultimate result of our age of crises is thus still to be determined and presents radical opportunities as well as existential dangers.

Critical Theory, despite all its ostensible pessimism, remains dedicated to the possibility, however remote it might appear, that humanity might eventually liberate itself without minimizing the societal constraints impending liberation. Or as Horkheimer put it in a conversation with Adorno in 1956: “I do not believe that things will turn out well, but the idea that they might is of decisive importance.” (Adorno/Horkheimer 2020) But how might these general reflections on the concept of progress and crisis be mediated with the issue of technological development and automation? How did the proponents of the early Frankfurt

¹⁷⁰ Even Grossmann, infamous for his theory of capitalist crisis based on the tendential fall in the rate of profit, dedicates more than 100 pages of his magnum opus to discussing the rejuvenating tendencies within capitalism postponing its eventual demise.

¹⁷¹ In the context of automation, Frase (2016), Wark (2021) and Roberts (2015) have explored such postcapitalist but nonetheless anti-emancipatory futures.

School, revered as some of the most ardent critics of “instrumental reason” (Horkheimer, Adorno) and “technological rationality” (Marcuse), relate to the issue of technological development? Is, according to the early Frankfurt School, potential progress dependant on technological development or impended by it – and if so, in what way?

Marx on the Emancipatory Potential of Technology¹⁷²

To answer these questions, it is worthwhile to first consider Marx’s discussion of the implications of technological development, as his thinking has to be understood as formative to the Frankfurt School’s approach to technology (Holz 2013; Ruschig 2016). After having discussed some of Marx’s analysis regarding the economic effects and drivers of technological development within capitalism, we will now focus on the importance Marx attributed to technological development in the context of a wider-ranging project of social emancipation. We have already learned that, under capitalist conditions, labour-saving technologies according to Marx might lead to material and social deprivation of workers – yet, it is important to highlight that it is precisely social relations that according to Marx determine the effects of the employment of labour-saving technologies:

“It is an undoubted fact that machinery is not as such responsible for ‘setting free’ the worker from the means of subsistence. It cheapens and increases production in the branch it seizes on, and at first-leaves unaltered the quantity of the means of subsistence produced in other branches. Hence, after the introduction of machinery, society possesses as much of the necessaries of life as before, if not more”. (Marx 1982: 568)

Marx maintains that the tension between rising societal wealth and a possible degradation of workers’ positions arise primarily due to the “capitalist employment of machinery”, not due to some magical property of the machine itself. In no uncertain terms, he polemicizes against the stupidity of “contending, not against the capitalist application of machinery, but against machinery itself” (Marx 1982: 569). His understanding of the relationship between technological development becomes particularly clear in his discussion of a short passage in Aristotle’s *Politiká*, where he discusses the prospect of instruments, “obeying or anticipating the will of others”, employing mythological examples such as the statues of Daedalus or the tripods of Hephaestus, and concludes: “if, in like manner, the shuttle would weave and the plectrum touch the lyre without a hand to guide them, chief workmen would not want servants, nor masters slaves.” (Aristotle 1999: 7) Aristotle’s technology assessment seems clear enough:

¹⁷² Parts of the following have been adapted in Frey et al. (2021).

the introduction of automation technologies would enable the emancipation from slavery.¹⁷³

Marx's rejection is as resounding as it is appreciative:

“Oh those heathens! They understood nothing of political economy and Christianity [...]. They did not, for example, comprehend that machinery is the surest means of lengthening the working day. They may perhaps have excused the slavery of one person as a means to the full human development of another. But they lacked the specifically Christian qualities which would have enabled them to preach the slavery of the masses in order that a few crude and half-educated parvenus might become ‘eminent spinners’, ‘extensive sausage-makers’ and ‘influential shoe-black dealers’.” (Marx 1982: 532-533.)

Far from condemning technological development in abstract terms, Marx thus highlights the cultural as well as the economic conditions that frame the employment of technology in capitalist society and turn technology into a tool of domination of the working class under the interests of a small class of capital owners. In doing so, he reinforces time and again that it is the way technology is employed, rather than technology itself, that has to be criticised. What is more, he also reflects on the sociotechnical potentials objectified in technology.

Blowing Capitalism's Foundation Sky-High

The *Grundrisse* is not only (in-)famous for Marx's discussion of the inner contradiction of capital that we acquainted ourselves with in chapter 4.2 – it is also the place in which Marx anticipates many of the concepts he later presents in *Capital* (Fuchs 2017: 522), allowing us to grasp the genesis of his understanding of technology. At the same time, it is one of Marx's most visionary texts, not only outlining the eventual demise of capitalism, but also the advent of a sociotechnical utopia to replace it. Marx postulates that with the continued development of “large industry [...], the creation of real wealth comes to depend less on labour time [...] than on the power of the agencies set in motion during labour time” (Marx 1993: 704). Instead of human labour playing the key role in production, the worker develops into a „watchman and regulator to the production process“, employing the “powerful effectiveness” that results from “the general state of science and [...] the progress of technology” (Marx 1993: 704-705). He goes on to herald technology as “natural material transformed into organs of the human will over nature” – or even more interestingly: “human participation in nature” – and postulates a

¹⁷³ It is only fitting that the modern “emancipation” derives from the Latin term *emancipatio*, namely the act of freeing a slave or releasing a son from paternal supervision. From this origin, the term has developed further and today encompasses the liberation from a multitude of oppressive conditions—for example, women's struggle for liberation from patriarchal domination. The common denominator of emancipatory politics is that they are dedicated to dismantling societal power relations, to “overthrow all conditions in which man is a debased, enslaved, neglected, contemptible being” (Marx (1970: 137)).

tendency of “general social knowledge” becoming “a *direct force of production*”, introducing the notion of a “general intellect” in this context (Marx 1993: 706).

Marx continues to expound that the scientific-technological forces unleashed under capitalism appear and are, to capital, nothing more than “means for it to produce on its limited foundation.” According to Marx, they are “in fact, however, [...] the material conditions to blow this foundation sky-high.” (Marx 1993: 706) Marx outlines an economy in which the worker “steps to the side of the production process instead of being its chief actor”, with “understanding of nature and mastery over it” appearing as “the great foundation-stone of production and of wealth.” (Marx 1993: 705) His judgment is clear: “The *theft of alien labour time, on which the present wealth is based*, appears a miserable foundation in face of this new one, created by large-scale industry itself.” (Marx 1993: 705) What is more, as we saw, he argues eventually the law of value might break down (see chapter 4.1). While this formulation indeed suggests a determinist interpretation of capitalist inner’s contradictions delivering the emancipation from capitalism,¹⁷⁴ it is situated within a wider argumentative context in which Marx highlights the need that “the mass of workers must themselves appropriate their own surplus labour” as the contradiction between the development of labour-saving technologies on the one hand and the persistence of the law of value on the other hand develops (Marx 1993: 708).¹⁷⁵

His consideration of actually existing technology is fairly nuanced as well. He even goes so far as to point out that the development of machinery implies the “reshaping of the traditional, inherited means of labour into a form adequate to capital”, and even more radically that machinery would appear to be “the most adequate form of *fixed capital*, and fixed capital [...] appears as *the most adequate form of capital as such*” (Marx 1993: 694). Machinery, or more generally modern (production) technology, as capital reified? Despite this damning conviction, Marx maintains that there nonetheless is an inherent potential to technological development: although capital finds its most adequate form “as use value within the production process” as machinery (or other forms of fixed capital) “this in no way means that [...] its existence as machinery is identical with its existence as capital”. (Marx 1993: 699) Instead, the social dimension of fixed capital might be separated from its immediate use value, much like gold could still have an immediate use value (for instance in the production of electrical connectors)

¹⁷⁴ To be sure, the *Fragment*, has been a key inspiration for many, if not most, of contemporary techno-optimist Marxists, leading to occasional determinist tendencies in their writing, e.g. in Paul Mason’s *PostCapitalism* (2016).

¹⁷⁵ As I argued above, it is also problematic to conclude an automatism of emancipation from a critical analysis of the contradictions that ail capitalist political economy.

even if it was no longer used as currency. He concludes: “While machinery is the most appropriate form of the use value of fixed capital, it does not at all follow that therefore subsumption under the social relation of capital is the most appropriate and ultimate social relation of production for the application of machinery.” (Marx 1993: 699-700) What *appears* to be the most adequate form of capital’s existence might well be appropriated under other social relations – no longer serving as the materialisation of a specific relation of production, but simply as useful tools. This appropriation is to be understood as a conscious human act however (see above). These passages thus seem to highlight the importance, to Marx, of human activity – or *Praxis* – in societal transformation, lending some credibility to authors such as Fuchs who insist on a non-determinist reading of the *Grundrisse* (for an overview over the debate on the General Intellect as well as Fuchs’ own argument, cf. Fuchs 2017: 527ff.).¹⁷⁶

While this overview of Marx’s thinking on the emancipatory potentials of technology can hardly be considered conclusive, it is safe to conclude that he continuously considered technological and scientific development to be the very foundation of a postcapitalist economy and even a (possibly crucial) factor in a transformation towards it. But does this hold equally true for the thinking of the early Frankfurt School?

The Early Frankfurt School and Technology

Faced with the horrors unleashed by modern warfare and industrialised mass murder, the scholars of the Frankfurt School set about to reevaluate the promises long associated with the march of reason – the same historic experiences also led them to question whether the technological development unleashed in the 20th century would actually support, or even drive, working class emancipation (Ruschig 2016: 187). Adorno and Horkheimer thus challenged conceptions that short-circuited social emancipation and technological development. Rather, in their conception of social emancipation they emphasised the importance of the abolition of capitalist social relations, relatively independently of technological development (cf. Ruschig

¹⁷⁶ This is not to deny the existence of more apparent forms of technological determinism in Marx oeuvre – think for instance of the famous remark in *The Poverty of Philosophy* by the young Marx: “Social relations are closely bound up with productive forces. In acquiring new productive forces men change their mode of production; and in changing their mode of production, in changing the way of earning their living, they change all their social relations. The hand-mill gives you society with the feudal lord; the steam-mill, society with the industrial capitalist.” (Marx (1973: 95)) At the same time, it is unclear in what way the mills “give” certain forms of society – it seems to be at least mediated with human practices, allowing for more charitable interpretations. This is reinforced by the fact that Marx highlights the importance of social antagonisms in driving the development of productive forces (Marx (1973: 53)), even in *The Poverty*.

2016: 185–187). Adorno in particular criticised a “metaphysics of the forces of production” that would expect social emancipation to result from unleashed technological development. Instead, Horkheimer and Adorno suggest understanding the march of technological development as a dialectical, contradictory process enabling a qualitatively better society as well as technocratic domination or even collective destruction (Ruschig 2016: 187–189).

Discussions of the implications of technological development particularly reoccur throughout Adorno’s thinking, up to the very end of his career. To gain a more detailed understanding of his conception of the (potential) link between social emancipation and the development of the productive forces, we shall take a look at two of his late contributions: His lectures on *History and Freedom* (1964-1965) and lastly, his much more famous opening address to the 16th German Sociological Congress *Late Capitalism or Industrial Society*. In his lectures, Adorno expounds in great detail the historical development of the Spirit (in the Hegelian sense) in his form of technological rationality. After providing some insight into the genesis of the Spirit and its interconnection with human practices and material conditions, he states that it would be extremely easy to blame technological rationality itself for the perennial misery of human history (Adorno 2006: 90) – but he urges not to reify rationality by separating it from the purposes it serves and its concrete embeddedness in social relations. The dominant forms of rationality, according to Adorno, should not be reflected in the abstract, but should be understood as closely linked to societal conditions.

Despite the fact that rationality in late-capitalism would be closely entangled with the reproduction of social domination, it would thus nonetheless be wrong to blame the existence of social domination on rationality itself (Adorno 2006: 91). And although he notes that this entanglement with social domination does not leave rationality itself unaffected but profoundly reshapes it to serve this purpose, his discussion of the “irrationality of the *ratio*” in late-capitalism nonetheless takes a more optimistic turn. He criticises the fact that the immense achievements of modern society only benefit a very small number of people and that the scientific progress increasingly threatens to lead to the annihilation of humankind – and he emphasises that he is not keen to defend this form of rationality against this criticism. However, in unusually colloquial language¹⁷⁷, he continues that it is not abstract science or rationality that is to blame but precisely the intertwining of science with “very real” social conditions that would lead to the orientation of science towards ends that are irrational because social

¹⁷⁷ He employs the phrase *man soll hier doch wirklich die Kirche im Dorf lassen* (“one ought really leave the church in the village”), which suggests not to go too far in one’s argument.

conditions themselves are irrational (Adorno 2006: 92). In doing so, he echoes earlier positions of Marx. This understanding of technological rationality is also consistent with his understanding of progress: isolated technological development can hardly be called progress as long as it serves oppressive social conditions.

In concluding his lecture, he investigates what possible source of courage there might be, in order to not succumb to the violent “Machinery of History”. He finds it in the category of „objective possibility“, arguing that despite all apparent powerlessness, a legitimate basis for critique would remain: the insistence on the concretely and tangibly possible. This realm of possibility is born out of the Hegelian Spirit – and in the first instance by nothing else but the development of the productive forces, which increase the possibilities for a humane life and its reproduction on a global scale (Adorno 2006: 98-99).¹⁷⁸ It appears clear then that despite the rejection of optimistic technological determinism and naïve believe in (sociotechnical) progress, Adorno rejected to denounce science, technology and rationality in toto. Rather, he focused on the entanglement of irrational social conditions and the mutilation of science and technology in their own image. Furthermore, he emphasises the category of objective possibility as the fall-back position for the formulation of critique in the face of rampant rationalised irrationality: the task of critical thinking would not be the abstract and moral rejection of all technological development altogether, but rather the confrontation of the present misery with the objective possibilities hampered by current social conditions.

Adorno maintained this general thrust in his opening address to the 16th German Sociological Congress in 1968, one of his last major appearances. No one could deny, he stated, that a life free of hardship would be a concrete possibility – even in the poorest of countries – and that the main obstacles to their realisation are of a political nature (Adorno 1972b: 361-362). Critical theorists ought not to blame technology itself (which he equates with the forces of production) and become theoretical luddites. Technology itself is not the issue, but, again, rather it is its particular entanglement with social conditions that directs technological development towards profit and domination. He does not deny the extent to which this affects further development – rather, he posits that in an era of mutually assured destruction, the potentials of technology that would lead away from centralism, social domination and violence against nature, that would even allow to mend many of the wounds struck by technology in the past, would wither (Adorno 1972b: 362-363).

¹⁷⁸ I would suggest to understand this „chance“ in the sense of an increasing realm of possibility, not in the sense of an increased probability.

Aside from an open criticism of Marx's technological optimism and "affirmative construction of history" in his lecture, we can detect a slight shift in his argument. He postulates a "preponderance" of the relations of production over the forces of production – which could simply be considered a reformulation of the determining role of social relations in the design and application of technology. However, despite insisting on a tension between the development of the forces of production and the relations of production, he goes on to argue that they ought not be contrasted as polar. Rather, they should be understood as interconnected – each would "contain" each other: the forces of production would be mediated by the relations of production (Adorno 1972b: 363–365).¹⁷⁹ Cutting through the Hegelian and Marxian terminology for a moment, this would suggest that in contrast to the sharp differentiation between social relations on the one hand ("relations of production") and technology on the other ("productive forces")¹⁸⁰, which would leave actually existing technology untainted and open to be appropriated to serve other needs and ends under alternative social conditions, the intimate relationship between the technological means and the social ends pursued might leave technology mutilated and, to some extent, inaccessible to appropriation.

It is this attention to the entanglement of social domination and technological development which is formative to Marcuse's perspective on technology. Marcuse, arguably the most utopian thinker of the early Frankfurt School, appears to largely subscribe to the centrality of the distinction between forces of production (and their development) and relations of productions. In his *One-dimensional Man*, he states that one could argue that "the machinery of the technological universe is 'as such' indifferent towards political ends – it can revolutionize or retard a society." (Marcuse 2007: 157). And in other essays he explicitly highlights the "utopian possibilities" of modern technology that, rationally employed, might lead to the end of scarcity and poverty on a global scale (Marcuse 1969: 4), polemicizing against a "philosophy of the simple life [...] [that] frequently serves to teach men distrust of the potential instruments that could liberate them" (Marcuse 1941: 437). He maintains, however, that social relations, rather than technology would be "the basic historical factor" in Marxian theory (Marcuse 2007: 158),

¹⁷⁹ In a 1965 dispute with his conservative antipode Arnold Gehlen Adorno persistently insisted on the differentiation between the forces of production and the relations of production, dismissing the term *Industriegesellschaft* (industrial society) due to its tendency to obfuscate this difference. In his 1968 lectures, he does not drop this differentiation altogether either – he merely seems to shift the focus of his argument to highlight a problematic tendency of technological development in late-capitalism. (cf. Adorno and Gehlen (1974)).

¹⁸⁰ Treating technology and the productive forces as equivalent, as done by Adorno, either presupposes a wide understanding of technology (including cultural techniques etc.) or is somewhat simplifying, as the development of the forces of production in Marxian terminology includes, for instance, improvements in the qualification and cooperation of workers.

issuing “a warning against all technological fetishism” popular among some of his contemporaries (Marcuse 2007: 239). Rather than hoping for liberation from “technological omnipotence”, “the new state” or “the central plan”, Marcuse points out that the task ahead would be to free technological rationality from its “exploitative features” and enable individuals freed from social domination to collectively give political direction to its application (Marcuse 2007: 240).

Towards a Critical Theory of Technology?

In his essay *Technology and Science as ‘Ideology’*, dedicated to Marcuse on the occasion of his 70th birthday, Habermas reflects upon Marcuse’s thinking on technology to highlight a more general tension within the discussions on technology of the early Frankfurt School.¹⁸¹ According to him, the vivid discussion of the entanglement of social domination and technological development on the one hand, and the restoration of the “political innocence” of technology as the material basis of the liberated society on the other, remains unsatisfying (cf. Habermas 1970: 89). Marcuse, in Habermas’ view, seems to shy away from his occasional calls for a transformation of science and technology and its radical implications for scientific methodology and the very understanding of rationality (Habermas 1970: 85–86), limiting himself to the demand to revolutionise the institutional framework that directs scientific and technological development, leading to a normative reorientation of said development but leaving the concept of rationality untouched (Habermas 1970: 89).

Andrew Feenberg, a student of Marcuse, returned to this tension in his *Critical theory of technology*, arguing that the issue had been dropped by Habermas (Feenberg 2002: 14). Reconstructing Marcuse’s demand for a political reorientation of (natural) science, he points to obvious warning signs. Drawing from Carmen Claudin-Urondo’s work on the cultural revolution in early Soviet Union, he introduces the historic example of the Proletcult, an organisation that in the early Soviet Union questioned the universality of modern science and argued “for the substitution of a new proletarian culture for the reactionary inheritance of bourgeois technology, science, and even language” (Feenberg 2002: 172). In a departure from orthodox Marxism, which contended that modern science was born from “early bourgeois society, while insisting that this historical background in no way diminished the universality of

¹⁸¹ Habermas does not explicitly state that his criticism largely also extends to the thinking of Adorno and Horkheimer, but from what we have seen so far, I would suggest that it does.

modern scientific achievements”, members of Proletcult turned to rejecting this distinction and highlighted the convergence of “genesis and validity” (Feenberg 2002: 172).

Feenberg emphasises that the catastrophic failure of early attempts by Proletcult and even more of the politics implemented in the Soviet Union associated with the name Trofim Lyssenko¹⁸² discredited any “project of politicizing science” (Feenberg 2002: 172). Rather than attempting to anticipate some desirable “future state of science” and implementing it politically, he suggests to affirm the relative autonomy of science, leaving the ontological and epistemological reorientation of the natural sciences to their own “self-reconstructive powers” (Feenberg 2002: 172-173). Feenberg thus refutes the call for an active politicisation of science, but invests his hopes in the positive effect a transformation of social conditions might have indirectly on the further development of science:

“Not political power but scientists' own evolving categories and perceptions in a radically new social environment would inspire new types of questions and new theories generated spontaneously in the course of research by scientists themselves.” (Feenberg 2002: 172)

In doing so, he echoes the centrality attributed to social conditions by the early representatives of the Frankfurt School and, as he is keen to point out, by in particular Marcuse who was confident that “the change in the direction of progress [...] would also affect the very structure of science.” Confronted with radically different contexts and social conditions, science would not become irrational, but would develop “essentially different concepts of nature and establish essentially different facts” (Marcuse 2007: 170). The transformation of science thus need not happen through outside interventions into science itself (e.g. by politicians), but rather by changing the social conditions under which science operates, allowing it to adapt under its own accords.

Although Feenberg refrains from a call to politicise science, he substantially refines and concretises the early Frankfurt School’s musings on the relation between social relations, e.g. forms of social domination, and technological development. He reconstructs three different forms of critique developed by Marx in regards to technology: The first focusing on “the ends technology serves under capitalism, while approving the means” (affirming the development of the productive forces, sharply distinguishing them from the relations of production), the second one criticising the way technology is being employed under capitalism with its disregards for

¹⁸² Lyssenko was an admirer and protégé of Stalin whose misguided views on biology and agronomy were forced through with the support of severe state repressions, including the sentencing of dissent researchers to death, according to some accounts setting the Soviet Union’s research in these fields back by decades and leading to the worsening of food shortages. (cf. Graham (1993)).

the well-being of workers and the planet alike. While those two forms of critique would be compatible, the third would no longer “describe technology as innocent but asserts, on the contrary, that industrial tools are a constant source of dangers that can be avoided only through scientific study and humane and rational planning unbiased by the drive for power and profit” (Feenberg 2002: 46).

Feenberg suggests that this third form of critique can be found in Marx’s work and, more explicitly, in the writings of the early Frankfurt School. It would highlight that “[c]apitalists interests control the very design of technology [...], not just the choice of goals or the method of application.” He considers this attention to the way technology “is shaped in its design and development by the social purposes of capital” as the original foundation of a Critical Theory of Technology, denoting its approach as “design critique” (Feenberg 2002: 47-48). Instead of discussing technological development only in abstract terms, this strand of Marxist critique of technology would enable a discussion of the “concrete form in which these advances are realized” and that are “through and through determined by the social power under which they are made”. This approach would understand technology as “a dependent variable in the social system, shaped to a purpose by the dominant class” (Feenberg 2002: 48).

In contrast to reifying accounts of technology, a Critical Theory of Technology would not confuse the bias of concrete technologies with a bias of technology in general: “By contrast, the design critique relates the values embodied in technology to a social hegemony.”¹⁸³ Feenberg moves on to discuss how to apply this approach to concrete technologies. He describes modern technologies as “ensembles of technical elements” (“specific principles, such as the spring, the lever, or the electric circuit”), designed to “meet social criteria of purpose”. While he considers the individual technical elements as relatively neutral when it comes to issues of social domination, he highlights the importance of social criteria “in the very selection and arrangement of the elements from which they are built up” (Feenberg 2002: 77-78). Due to the penetration of biases at the level of the design process, concrete technologies should not be understood as mere “neutral tools” open to be applied to any social ends. Of course, individual technologies would still need to meet certain minimum criteria of technological coherence, but

¹⁸³ Feenberg correctly highlights that “effective hegemony is one that need not be imposed in a continuing struggle between self-conscious agents but that it is reproduced unreflexively by the standard beliefs and practices of the society it dominates” (Feenberg (2002: 75)). This seems particularly important to me in the context of largely technocratic and depoliticised debates on technological development: As long as a hegemony remains stabilised that prioritizes the demands of capital accumulation and appropriate standards of technology design have been established, the design of technology can appear as a neutral act to the average engineer, despite the fact that social values and interests are implemented through this “neutral” design process.

it would not be a maximum technological coherence that leads to the prioritisation of one technological ensemble over the other, but its fit to dominant social interests (Feenberg 2002: 79).

Critical Theory's insights allow us to move beyond understanding concrete technologies merely in terms "of the abstract technical elements they unite". Rather, by understanding concrete technology as "value-laden" it would allow for a "historically concrete understanding of technology" (Feenberg 2002: 82). This does not, however, imply that to Feenberg the appropriation of the potentials afforded by technological development is impossible, as illustrated by Feenberg's insistence on the relative neutrality of technical elements. To the contrary, Feenberg's contribution allows for a more sophisticated discussion of concrete technologies and the biases materialised in them – and thus of possible strategies of appropriation. It is precisely the link between technological development and social hegemony that allows for the possibility of an alternative design of technology: "what depends on a social force can be changed by another social force. *Technology is not destiny*" (Feenberg 2002: 64, emphasis by me). Instead of attributing an autonomous bias to technology, technological development can and should thus be understood as "a scene of struggle" (Feenberg 2002: 15).

Feenberg's contribution to the Marxist debate on technology largely underlines the determining role played by social conditions in the application and development of science and technology according to Marx and the early Frankfurt School.¹⁸⁴ While we were able to observe some shifts over time, the assertion that the development of the forces of production offers a basis for critique in the objective possibilities it affords for a better society remains remarkably stable – despite all criticism of a (techno-)deterministic interpretation of this concept and the development of a more nuanced understanding of the extent and depth to which technologies are shaped by social conditions, rejecting a simplistic understanding of the appropriation of concrete technologies. The continued reference to the development of the productive forces as providing the material basis of liberated society supports the conclusion that despite the lack of a detailed and cohesive theory of technology, technology nonetheless is a central concept of Critical Theory (Ruschig 2016: 183). By insisting on contrasting actually existing technology and its employment with the wider possibilities offered by the development of the productive

¹⁸⁴ Many aspects of the positions reconstructed in the above can also be found with other, less prominent proponents of the early Frankfurt School: In his essay *The Draught-Animal and Slavery* Leo Löwenthal for instance links the lack of human solidarity in ancient civilisations and their prevalence of slavery to the lack of technological development. Yet, he concludes that it would be wrong to deduce the liberation of the toiling masses through technological development by itself. Technological development should be considered an ancillary science, rather than the key to social theory and development (Löwenthal (1933: 211)).

forces, Critical Theory opens up a perspective that transcends the dichotomy of naïve belief in technological progress on the one hand and a conservative criticism that reifies technological development on the other. Or as Adorno summarises in his dispute with Gehlen: Adorno –and I would suggest the early Frankfurt School in general – is “old-fashioned enough” to be convinced that rather than criticising technology as such, it would be prudent to level criticism against the society that leads to a certain form of its application. Technology in general, according to Adorno, would be neither good nor bad. Or rather, he states, technology more likely than not would be good and the undesirable features assigned to it would “in truth” be down to the one-sided application of technology in today’s society (Adorno/Gehlen 1974: 237-238).

This seems to hold particularly true of our subject at hand: automation. As I have argued in chapter 2, automation technologies come in a great variety of combinations of technical elements, with the substitution of human labour being their common denominator. Insofar as technologies are considered as automation technologies, their impacts mostly emerge from the interaction between technology and the labour market. Here, the insistence of Adorno and others to not confuse the social implications of technology under given social conditions with their overall potential seems particularly pertinent: While the substitution of human labour by technological means might occur under many alternative social conditions, it is the proletarian condition (see chapter 4.2) that renders this development a social risk rather than a welcome addition to the tools at one’s disposal. In dealing with automation technologies on this level of abstraction, it thus seems adequate to critique the ends (increased relative-surplus-value extraction), not the means.

This does not answer the question yet what other ends might automation serve. We have already learned that Marx imagined an economy no longer based on the “*theft of alien labour time*” (Marx 1993: 705), while Adorno and Marcuse stressed the possibility that modern technology might be used to pave the way for a life free of hardship on a global scale. But how might this – according to the Critical Theory – rational end of technology be qualified further?

In the third volume of *Capital*, Marx outlines an emancipatory technopolitical project by distinguishing two realms of human activity (cf. Frey/Schneider 2019a): the so-called realm of freedom which “really begins only where labour determined by necessity and external expediency ends” and the realm of necessity which is determined by said necessity and mundane considerations. To him, emancipation in the context of work “can consist only in this, that socialized man, the associated producers, govern the human metabolism with nature in a

rational way, bringing it under their collective control instead of being dominated by it as a blind power; accomplishing it with the least expenditure of energy and in conditions most worthy and appropriate for their human nature.“ (Marx 1991: 958-959) There is a clear connection to automation be made, insofar as automation technologies allow to do just this: reduce the amount of human labour needed to ensure the satisfaction of human needs.¹⁸⁵ Marx continues: “The true realm of freedom, the development of human powers as an end in itself, begins beyond it, though it can only flourish with this realm of necessity as its basis. The reduction of the working day is the basic prerequisite.” (Marx 1991: 959)

The expansion of the time that humans can dedicate to their free development by minimising socially necessary labour is thus to be the emancipatory objective of technology in the field of work. He even goes so far as to affirm that the true wealth of a nation would consist in the “*disposable time* outside that needed in direct production, for *every individual* and the whole society” (Marx 1993: 706). In other passages, he continues to praise “capital [because it] – quite unintentionally – reduces human labour, expenditure of energy, to a minimum. This will redound to the benefit of emancipated labour, and is the condition of its emancipation.” (Marx 1993: 701) To him, the founding principle of the rational planning of a future, postcapitalist economy might be broken down to an “[e]conomy of time” which “remains the first economic law on the basis of communal production” (Marx 1993: 173). Just as the struggle over the length (and intensity) of the working day is pivotal to the organisation of the work process in capitalism (see above), so is the application of labour time key to Marx’s concept of a postcapitalist economy tasked with delivering as much disposable time as possible, provided that the satisfaction of collective and individual needs is ensured. It is here where Marx’s quality as a philosopher of human freedom becomes clear: all economic activity is to be dedicated to liberating them from socially necessary labour as much as possible while providing the material basis for “the universal development of individuals” (Marx 1993: 158).

The early Frankfurt School largely continues this line of thought. If anything, its proponents escalate it – with Horkheimer criticising the ideological reverence of work in modern society¹⁸⁶ and linking freedom and overcoming the necessity to work (Adorno/Horkheimer 2020). Equally Adorno valued disposable time even more highly than Marx who still partly justified

¹⁸⁵ While expenditure of energy might also be understood in an ecological sense, the German original „ihn [den Stoffwechsel mit der Natur] mit dem geringsten Kraftaufwand [...] vollziehen“ indicates that Marx (2008a: 828) refers to the expenditure of human energy, i.e. labour.

¹⁸⁶ By now many excellent introductions to the historic rise and enforcement of the ideology surrounding work exist, cf. Weeks (2011); Frayne (2015); Srnicek and Williams (2015); Stronge and Lewis (2021).

the expansion of disposable time instrumentally by highlighting its potential to accelerate the development of better means of production (Marx 1993: 707). In his remarkable aphorism *Sur l'eau* (Adorno 2021: 177–179)¹⁸⁷ reluctantly engages with the question “of the goal of an emancipated society”. Rather than joining into a praise of the “richness of life” or the “fulfilment of human possibilities”, he criticises these aspirations, “the idea of unfettered doing, of uninterrupted creating, of chubby-cheeked insatiability, of freedom as intense activity”, for echoing “the model of production as its own purpose”. He continues to warn against imagining emancipated society as “collectivity as the blind rage of making.” In contrast, Adorno argues that the goal of emancipated society would be to meet the basic needs of its members.

“What would begin to dawn on a humanity, which no longer knew hardship, is just how delusory and futile all the arrangements hitherto created to escape hardship have been – arrangements which used wealth to reproduce hardship on an expanded scale. [...] Rien faire comme une bête,¹⁸⁸ lying on the water and looking peacefully into the heavens, ‘being, nothing else, without any further determination and fulfilment’ might step in place of process, doing, fulfilling, and so truly deliver the promise of dialectical logic, of culminating in its origin.”

Rather than identifying the realm of freedom with the development of an ever more ambitious humanity, Adorno thus stresses the historicity of these aspirations and sets, as an economic minimum criterion of emancipated society, that it ought to ensure to end hardship, suggesting that individuals might beyond this prefer leisure to a “blind rage of making”. Adorno’s utopia of liberated society might be called antiproduktivist and, in today’s lingo, “postwork” (Weeks 2011; Frayne 2015; Srnicek/Williams 2015), eschewing in contrast to Marx to substitute one form of work – waged labour – through other forms of ostensibly voluntary work.

It is also almost frugal with its focus on the satisfaction of basic needs (although Adorno also sympathetically mentions the possibility of “the slackening of humanity in a life of luxury”) and its postulated abandonment of development as a purpose in itself.¹⁸⁹ Therewith, Adorno – and later theorists such as André Gorz (1985) who presented a similar concept of a postcapitalist future – offers a perspective that reconciles high productivity and frugality by focusing on working time reduction. Against the backdrop of the ecological crisis, I would argue that this

¹⁸⁷ The translation is slightly adapted from the no longer available online translation by Dennis Redmond.

¹⁸⁸ French for “Doing nothing, like an animal”. Interestingly, this phrase anticipates Horkheimer’s characterisation of freedom as not having to work – a condition which he, too, links to the way animals exist, see Adorno and Horkheimer (2020).

¹⁸⁹ Adorno’s critique of an ideology of self-serving development seems even more relevant in light of some of the more absurd grand technological schemes of our age. Imagine for instance that a bunch of ever-adolescent men are spending phenomenal amounts of money and burn vast amounts of fuel to satisfy the personal fantasies of space exploration of themselves and their rich cronies all the while more and more of our planet’s ecosystems reach critical tipping points. Adorno’s proposition seems much more rational: “Perhaps the true society would become bored with development, and would out of freedom leave possibilities unused, instead of storming alien stars under a confused compulsion.”

perspective is essential as it allows us to develop an emancipatory project for automation without ignoring the sustainability demands of our age.

The Frankfurt School's reservations towards the ideological appreciation of work and their awareness of the social conditionality of the impacts of technological development also set them on a path as critics of some of the more culturally conservative concerns raised in the context of automation. Rather than for instance succumbing to the concern that automation might leave people without purpose, Pollock argued that educational systems should be reformed to empower individuals to develop their own interests and to organise their free time according to their interests and dispositions (Pollock 1964: 337).¹⁹⁰ In a similar vein, Adorno and Pollock refused to translate their discussion of the socioeconomic effects of automation and automation anxiety in particular into a generalised critique of automation. Rather than lamenting that robots would steal anybody's jobs, Adorno for instance problematised social conditions which would reduce the individual to its increasingly dispensable capacity to provide labour, as we have seen in his discussion of automation anxiety (Adorno/Gehlen 1974). The critical issue is not the capacity of robots to substitute human labour – the issue is a society in which this fact understandably leads to anxiety. The real disgrace, according to Adorno, consists in the fact that a society should treat humans as instruments to provide labour (i.e. robots)¹⁹¹ instead of autonomous subjects, not in the fact that human labour might be needed less and less to satisfy our collective needs (Adorno/Gehlen 1974: 248-249).

But it is Marcuse who is the most fervent advocate of automation within the early Frankfurt School, arguing that “Automation, once it became the process of material production, would revolutionize the whole society. [...] Complete automation in the realm of necessity would open the dimension of free time as the one in which man's private and societal existence would constitute itself. This would be the historical transcendence toward a new civilization.”

¹⁹⁰ For an excellent refutation of the “leisure issue”, see Frayne (2015: 111-112) who builds on Bertrand Russell. I agree with Frayne, too, that of course work even in today's society can be enjoyable and serve an important social function – however, that is not to say that better ways of organising the work necessary for our social reproduction beyond wage labour (or its gradual reduction) might not be welcomed. It is telling, by the way, that the cultural and emotional misery of people living on capital income, rather than wage labour, is hardly ever broached as an issue. It seems as long as one is provided with sufficient material resources and a social and intellectual infrastructure to enjoy themselves, a life beyond coerced wage labour might be enjoyable after all. Or as Kathi Weeks cunningly points out, drawing from a discussion with a trade unionist: “If hard work were really such a great thing, the rich would have kept it all to themselves.” (cf. Weeks (2011: 79)).

¹⁹¹ This characterisation of the degradation of workers under capitalism echoes Marx earlier critique: “Time is the room of human development. A man who has no free time to dispose of, whose whole lifetime, apart from the mere physical interruptions by sleep, meals, and so forth, is absorbed by his labor for the capitalist, is less than a beast of burden. He is a mere machine for producing Foreign Wealth, broken in body and brutalized in mind” (Marx (1910: 109)).

(Marcuse 2007: 40). The emancipatory potentials of automation to Marcuse appear no less than epochal. It would allow free time to become a “full-time occupation” and help “overthrow the repressive work morale”, leading to a “clash with the basic institutions of the established industrial society” (Marcuse 2013: 43). He remains sceptical however of technological determinism, pointing out that “the highest productivity of labor” coincides with “the perpetuation of labor” (Marcuse 2013: 57). Yet, there can be no doubt that Marcuse closely linked the rise of automation to the potential *Aufhebung* (sublation) of capitalist society, calling it a “spectre of its own potentialities” (Marcuse 2013: 43), i.e. an as of yet unredeemed emancipatory potential haunting capitalist society and pointing to a realm of freedom beyond it. Accordingly, automation can justifiably be called a key concept of Marcuse’s late work (Lenhard 2016).¹⁹²

Perhaps the most sceptical of the major proponents of the early Frankfurt School that engaged with the issue of automation was Pollock, who had a different disciplinary socialisation (economics rather than philosophy) and research focus – dealing with the more immediate impacts of automation within capitalist society rather than their emancipatory potentials (cf. Lenhard 2016). But it is his scepticism that provides a particularly valuable guide as to how the potentials of automation might be usefully discussed today.

Automation’s Potentials and Social Conditions

Although Pollock polemicizes against “facile optimists” praising automation’s blessings without recognizing the need for radical economic changes to ensure that it indeed might deliver the blessings they claim (Pollock 1957: 252), he does not categorically negate its potentials: “If only automation is deliberately used to promote the welfare of the human race it could help to banish poverty relatively quickly from the face of the earth. And this could be done on a scale that has hitherto been regarded as a mere Utopian dream.” (Pollock 1957: 248-249)

Pollock thus is not insensitive to the radical emancipatory, even utopian, potentials of automation. But he is more stringent in highlighting the potential negative impacts of automation under capitalist conditions – and he calls attention to a dialectical mediation of the fruitless juxtaposition of naïve techno-optimism and backward techno-scepticism: developing

¹⁹² Although his interest in technological development and its capacity to allow for an expansion of free time is documented early already, see for instance Marcuse (1941).

a progressive political programme that would transform socioeconomic conditions, thereby transforming the social impacts that automation has. To take the challenges of automation seriously, Pollock argues, compels us to consider an economy beyond capitalism. This would mean that humanity has to transcend the crude irrationality of capitalist economy by changing the economic framework of society through what Habermas called “planned, purposive-rational action” (Habermas 1970: 115). Or going back to Adorno: facing the challenges of automation urges us towards social transformation, i.e. towards progress (Adorno 1998). Responding to the challenges of automation in such a way would indeed turn this technological development into the “pacemaker of a rational societal order” (Pollock 1964: 354).

These general considerations imply a programme for researchers in technology assessment (TA), insofar as they are willing to follow the argument developed by the Frankfurt School on automation (cf. Frey 2018): Not only are they tasked to discuss the (likely) impacts automation will have under current social conditions – or abstractly what emancipatory potentials it might hold if things were better. They are also provoked to critically engage with issues of the political economy of contemporary society. If it is true that the impacts of automation largely hinge on the social conditions under which automation takes place, TA consequently has to shift its focus to (at least indirectly) providing an assessment of these societal conditions, rather than providing an assessment that presupposes these conditions and thereby naturalises them. This approach promises to be far more enlightening than most of contemporary research on automation, which largely fails to recognise the social character of automation’s place in society.

Moreover, by insisting on the tension between the impacts of automation under actually existing social conditions and its unredeemed potentials, Critical Theory adds an emancipatory twist: instead of merely assessing what kind of impacts of technological development is likely to have, we are challenged to answer the question of what kind of impact of technological development we can and should hope for and what kind of social conditions this impact would require – and to strive in that direction. The high degree of interdependence of technology’s impact and social conditions thus raises questions about the nature of TA itself: should it confine itself to the role of a powerless observer of looming threats, or should it join Critical Theory in its aspiration to contribute to a more rational society and the eventual overcoming of the prehistoric stage of human society?

In line with TA's role as a scientific advisory practice to policy-makers, this would imply seeking policy options that address the challenges that automation might pose under current conditions – increasing social polarisation, economic instability, growing support for the authoritarian right and accelerating ecological degradation – and then also considering how the framework within which automation takes place might be transformed so that it leads to shared prosperity, increased leisure and, crucially, so that it can be democratically governed. The next and final chapter is dedicated to discussing such policy options.

5 Managing Automation for the Many, not the Few

A central objective of Technology Assessment (TA) is to provide scientific policy advice not only on the likely impacts of technological development, but also on possible ways to shape it in a socially responsible and beneficial way (Grunwald 2019b). As I have argued in the previous chapter, there is a strong case to be made that in order to provide meaningful advice on how to best manage automation, TA needs to engage with economic policy in particular. In the following, I will provide an overview of my contribution to this field. This contribution consists mainly of six policy papers that will be discussed in detail below and have all been either already published or accepted for publication by Autonomy, an independent, progressive research organisation based in the United Kingdom (UK) focused on tackling climate change, issues of economic planning and the future of work.

Before discussing the individual policy papers, I first want to provide a few general comments on their character. They are intended to contribute to the task set by Pollock in the context of automation (see chapter 4): to identify concrete ways to mitigate automation's potentially negative effects (e.g. social polarisation, economic instability, rising support for the authoritarian right and accelerated ecological degradation) and to bring forth the emancipatory potentials of automation (e.g. shared prosperity and increased free time created through democratic governance), rather than naively hoping that they would come into their own without additional intervention. The aspiration of these papers then – despite their at times slightly technical arguments – is ultimately this: to avert the crises that might be exacerbated by automation under current conditions and to contribute to a scientific discourse that strives to promote the expansion of human autonomy and freedom (see chapter 4).

Since the majority of scientific research on automation limits itself to exploring the possible impacts of automation within given socioeconomic conditions – either critically or by promoting economic policy such as the Industry 4.0 (see chapter 2) – my approach implies a departure into less charted territory. This means that despite rather rigorous desk research (particularly reviewing the literature on automation by progressive think tanks in the United Kingdom), the methods applied in the policy papers might at times seem a bit unorthodox. This is exacerbated by the fact that, due to the alternative normative framework that informs these policy papers, the questions that motivate them also might seem curious. These qualifications notwithstanding, I endeavoured to comply with good scientific practice by discussing pre-existing research, by making the assumptions of my calculations explicit, by sharing drafts of

the papers with colleagues for review, by using publicly available data and by not unnecessarily overcomplicating the papers.

The latter two qualifications were in large part necessitated by practical constraints (lack of experience in elaborate macroeconomic modelling and access to the appropriate models and data bases). Even more determining¹⁹³, however, was my intention not to obfuscate normative originality with complex modelling. The policy papers mostly were intended to build awareness for alternative ways to utilise technological development. As such, they represent thought experiments with some calculations attached that, despite being carried out to the best of my abilities, merely have an illustrative character. They serve as epistemic tools by which to determine plausibility rather than definite answers. This modest claim dovetails with my earlier arguments, that even the most advanced modelling could not claim to provide neutral and definite answers to today's challenges in any case (see chapter 2).

These thought experiments are intended to expand the public debate on automation, which tends to be limited to the economic potentials of automation within a very narrow framework (see chapter 3). As such, I have striven to unlock the limitations on our policy repertoire around automation, offering glimpses on a trajectory that might help us transcend existing economic relations. Following Antonio Gramsci's insight that "the program of economic reform is the concrete way in which every intellectual and moral reform expresses itself" (Gramsci 2007: 249), the policy options that I discuss thus allude to a more comprehensive programme of societal transformation.¹⁹⁴ I opted for such a policy heavy approach, in order to discuss how a socially beneficial use of automation can be brought about, because I feared that a discussion of automation's emancipatory potentials in an ideal world would quickly risk becoming abstract and potentially ideological (cf. Adorno's critique of Utopian thinking on the emancipated society in chapter 4).

Focusing on the more immediate possibilities to manage automation also allows us to respond to some of the sound concerns about more speculative thinking about technology, as it allows us to develop policy options without introducing all too many (potentially unsound) assumptions. It also corresponds with a need identified by Adorno and Horkheimer in their late works, stressing the increasing importance of scientific research that would concretely investigate the "insane contradiction" (Adorno 1972c) between the objective potentials of

¹⁹³ After all, modelling capacities might have been obtained by co-authoring, see for instance the paper on carbon taxation and a "green" UBI with Luiz Garcia.

¹⁹⁴ In part, this means revitalising and updating a progressive economic agenda dealing with automation that already existed in the 1960s (cf. Pollock (1964: 311; 367)).

contemporary society and the continued hardship of its citizens. Although they both refused to take responsibility for this endeavour (Adorno/Bloch 1978; Horkheimer 1985), they nevertheless promoted it – echoing the Frankfurt School’s emphasis on the potentials for societal progress and reconciling it with its critique of non-scientific utopian thinking.¹⁹⁵

In this sense, the policy papers are not utopian, at least not in the pejorative sense. Yet they are distinctly utopian in that they strive to break the dominance of current social conditions and reconstitute a sense of possibility (Urry 2016: 93–98). They thus strive to dereify today’s concurrence of technological development and perpetuated misery. Demanding an alternative use of technological development in this sense is also epistemologically productive (Weeks 2011: 131): new questions provoke new ways to think about the future and allow us to relate differently to the future – as a space of promises, rather than a continuation of our everyday life that promises, at best, perpetuated drudgery and at worst threatens us with catastrophe. Suggesting shorter working times, robust environmental policy and the democratisation of investment (and its returns) is thus not only aimed at achieving these immediate goals – it also is supposed to encourage us to reclaim agency over our collective future more generally (Weeks 2011: 136). The demands set out in these papers are thus not only supposed to illustrate concrete possibilities at the present stage of technological development – they are also supposed to “generate critical distance, and stimulate the political imagination” (Weeks 2011: 221). They strive to “open up new avenues for critical thought and social imagination”, thereby contributing (however marginally) to a change in political debate (Weeks 2011: 229).

To develop policy options is not the same as dictating prescriptions out of the lofty heights of the academic ivory tower: to the contrary, for a theory committed to extending human freedom, dictating ways to move forward is self-contradictory. They are instead intended as proposals to be reflected, criticised and hopefully refined in policy, public and scientific debate.¹⁹⁶ Although the policy papers primarily focus on the government’s capacity to act, they are thus also meant to strengthen the position of civil society actors such as trade unions and environmental

¹⁹⁵ Horkheimer’s (2002: 219) *Traditional and Critical Theory* already anticipates this mediation of scientific and utopian thinking by claiming that Critical Theory’s societal alternative “is not an abstract utopia, for the possibility in question can be shown to be real even at the present stage of productive forces.” The emphasis on a scientific exploration of societal (not least technological) potentials is Adorno’s and Horkheimer’s way to reconcile the critique Marx, Engels and their own critique of Utopian thinking and the necessity to discuss emancipated society – ultimately the motive that inspires all of Critical Theory.

¹⁹⁶ This statement in part refers to the long tradition of liberal critiques of utopian thinking (for instance Popper (1992)) that itself is at risk to degenerate into authoritarianism if it taboos the democratic debate of societal alternatives. It should also be noted that the risk of perpetuating today’s (deteriorating) societal conditions seems far greater than the risk of radical economic reform.

organisations. Practically, if the policies were to be implemented, this benefit would include freeing up time for voluntary work; intellectually, it could inspire them in their own discussions on how best to make use of technological development.¹⁹⁷ Ideally, this would contribute to the formation of broad societal alliances formed round progressive policy demands intended to translate technological development into societal progress (Srnicek/Williams 2015; Butler 2018). Instead of accepting resignation or fatalism, these policy papers are meant to contribute to the invention of a “politics of technological transformation” (Feenberg 2002: 13) that might help us chart a course out of our current ages of crises.

In the following, I will briefly introduce the policy papers, assess them in terms of their contribution to research and to public and policy debates, and provide preliminary ideas about how these policy areas might be developed further.

¹⁹⁷ Civil society actors not only come to mind as recipients of policy papers, they would also be crucial in enforcing progressive policies, even if it is the executive or legislative that issues the final directives. Believing that a more rational socioeconomic model might be established through a couple of clever policy fixes from above is just as misguided as the believe in technological fixes for today’s societal issues (Nachtwey/Seidl (2017); Grunwald (2018a)) – rather, the implementation of an ambitious programme of economic transformation will likely require a massive mobilisation of civil society to make sure that the government’s capacities to act are indeed leveraged for the public good. As such, the state has to be understood as a site of struggle, rather than a neutral facilitator of rational policy (cf. Polanyi (2010); Wright (2010)).

5.1 Costing a Shorter Working Week in Germany

The first policy area I dealt with extensively is focused on possible actions a progressive government might take to facilitate the transition towards a four-day work week. The focus on shorter working times was on the one hand normatively informed by Marx's and the Frankfurt School's position that the expansion of the "realm of freedom" ought to be one of the central objectives of technological development. On the other hand, the implementation of shorter working times with no loss of pay, and the necessary increase in staff that it would entail, would be a strong redistributive policy, ensuring that the benefits of technological development are shared more widely as well as helping to stabilise the labour market. Throughout the years of my research, working time reduction also became more and more of a hot-topic issue, particularly in policy discourse. The debate in the UK certainly can be considered pioneering – with 63 percent of the public (Autonomy 2020) and even a majority of business people (Ibbetson 2019) supporting the adoption of a four-day work week. 2019 also saw the UK's largest opposition party, the social democratic Labour Party, endorse the four-day work week as part of its electoral programme (Rodgers 2019). This positive attitude contributed to the start of the world's biggest four-day week trial, moving more than 3,300 workers at 70 UK companies to shorter working hours (for additional information and a glimpse into the massive news coverage, see Autonomy 2022). Just as in the case of the recent working time reduction in Iceland's public sector (Haraldsson/Kellam 2021), Autonomy has been at the forefront of reporting on these experiments as well evaluating them.

Although the positive momentum for working time reduction has been somewhat overshadowed by the devastations of the Covid pandemic, rampant inflation and an energy crisis exacerbated by the Russian war on Ukraine, but interest has continued to grow steadily and is no longer limited to the UK or Iceland. The federal government in Spain, for instance, has agreed to conduct a state-supposed trial of working time reduction (Kassam 2021), a policy that is already being tested by the Valencian regional government who passed a law (Generalitat Valenciana 2022) to offer subsidies to companies who want to increase productivity and decrease their work week by at least 20 percent (to a maximum of 32 hours per week). Autonomy had earlier consulted the Valencian regional government on working time policies, contributing to the design of the policy (cf. Stronge et al. 2019; Frey et al. 2020a).

Germany saw a debate revolving around a similar subsidy scheme fuelled by trade unionists and left-wing politicians after the Covid-pandemic hit the German labour market (see below), with the IG Metall recently announcing to focus on winning a 32-hour work week for the

workers of Germany's steel sector (tagesschau 2023). Even before then, experts on Germany's trade union activities and industrial actions postulated a "renaissance of working time politics" (Schulten 2019: 25). My research was supposed to provide some input to these debates.

I was involved in three policy papers on practical issues of working time reduction: *Time For Change: the four-day week as a strategy for unemployment* (Frey et al. 2020a), *Zeit für Veränderung! Costing a shorter working week in Germany's public sector* (Frey 2021b) and *Mehr Zeit für Veränderung! Costing a Transformational Shorter Working Time Subsidy Scheme for the German economy* (which has been accepted for publication but has not yet been copy-edited and formatted). I decided to omit the first report that modelled the costs of a Shorter Working Time Subsidy Scheme for industries particularly hard hit by the Covid pandemic because I took only a minor role in its composition and because it is focused on the UK. It was however well received and earned praise by Howard Beckett, the Assistant General Secretary of the UK's second biggest trade union Unite and Clive Lewis, a progressive Member of Parliament of Labour, in addition to a fair share of coverage in national news. The latter two which I sole-authored are reproduced in Appendices A and B.

Post-Publication Assessment

Although I do not want to reproduce the papers, I want to highlight some of their key achievements: Despite only providing a rough estimate of the costs of the costs of shorter working times in Germany, I believe both papers succeed in illustrating that the costs of implementing a four-day (or more precisely 30-hour) work week would be relatively moderate based on a limited and reasonable set of assumptions.¹⁹⁸ As such, they provide costing estimates for Germany that to my knowledge were non-existent beforehand, advancing on earlier research that links automation and working time reduction without going into great detail discussing concrete instruments or costs (e.g. Srnicek/Williams 2015; Roberts et al. 2017; TUC 2018). At the same time, the two papers demonstrate concrete possibilities for action by the state, based

¹⁹⁸ Some of these assumptions even turned out to be arguably too conservative. The assumption that I adopted from pre-existing research that only half the working hours lost might be compensated by productivity has been eclipsed by the actual productivity increases that accompanied working time reduction in Iceland (whose public sector largely adopted a 35-hour work week without substantially increasing staff levels – rather, as Haraldsson/Kellam (2021) have shown, the workers in Iceland achieved productivity increases that I projected to take place over a decade and thanks to additional investment into new technologies immediately through organisational innovations). At the same time, my corporatist suggestion that workers might contend themselves with stagnating real wages has recently been severely undercut in many countries by wage increases that not even compensate for inflation, leading to painful cuts into real wages.

on its role as employer in the public sector as well as based on existing labour market instruments. As such, they exemplify how the state might facilitate demonstrations of the feasibility of working time reduction, as well as accommodate room for experimentation – which could be key to any large-scale societal transformation (White 1987: 89–92).

Not only are working time reduction discussed as a possibility, I also provide a short argument that the German population has not adequately participated in productivity increases in the past decades. In regards to the costing of a shorter working week in the public sector, I am particularly pleased with having highlighted the returns in additional tax revenue and social security contributions as well as potentially reduced costs of unemployment such a policy might have. Policy debates regarding public sector spending are all too often fixated on the money spent, rather than the returns generated. Gaining a better understanding of the upsides of public spending hopefully is enlightening in this respect.

While *Mehr Zeit für Veränderung!* offers little innovation in terms of its method, I believe it to be a significant contribution to the debate around shorter working times as it provides a cost estimate for the private sector where before there existed none. What is more, the estimated costs for the public purse are net negative, illustrating that a shorter working time subsidy scheme might make good fiscal sense. Lastly, I also want to highlight the argument made at the end of the paper revolving around the virtues of full employment and labour shortages which might be considered provocative, given that the demand by companies for cheap labour is generally left unscrutinised in Germany. Addressing this one-sidedness by raising at least some doubts regarding this ostensibly self-evident demand, and marking it as being determined at least in part by specific class interest (i.e. the interest of capital to satisfy its need for labour as cheaply as possible) seemed worthwhile to me. Rather than absolutizing the needs of capital as the demands of some general economic rationality, this allows us to understand labour market policy as an expression of specific societal interests – with the public good and the interests of workers perhaps better suited by prolonged labour shortages that strengthen their bargaining position rather than an intense competition for jobs that devaluates wages and labour standards.¹⁹⁹ In a way, the papers also mark a return to earlier policy discourses, which, for instance, in the 1960s considered the link between automation and working time reduction as self-evident, considering working time reduction both as a way to stabilise the labour market

¹⁹⁹ Karl-Heinz van Kevelaer and Karl Hinrichs (1985) have termed working time reduction an “intermediary collective good” due to its potential to increase the bargaining power of workers (employed as well as unemployed).

and to share the benefits of higher productivity (e.g. Kregel 1962; Pollock 1964; Nye 2006: 119).

While the costing for a national shorter working time subsidy scheme has not been published yet, a preliminary assessment of the impact of the first paper on the public sector is possible: the first major learning is that despite decades of international economic and academic integration, language barriers still persist – in politics as well as in trade unions and the media. Perhaps unsurprisingly, it thus does not help to publish policy papers on a national economy in a foreign language. Contacts from the trade unions and politicians are less likely to react to being approached for comment. Even more understandably, British media will likely have less interest in reporting possible progressive policies in other countries whereas domestic media are much less likely to pick up on publications of think tanks in other countries. One of the conclusions drawn from the publication of the report is thus that country-specific reports need to be published in the native language, in order to increase their chance of penetrating public debate as well as more specialised policy discourses. A German executive summary does not suffice.²⁰⁰ Nonetheless, the policy paper had some public impact. Together with earlier activities and publications on working time reduction, it helped consolidate a status as an expert for working time reduction, leading to interviews in the business magazine *Capital* (Tillar 2022), later syndicated by N-TV (2022), and even a press release by the dpa, Germany's largest press agency, which was reproduced by a variety of German newspapers such as *Süddeutsche Zeitung* (2022) and *ZEIT ONLINE* (2022a). It also contributed to features by several major German public TV broadcasters (Bavarian Broadcasting (2022), West German Broadcasting (2022) and ZDF (2022) as well as a multitude of radio interviews.

In terms of impact on policy discourse, the paper was meant to inform debates of the actors that might have formed a progressive federal government in Germany in 2021 – the Greens, the Social Democrats (SPD) and the Left. Initial signs were promising: Serpil Midyatli, chairwoman of the SPD in Schleswig-Holstein and deputy leader of the federal party commented the paper sympathetically, pointing out the “key responsibility” of the public sector “to show that working time reduction are possible” (Autonomy 2021). In addition, I was able to discuss the paper with one of the leading economists of ver.di, Germany's premier public sector trade union. Lastly, the paper was informally recognised by a leading politician of the German Left who would have been a likely member of their party's negotiating team to explore

²⁰⁰ Besides the two costing papers for Germany, this also applies to the policy papers on TRANSFORM (see chapter 5.4). The issue how to provide versions of these papers most effectively to German recipients is currently being explored.

the possibility of a progressive government on a federal level (they went on to become a senior official in one of the provincial governments in Germany). As the opinion polls for the Left continued to sink, reactions became more muted as politicians from the SPD and the Greens seemed to become reluctant to associate themselves with more ambitious policies such as working time reduction, with even the progressive wings of their respective parties accepting that things were pointing towards a coalition with either the conservatives or the neoliberal Free Democratic Party (FDP). In light of the fact that the FDP has proven quite effective in keeping the ambitions of its coalition partners in check, readdressing a German version of the paper to the trade union movement and progressive provincial governments might be a sensible route forward.

I want to conclude my discussion of these two papers by pointing out possible other policy instruments and implementation challenges regarding working time reductions that are still open to be explored.

Pushing Back Overtime

In 2019, workers in Germany worked an additional 1.896 billion hours of overtime – equivalent to more than a million full-time jobs. More than half of these extra hours were unremunerated (IAB MAKRO 2021). Not only is this form of absolute surplus-value extraction (in the form of wage theft) burdensome for workers both in work (DGB 2014) as well as those left unemployed²⁰¹ – a paradigmatic expression of what Marx called capital’s “werewolf-like hunger for surplus labour” (Marx 1982: 353) – working time reduction are also likely to reinforce the importance of this issue. Not only can more strict (and better enforced) regulations of maximum working hours be used as a lever for a reduction in working time (Krull/Steinrücke 2020; Coote et al. 2021; Spencer et al. 2021; BBC 2022), past research has also shown that companies tend to react to working time reduction by expanding overtime, reinforcing the importance of this kind of regulation.

Additional overtime is attractive for workers insofar as the additional hours are compensated (and oftentimes at a higher hourly wage than regular hours) and seems attractive to management as administrative complexity does not need to be increased if staff levels can be kept constant – with no additional costs for recruitment and initial training accruing (White 1987). Realising

²⁰¹ As early as 1925, an organisation of the unemployed agitated their fellow workers by putting up posters reading “Avoid overtime – think of the unemployed! Fight for the 8-hour working day” (see DHM (2019)).

the full benefits of working time reduction both as a policy to shape the labour market as well as a way to unlock more free time for individual workers however requires more than just renaming parts of the work week from regular hours to overtime hours. Accordingly, policy needs to be developed to discourage excessive use of overtime work, e.g. by limiting maximum working hours further and/or by implementing additional legal barriers to the use of overtime and/or by increasing the wage costs of overtime hours (e.g. by introducing an overtime premium of 50 percent). At the bare minimum, the German government should finally stop dragging its feet in implementing the ruling of the European Court of Justice that all working times need to be properly documented (Ulber 2020; Coote et al. 2021), so that at least unpaid overtime might be repressed.

Democratising Personnel Policy

After years of work intensification leading to a surge in burnout cases,²⁰² the call for working time reduction can understandably trigger reservations that they might be accompanied by further intensification of work. It is indicative, too, that the most determined strikes in recent years – namely the large strikes in the healthcare sector – have not been about higher wages or shorter working times but rather about staffing levels and workload policy. The demand for co-determined staff planning has also received increased attention as a policy objective at a federal level (DGB 2022). This raises the question how the urgent demand for adequate staffing levels can be mediated with the demand for shorter working times. Three arguments could be explored:

Firstly: Work time reductions can be used to (re-)gain workers. To use the care sector as an example: According to a recent study (Auffenberg et al. 2022) hundreds of thousands of workers that have left the care-sector might be convinced to return if working conditions were to improve substantially. Proper staffing levels and a shorter working week (with the majority of workers indicating a preference for a 30-hour work week) have been identified as key factors in this respect. It might sound counterintuitive to some, but sectoral labour shortages might best be resolved by offering better working conditions, i.e. shorter working times and decent staffing levels, to a larger number of workers, instead of exploiting a dwindling number of workers

²⁰² The AOK, Germany's largest health insurer, reports that between 2004 and 2020 the number of annual sick days reported due to burnout has increased from 8.1 days to 131.7 days per 1,000 insured persons – or to more than 16 times the original level (Meyer et al. (2021: 503)).

more and more intensely. Competition, amongst employers, for offering better working conditions ought to be encouraged (see above).

Secondly: Work time reductions can be used to force employers to take action and to compensate workers for additional stress (e.g. the collective bargaining agreement for North Rhine-Westphalia's university hospitals grants an additional day off for workers for every seven shifts that they had to work at suboptimal staffing levels (ver.di 2022)).

Lastly: The demand for democratic co-determination of staffing levels and workload planning and the demand for shorter working times should be joined by making clear that involving workers in the democratic planning of working times reductions (including determining necessary staffing levels and future workloads) is the most efficient, inclusive and democratic way to go, so that both struggles about staffing levels as well as shorter working times can mutually reinforce each other (Kunkel 2020). This would also help meet the challenge of indirect labour control, i.e. that many employers, particularly in the so-called "knowledge economy", care little for the concrete working time that is needed to produce a specific product – hence, they might be open to working time reduction but demand the same level of output without any compensation in staffing level, making unpaid overwork extremely likely.

Qualitative Working Time Policy

Aside from policies that impact working times on a quantitative level, there is also a discussion to be had regarding the question as to which activities actually qualify as working time and which do not. Phil Jones, for instance, has argued in an earlier Autonomy report on Universal Workers' Rights that "workers should receive an allowance of time per year to focus on projects and pursuits outside of the daily tasks that compose their jobs" in order to implement "A Right to Development", citing pre-existing schemes at Google and other companies as precedent (Jones 2022: 32). In Germany, this Right to Development is already to a certain degree implemented in the form of educational leave, affording most workers²⁰³ the right to one week of additional paid vacation for educational purposes. A number of additional routes might be explored in this respect however:

In their draft for a reformed Works Constitution Act, the German trade unions (DGB 2022) have put forth the demand for one hour of *Demokratiezeit* (time for democracy) per week for

²⁰³ Only the notoriously conservative federal states Bavaria and Saxony do not have corresponding legislation in place.

employees to discuss their work processes (the DGB draft gives work process planning and changes regarding workplace technologies as examples of topics). While this demand might seem curious at first, spending parts of their working time thinking about work organisation is a “natural” part of almost any managerial occupation. It is also an everyday activity for the hundreds of thousands of works council members and trade union functionaries in Germany. And although one could likely justify involving more workers into shaping their own workplaces on instrumental grounds (i.e. the epistemic potentials of workplace democracy, cf. Gerlsbeck/Herzog 2020), I would argue that such a policy would already be justified because it empowers workers, pushing back against the lack of self-efficacy that I have identified as a threat for democracy in chapter 4.

Another policy area open for exploration is the realisation of an actual eight-hour working day. For more than a century, the labour movement has fought for “Eight hours for work, eight hours for rest, eight hours for what we will”. Today, leaving aside overtime hours, this policy goal is usually considered to have been achieved. This is only partly true however: on average, German workers spend 52 minutes per day commuting back and from work (Eurostat 2020); in addition, the working day is prolonged by another compulsory half an hour of break time. The average working day is thus well over nine hours long, even when discounting overtime. Classifying breaks and commute times as working time is not the dominant approach to these activities, but there is precedence and justification for such a perspective.

First, as regards break times: workers in a number of economies enjoy paid breaks even today. They have been implemented through collective bargaining agreements (for instance in Germany’s metal and electrical industries, cf. Beck 2012), granted as perks by companies or enforced through national legislation, for instance in Sweden (Regeringskansliet 2015). Smaller breaks for smoking, picking up something to drink or using sanitary facilities are generally considered part of regular working times in Germany. But as a matter of fact, according to a (non-representative) survey of 15,000 employees in 27 countries, even paid lunch breaks seem to be fairly common, with 43 percent reporting that they enjoy paid lunch breaks, 44 percent did not and for 13 percent only some breaks were part of paid work (QuickBooks 2019). Breaks from work (after six hours of work) in Germany are mandatory, as already indicated – and for good reason. They are crucial to maintaining productivity and preventing accidents in the workplace. In creative work in particular (including research) breaks can be some of the most productive times of the working day when it comes to generating new ideas and facilitating networking, cross-team cooperation and knowledge sharing. But even in other fields of work

they can help improve the flow of information within a company and often serve as a room for the reflection and optimisation of work processes. At the same time, workers have to make use of them in or nearby their workplace, limiting their free disposition over this time of their day. As such, the fact that the breaks of some workers are paid, and some are not, seems arbitrary.²⁰⁴ Adopting the Swedish model would mean a huge step forward in realising an actual eight hour working day in our time.

The case to include commuting times in working times is a tougher one, but there are some similarities. Similar to breaks, the commute to and from work forms an integral part of the working day (Murray/Stronge 2021).²⁰⁵ Similarly, parts of commutes are already paid – for instance when they take place as part of business trips or are undertaken by mobile sales forces or craftsmen. Commuting time is often used as additional work time with people checking mails, rehearsing their presentations and reflecting on their working day on the way to and from their workplaces. The issue has become even more pressing with the sharp increase in the number of workers working from home during the Covid-pandemic, as some economists have started to argue that workers should compensate the time they saved not commuting by providing this time free of charge to their employers (Goolsbee 2021). In other words, they seem to assume that employers always had a claim to the time spent commuting, although they paid for it only indirectly, or not at all.

Progressive policy should turn this argument upside down: if commuting time always formed part of the working day, it should have been paid all along. This would also prevent discrimination of personal services, manufacturing work and other forms of localised work (Birch 2022):²⁰⁶ Rather than preserving the time saved by working from home as a privilege of a specific segment of service workers, commuting might be recognised as a necessary part of the working day for many workers. For instance, the average working day could be shortened by the average commute time in the economy (in order not to discriminate against localised forms of work and at the same in order not to incentivise extra-long commutes) – with exemptions granted for working days that were worked from home (with the legal right of workers to come into the office, as long as there is no major health crisis). Not only would this

²⁰⁴ Which is not surprising as it constitutes a clear conflict of interest in the workplace – while workers should have an obvious interest in paid breaks, employers will likely have to be forced to grant them.

²⁰⁵ Arguably, the existence of tax allowances for commuters already illustrates that the commute is accepted as a necessary part of work by the state, rather than some personal passion.

²⁰⁶ These localised forms of work are already more likely to be worse off in terms of wages, anyway. This becomes clear when looking at the distribution of workers working at least partly from home: in 2021, as few as 25.7 percent of those earning low wages reported to do so. This is less than one third of the rate of high earners (86.8 percent of which reported to work at least partly from home), cf. Bundestag (2022: 6).

– in combination with paid breaks – fully realise the objective that only eight hours of every day should be occupied by work, it would also incentivise companies to be more generous when it comes to remote working. Another positive side-effect of such a policy might be that employers would be strongly incentivised to support investment into better mobility systems that promise to drive down the average commuting time and public housing programs that offer affordable living space close to work – which could also help reduce emissions in the transport sector (Burgis 2019).

Expanding the policy discourse on quantitative working time reduction by a qualitative dimension seems worthwhile,²⁰⁷ although the question as to what activities qualify as part of the working day and what do not will ultimately be decided practically. Nonetheless, drawing attention to the fact that we arguably have still not realised the eight hour day, even after more than a century of struggle, and developing policy proposals to do so might contribute to a renegotiation of the time-regime we are subjected to at work.

Qualitative working time policy might however address the question as to what kind of work is socially recognised in an even more fundamental form, for instance by the introduction of a Shorter Working Time Subsidy Scheme on an individual, rather than a company basis for people engaged in socially useful but unpaid work, e.g. care or voluntary work. Granting people engaged in municipal politics, trade unionism, environmental protection or even the local sports club a free day per week to pursue their honorary offices would materially recognise the importance of these activities and make it easier for people to reconcile their waged and non-waged labour (in effect, such a policy would constitute a massive subsidisation of civil society).²⁰⁸

Including care engagements in the activities that might be supported through subsidised working time reduction might also correct some of the gender-biased negative that impacts individualised forms of working time reduction have had in recent decades, with people

²⁰⁷ A discussion along those lines has already been demanded in the context of the debates on automation of the 1980s but to my knowledge to little effect (cf. Briefs (1988)).

²⁰⁸ Such a policy might be tailored to additional policy goals. If an additional goal would for instance be to incentivise civil society engagement of low-wage earners in particular (who are often underrepresented in civil society organisations), the subsidy might be set at a fixed rate (for instance 20 percent of the mean income), making it particularly attractive to those on lower incomes and less attractive to people on higher wages (who can afford to lose some income more easily and who are more likely to make themselves heard anyway). If the goal were to ease older employees into retirement and help them find a purpose beyond their waged labour, the subsidy might allow people to enter retirement a couple of years earlier if they commit themselves to a certain level of voluntary work (ver.di already negotiated some agreements along those lines in fringes of the public sector (see for instance BAnst PT (2018))).

(predominantly women) accepting individual wage cuts and consequently the threat of poverty in old age due to having to take up part-time work in order to find the time to care for their loved ones.²⁰⁹ Rather than forcing women into a “part-time trap”, accepting care responsibilities as a temporal (although prolonged) and legitimate reason for working time reduction could help them reconcile family and work without having to sacrifice either. This is particularly true as the 40-hours plus work week we accept more or less as normality today was established against a radically different backdrop, as Kathi Weeks (Weeks 2009: 114) points out: “when the current standard of full-time work, the eight-hour day and five-day week, was consolidated shortly after World War II, it was presumed that the worker, typically imagined to be a man, was supported by a woman in the home. [...] If it had been otherwise, had the male worker been held responsible for unwaged domestic labor, it is difficult to imagine that he could credibly be expected to work a minimum of eight hours a day.”

Holidays as a Tool for Working Time Reduction

A final approach to policy making around working time reduction I want to mention is the possibility of changing the quantity of holidays workers enjoy. This can take the form of expanding statutory holiday entitlement that currently stands at four weeks in Germany to the six weeks that are customary in most major collective bargaining agreements. The same could be effected by declaring New Year’s Eve and the 24th of December public holidays. These days are already additional free days, for instance under the collective bargaining agreement in the public sector (with holiday surcharges for those workers in the public sector who have to work on these days, such as nurses in hospitals). This would universalise working conditions that are already enjoyed by most workers, but are painfully lacking for some. German policy-makers might also decree that if a public holiday occasionally falls on a weekend, the Monday following this weekend will be free, so as to avoid the number of free days from public holidays fluctuating substantially from year to year.²¹⁰ This policy is already in place in Belgium, Spain and the UK and has been supported by various politicians of centre-left parties in Germany with Katja Kipping, Senator for Integration, Labour and Social Affairs of Berlin’s regional government, preparing corresponding legislation at the time of writing (Zeit 2022b; tagesschau 2022).

²⁰⁹ In 2018, 47.9 percent of all women worked part-time, while only 11.2 percent of men did (cf. BpB (2020)).

²¹⁰ To give just one example: four out of five public holidays that cover Christmas and New Year’s in Germany fall on a weekend in 2022, reducing the holidays by nearly a full week.

In addition, new bank holidays could be introduced (Jump/Stronge 2020). This would have major advantages: the challenge of doing so is minimal, as public holidays can be directly decreed by the government and affect only a few days in the year, but would nonetheless offer a sort of trial run for a four-day working week. At the same time, they have a strong signalling effect on a normative and cultural level. And lastly, since they enforce a reduction of work for most members of society at once, they are better suited to reducing everyday stress en masse and boosting social life than a small increase in mere individual holiday entitlements.²¹¹

A whole range of possible additional public holidays might be considered: A progressive government might decide to declare the 8th of March – International Women’s Day – a public holiday to underline the importance of feminist struggles and gender equality (as the centre-left regional governments in Mecklenburg-Western Pomerania and Berlin did). In light of the rising tide of the radical right, a progressive government might also decide to fulfil the request of various civil society organisations – spearheaded by survivors of the Shoah and their supporters who launched a petition on the subject that gained support by more than 175,000 signatories (change.org 2022) – to declare the 8th of May, the day that marks the victory of the allies in Europe, a public holiday. This could help refresh the alleged antifascist consensus in society and demonstrate year after year that the liberators from Nazism deserve to be celebrated.²¹² Other candidates are the 9th of May (Europe Day) or the 24th of October (United Nations Day) to demonstrate a commitment to international cooperation, the 10th of December (Human Rights Day) to mark a commitment to human rights and facilitate a debate around them or the 5th of December (Volunteer Day) to provide civil society with the most precious resource of all: time. This list could easily be extended – a progressive government might even decide on a number of additional bank holidays and leave it up to citizen juries or some other participatory procedure to determine the eventual dates, facilitating a broad debate about the priorities and self-image of the German public.

²¹¹ Public holidays are also beneficial in an ecological sense as the fact that whole institutions are shut down allow for greater energy savings than a rotation of workers going on holidays.

²¹² The regional government of Berlin had declared the 8th of May 2020 a regional public holiday to mark 75 years of liberation.

5.2 The Ecological Limits of Work

The following paper was the first that I published through Autonomy. It is motivated by my diagnosis in chapter 3 that the dominant strategy to prevent technological unemployment in Germany is to boost economic growth (by winning ever greater market shares for the German economy due to its competitive edge). As I have argued in chapter 4, this strategy is likely to exacerbate the ecological crisis and is thus not sustainable and rational. This led me to investigate policies that might help regulate the immense productivity that we have fortunately reached in such a way that it does not lead to ecological ruin. In line with my special interest in working time reduction policy, I came up with a research question that in a way inverses the dominant focus on expanded economic activity to allow the integration of as many workers as possible based on a 40-hour working week: how much work can we still afford to do from an ecological perspective? Combining data on the average carbon intensity of economic activity and the average productivity per working hour I set out to derive a sustainable level of waged labour. The resulting paper *The Ecological Limits of Work: on carbon emissions, carbon budgets and working time* is reproduced in Appendix C.

Post-Publication Assessment

The results of my thought-experiment-turned-calculations took me by surprise and were, quite frankly, shocking, with the length of sustainable working weeks at today's carbon intensity ranging from six to twelve hours. One of the central conclusions of the paper thus was that working time reduction by themselves would likely be insufficient to reach sustainable emission levels. This is largely down to the fact that even if one assumes a linear relationship between working hours and emissions, the respective working time reduction would translate into a reduction of GDP per capita by more than two thirds – even in the case of the relative carbon efficient Swedish economy. It is hard to imagine how such an immense collapse of economic performance, and thus living standards, might be socially sustainable. Nonetheless, the approach to the issue of automation and working times can justifiably be called innovative insofar it introduced a radically different form of thinking on sustainability into the debate.

But it is not just the debate on automation that might benefit from an increased awareness of issues of ecological sustainability; approaches within the field of sustainability studies might benefit from at least an elementary exposure to issues of political economy too. While the paper was warmly received by a number of social scientists and humanities scholars – mostly

colleagues doing research on automation and/or the future of work – there was a widely shared knee-jerk reaction from colleagues dealing with sustainability studies (and a smaller number of journalists): that working time reduction might not lead to reductions in emissions at all but to the contrary might even lead to greater emissions as people would use their additional free time for emissions-intense activities, short getaways by aeroplane being the prime example.²¹³

While I agree that the assumption that there is a linear relationship between emissions and working hours is precarious – with temporal rebound effects indeed being an issue for further research (see below) – I was slightly surprised and even disturbed by that fact that a significant number of colleagues, some of whom have dealt with sustainability issues over an extensive period of time, would time and again fail to deduce that a drop in economic activity by at least two thirds would also affect consumption levels. Granted, I did not discuss this explicitly in the paper, but I had assumed that it would be obvious – at least to members of the scientific community – that labour (i.e. production) is a necessary precondition of consumption.²¹⁴ Both in the sense that workers rely on their wages to pay for the goods and services they consume (and would have to be content with much lower wages if the working week would be shortened this dramatically) and that even if you inherited wealth, your consumption still largely presupposes other people's work. After all, labour is the means by which we ensure our societal reproduction (what Marx calls the metabolism between man and nature (Marx 1982: 283)) – and under capitalism, the dominant form of labour is waged labour, at least insofar as commodity production is concerned.

To illustrate using the example of the short getaway by aeroplane as an example: according to a pre-Covid survey, only 8 percent of adults in Germany can be considered frequent flyers, while nearly two thirds report hardly ever flying, if at all (Destatis 2022). It is hard to believe that millions of Germans should suddenly convert to frequent flyers, particularly if their increase in free time would be accompanied by a decrease of their incomes to a third or fourth.

²¹³ There have been a number of positive responses to the paper from sustainability studies too, particularly from scholars engaged in degrowth debates. All in all, this policy paper was my most academically successful one (albeit only 21 citations in relevant academic publications were recorded thus far according to Google Scholar; this number is lacking a number of citations in books who, despite reaching a broad audience, are not covered by Google Scholar (e.g. Standing (2020); Zelik (2020); Liebig (2021); Stronge/Lewis (2021); Bucker (2022)).

²¹⁴ There might even be production that leads to no consumption – for instance because commodities cannot be sold – but significant emissions. At the same, prescribing a reduction in consumption without accompanying it with a demand for working time reduction amounts to a demand to increase exports even further – but what good does ecological austerity do if it leads mainly to an increased trade surplus? Combining a demand for moderation in consumption with a demand for shorter working hours thus seems much more sensible, cf. Behringer et al. (2020).

But even those without budget limitations might find it hard to board a flight if labour times would be reduced drastically. Would a halfway reasonable society really prioritise staffing check-in counters and stuffing luggage onto aeroplanes for a tiny privileged elite over other pursuits? Would the production of jet fuel for personal vacations be such a societal priority? To believe that an increase in free time would lead to leisure activities that might eventually outweigh the emissions from work overlooks that emissions in our free time are not disconnected from labour, but rather enabled by the labour of others – be it airport crews and pilots, or in the somewhat less pretentious case of motorcycle joy-riding the people that build and maintain roads, produce gasoline, design and manufacture motorcycles and so on.

The insinuation that a reduction in (capitalist) economic activity might actually be detrimental to the planet at worst betrays an implicit disregard for workers (who, freed from the heteronomy of the workplace would only go about wrecking the planet), and a projective (this concern was raised to me exclusively by relatively well-off journalists and academics who are much more likely to be frequent flyers than the working poor or people on social support – none of whom raised this issue when I discussed the paper with them) and defeatist perspective. A more charitable interpretation would be that the focus on individual consumption and behaviour adaption rather than political economy and economic policy that has been characteristic for large parts of sustainability activism and research in the past decades has simply led to a lack of orientation when it comes to economic issues. But again, this is not to say that the paper might not be reasonably criticised both methodologically²¹⁵ and politically.²¹⁶

The objection against the disregard for the fundamental connection between labour and consumption notwithstanding, I also agree that the issue of temporal rebound deserves some consideration. I will return to it in my outlook on further research desiderata below. First, let me turn towards the public reception of the paper – which was substantial. Apparently, the combination of a simple yet unconventional research question challenging today’s work regime and sensational and easy-to-communicate results struck a nerve. The study was featured in

²¹⁵ Not only is the assumption of a linear relationship of working hours and emissions problematic but it also turned out that the two of the OECD data sets I used were based on different baseline years for their purchasing power parity conversion – I reran the numbers but the effect was minimal since the relative purchasing power of the national currencies of Germany, Sweden and the UK had not changed substantially in between the two OECD baseline years. Accordingly, I decided not to include the updated numbers here.

²¹⁶ For a particularly scathing yet witty criticism of the paper, see for instance Worstall (2019). Worstall, a Senior Fellow of the Adam Smith Institute – a leading neoliberal think tank in the UK – quite correctly points out that the UK public would be rather unwilling to accept income levels being cut back to a quarter (or the equivalent of the 1953 living standard), calling Autonomy “a non-think tank apparently” for publishing the paper.

leading media such as the Guardian, the Independent and the New Statesman in the UK, or the Deutsche Welle,²¹⁷ ZEIT, taz and the Standard in Germany and Austria.²¹⁸ It was even picked up in tabloid media such as the Sun and Daily Mail with the Daily Star – reporting an average circulation of around 330,000 in 2019 (Mayhew 2019) – dedicating its frontpage to a picture of the globe superimposed with the somewhat satirical headline “BEST NEWS EVER ... WORK A 9-HOUR WEEK TO SAVE THE PLANET!” (for an (by now somewhat outdated) overview over the media coverage of the paper, see Autonomy 2019).

Despite the tongue-in-cheek character of some of these reports, the general idea – working less, i.e. reducing economic activity, to help fight climate change – was generally taken up favourably. What is more, some of the comments hinted at the possibility that working time reduction might be an area where interests of the environmental movement and the labour movement might converge, an idea that also motivated me to take this approach. The Daily Star for instance supplemented its picture of earth as seen from space (a motive oftentimes found in environmental literature) with a comment by a would-be lumpenproletarian exclaiming: “I’m a bloody eco-warrior Barb”. The message is simple: While this character (apparently a regular appearance in the Daily Star) would usually not be associated with ambitious climate protection, working less is certainly appealing to him.²¹⁹ The demand for shorter working hours might thus serve as the policy glue that might bond the labour and the environmental movement together in a counter-hegemonial alliance (Srnicek/Williams 2015; Dörre/Becker 2018; Liebig 2019; Stronge et al. 2019). Facilitating a discussion about working time reduction as a tool for climate protection beyond the feature section of quality media can be considered a major success in this respect.

In terms of more immediate policy debate, there was also some success. The extensive media coverage the paper received even led to an opinion piece I had written as part of the paper’s publication strategy for Open Democracy being syndicated by the blog of the World Economic Forum as part of their “weekly update of the most important issues driving the global agenda”

²¹⁷ In addition to a feature in a documentary and a video interview, the Deutsche Welle, Germany’s public broadcaster for an international audience, went so far as to develop a set of educational materials for people learning German based on its reporting, see DW (2020).

²¹⁸ The initial reporting in the Guardian generated significant attention which triggered a cascade of reporting. Once an issue is covered by a number of quality media, this invites other media to join in, reinforcing the importance of securing initial coverage by a prestigious outlet.

²¹⁹ As the next policy paper will show, the working poor are actually ecologically trailblazers (albeit unwillingly) due to their relatively low consumption levels, with fairly low average emissions levels – whereas more educated high-income earners, who might be subjectively much more concerned with environmental protection, cause far more emissions.

(Frey 2019). This was not a place I had anticipated (or even aspired) for discussion of my research to be taking place. The debate around the publication of the paper also inspired a European-wide network of civil society organisations working towards a shorter working week to dedicate its annual conference in 2020 to the issue of “Working time reduction and climate crisis”, bringing together academics, parliamentarians, environmental activists and European trade unionists.²²⁰ In addition, I co-authored a policy brief on shorter working times and carbon emissions targeted at policy-makers in the UK (Frey/Schneider 2019c) as well as a leaflet (Frey/Schneider 2019b) on the same issue for a German audience that was distributed by a number of Fridays for Future and Attac groups across Germany. Furthermore, a number of events on the issue took place in Germany.²²¹ All in all, I can only agree with the IPCC whose latest report on climate change mitigation states that “[t]he reduction of working hours is increasingly discussed as an approach to improve well-being and reduce emissions” (IPCC 2022: 378).²²²

Albeit my individual contribution to the increased discussion of this area should not be overestimated, I am nonetheless happy to have been able to contribute to it. There remains research on the relationship between working times and emissions to be done, however. In the following, I will highlight three issues in particular.

Temporal Rebound Effects and Leisure Policy

The obvious first issue that needs to be addressed in order to unlock the potential of working time reduction for climate protection is the issue of temporal rebound effects, as already discussed to some extent above (cf. also UBA 2019; IPCC 2022: 378). This is a general issue concerning the expansion of human freedom: you cannot be sure how individuals might make

²²⁰ I was invited to serve as one of the hosts of the event which was supported by the European Trade Union Institute and the Rosa-Luxemburg-Foundation’s Office in Brussels. For the conference programme, see Rosa-Luxemburg-Stiftung (2020).

²²¹ One rather exceptional example being a panel discussing working time reduction from an academic, religious and political perspective under the headline of “Sabbath for everyone!” Aside from my research, Franz Segbers (2001) and Jonathan Schorsch (2019) presented an ecumenical theological argument rooted in the Sabbath tradition for working time reduction to protect creation whereas Katja Kipping provided some thoughts on the practicalities of working time policy (Rosa-Luxemburg-Stiftung (2021)). Seeing that the demand for shorter working times might bring together progressive politicians, academics, trade unionists, environmental activists and even religious communities was one of the most rewarding experiences of my outreach activities.

²²² Although my paper is of course not listed by the IPCC due to lack of scientific peer review, it is discussed in the Special Report on „Structures for climate-friendly living“ by the Austrian Panel on Climate Change (Hofbauer et al. (2023: 18)).

use of it. This applies not just to the ecological effects of working time reduction but also to other areas. The fact that workers need to spend less time at work does not, for instance, necessarily ensure that they will distribute private care work more fairly either (one of the key hopes of feminist proponents of working time reduction). Scientists dedicated to societal progress ought not limit themselves to registering this simple fact however. Rather, they should try to answer the question how the structural conditions that frame individual decision-making can be adapted so that the desired effects of working time reduction are more likely to manifest (White 1987; Platform London 2021).

To go back to the example of the undesirable getaways by airplane: merely lamenting the mobility choices people make in their free time seems unsatisfactory to me. Rather, one might acknowledge that certain ecologically destructive choices are structurally incentivised: a non-discounted second-class train ride from Berlin to Karlsruhe for instance costs over 140 euro, while budget airlines advertise flights within Europe for less than 10 euro.²²³ This is not to absolve individuals from their responsibility – but morally blaming them to make economically rational choices while on constrained budgets will likely have a limited effect. More generally, arguments centred on consumer sovereignty run the risk to distract from a stronger focus on the transformation of the infrastructures and production processes, including the working times related hereto, that determine much of the ecological impacts of individual behaviour (Huber 2019).

Designing leisure policies that incentivise ecologically sensible choices – free or heavily subsidised public transport, free admission to low-carbon leisure infrastructure such as parks, well-maintained hiking trails, libraries, public swimming pools²²⁴ or museums –, internalising the costs of emissions (see the next policy paper) and abandoning costly and environmentally harmful subsidies such as tax-exemptions for jet fuel might in contrast help better align economic and ecological rationality. The carbon intensity of leisure activities is not a transhistorical fact – it is open to design, just as our work environments should be.²²⁵

²²³ While it is true that these budget airlines generate additional revenue for instance by heavily pricing luggage (which is included if you ride the train), they at least guarantee you a seat free of charge (while this is only guaranteed for a fee if you go by train). A comparison of price tags also fails to account for the time spent on either mode of transportation – although having more free time might encourage people to reinterpret travel time as part of the voyage and to appreciate slower (and hopefully cheaper) modes of transportation.

²²⁴ We can see here that even the most frugal notions of leisure – for instance Adorno’s “lying on the water and looking peacefully into the heavens” (Adorno (2021: 179)) – requires for most city dwellers public infrastructure, if is not to take far more resource-intensive privatised forms.

²²⁵ Luckily, sensor readings from satellites indicate that even without massive policy intervention, carbon emissions in Europe and the US are substantially higher during the week, see Reuter et al. (2014).

Weakening the Link between Working Hours and Emissions

This also illustrates an approach that transcends my rather simplified calculations in the paper reproduced in Appendix C. Taking the average carbon intensity of our economy as an indicator and general benchmark for work, obfuscates the massive differences in carbon intensity that specific forms of labour have. While many activities might be extremely carbon intensive, others might even help sequester carbon or cut emissions (e.g. work done in a coal plant vs. work in a reforestation program). As indicated in the paper, additional research needs to be done on how to facilitate radical economic transformation to reduce the carbon intensity of our economic activities. A good example of this is the research done by Mario Candeias, Stephan Krull and others on how industrial manufacturing capacities might be redirected from car production towards the production of trains and buses (Candeias/Krull 2022).²²⁶

An alternative way to bring together the issue of working time policy and emissions reductions might be the combination of existing mitigation plans (for example nationally determined contributions under the Paris Agreement) with lessons from the Covid pandemic and past energy crises; namely, the ability of the state to shut down parts of the economy if there is a pressing need. For instance, a sanction mechanism could be developed that forces companies who fail to comply with sectoral greenhouse gas mitigation paths to temporarily shut down production once they exceed their designated emissions allotments. Such an approach would not be unprecedented: during the pandemic, a multitude of national governments mandated lockdowns to slow down the pandemic – and in 1974, the conservative government under Edward Heath in the UK imposed an economy-wide three-day work week to save energy to save energy in order to break the efficiency of industrial actions by the National Union of Mineworkers (Coote et al. 2010: 11). If conservative governments have been willing to shut down whole economies over prolonged periods to break the resistance of the labour movement, surely a progressive government ought not shy away from temporarily shutting down individual companies that fail to meet the minimum standards for sustainable economic activities.

As during the Covid lockdowns, the social costs of such a policy could be mitigated through short-time work subsidies (that might even have to be topped-off by employers to match regular wages). At the same time, the prospect of leaving extremely costly industrial manufacturing infrastructure underutilised would serve as a powerful economic incentive for companies to invest into more efficient technologies. Such a policy would combine (conditional) working

²²⁶ For my own contribution on possibilities to foster economic transformation, see Appendices E and F.

time reduction in the form of additional paid vacations with an attack on the profits of companies that fail to comply with their societal responsibility to innovate (see the policy paper *TRANSFORM Germany* (Appendix F) on how companies might be supported to obtain the necessary capital for these investments).

Working Times that Meet our Needs

The final issue I would like to highlight is the question what needs should inform the design of working time policy: while I would insist that a higher regard for ecological demands would set a more rational benchmark for the way we design the way we work – compared to the benchmark set by demand of the lobbyists of employers for ever-longer working weeks and working lives – an ecological benchmark nonetheless constitutes another standard external to the immediate needs of workers. Rather than asking ourselves how much work would be best for the accumulation of capital or our ecosystems, one might thus investigate how much work would be best for individual flourishing – and then ensure that this amount of work takes place in such a form that it does not erode our collective basis of existence and that it allows us to comfortably meet our consumptive needs. Research on the relationship between work and individual flourishing is plagued by a rather dichotomised approach to this issue however (Frayne 2015): while the negative impacts of unemployment are well documented (Gallie/Paugam 2000; Paul/Moser 2009; Young 2012), very few studies exist that do not simply highlight the benefits of being employed, but rather explore whether at a certain point the beneficial effects that employment has might invert as long working-hours lead to stress and in effect to decreased mental and physical health and well-being.

A notable recent exception in this respect is the work by Shinya Kajitani, Colin McKenzie and Kei Sakata (2017, 2020) who explored the impact of working hours on the cognitive ability and health²²⁷, identifying a “non-linearity in the causal effect of working hours” (Kajitani et al. 2017: 3), meaning that while working indeed leads to better cognitive functioning and mental and physical health – even when compensated for other factors – this effect eventually inverts, with excessive working times (above 44 hours a week) eventually leading to poorer cognitive functioning than being unemployed. In general, the peaks for the various indicators happen in a range from 15 to 29 hours (Kajitani et al. 2017: 13, 2020: 11), with an arithmetic average of

²²⁷ More specifically, their dataset referred to Australian residents aged 40 and older.

all indicators at around 22 hours.²²⁸ While one might sensibly question whether reading and memory tests, pain sensitivity tests and various tests for physical functioning, general and mental health really represent the richness of the notion of individual flourishing, they seem to be fairly decent proxy indicators. Since the results of such research are likely to vary from country to country depending on a range of variables – e.g. the way care work is shared in most households, labour regulation, possibly even commuting infrastructure – providing similar studies for different economies seems to me to be an extremely valuable endeavour, offering a perspective that transcends the simplistic veneration of waged labour and offers a more nuanced answer to the question what kind of work regime we might want to strive towards as a society.

²²⁸ This matches the intuition of workers remarkably well, with a majority indicating that a working week of 21-30 hours (Raja Workplace (2021)) or three, perhaps four, days of work respectively (YouGov (2019)) would be ideal for them. The minimum time needed to gain most of the well-being benefits of employment might be even much lower (cf. Kamerāde et al. (2019)).

5.3 Carbon Taxation and a Green UBI for All

The policy paper *TOLL GATES AND MONEY PUMPS: Why carbon taxation could be a simple, fair and transformative policy instrument* which I co-authored with Luiz Garcia (Frey/Garcia 2022) similarly derived from my reflection how the immense productivity of our society might be regulated so that it does not lead to ecological demise. But instead of combining it with a discussion of working time reduction, I decided to explore how ecological issues and another popular demand in the context of automation, the demand for a Universal Basic Income (UBI), might be unified. Motivated by the emphasis the early Frankfurt School scholars put on prioritising the end of hardship on a global scale over notions of luxury for a privileged part of the working class²²⁹ – and the research on the extreme levels of global carbon inequality – (for both, see chapter 4.2), I decided that I wanted to enrich the conversation around a possible UBI with an international perspective. Finally, after initial back-of-the-envelope calculations using World Bank Data on per capita emissions proved promising but lacked higher resolution when it came to emission and income distributions within nation states, I was very fortunate that Lucas Chancel – a close collaborator of Thomas Piketty – published an updated database on global emission distributions from an international as well as an intra-national perspective. Further, I was fortunate enough to connect with Luiz Garcia at Autonomy who contributed precious data science capacities by restructuring the dataset according to our research goal. The resulting paper is reproduced in Appendix D.

Post-Publication Assessment

The paper was my most expansive and ambitious paper published yet. I think it makes a reasonable case for carbon tax-and-dividend schemes as a way to reconcile ecological and social sustainability. This case has been made before – as the literature we reviewed in the paper shows. It has however, to my knowledge, not been made at this level of detail on a global level. But even where this case has been made on a national level (e.g. Troost/Ötsch 2019; Kalkuhl et al. 2021), this line of arguments deserves to be reinforced in order to problematise existing climate protection policy that delivers too little too late and even introduces counterproductive or contradictory effects, ostensibly in the interest of social balance.²³⁰ There still seems to be a

²²⁹ By returning to the case for intragenerational justice made by Adorno, Marcuse and other with climate protection, I expanded it by a notion of intergenerational justice whose importance was highlighted by sustainability studies in the past decades, cf. World Commission on Environment and Development (1991); Grunwald/Kopfmüller (2022).

²³⁰ A case in point is the German approach to carbon pricing which combines an exceedingly unambitious CO₂ price with income tax breaks in the form of increased commuter allowances to ostensibly ensure their social

need to hammer home the argument, that more ambitious climate protection might also lead to progressive economic redistribution. Besides this key insight, I also think that such tax-and-dividend schemes can serve an important strategic function for proponents of a UBI, as they can provide the basis to establish the necessary administrative infrastructure for more comprehensive UBI payments and entrench the basic principle of monthly indiscriminate payments by the public in everyday life (Groll 2010; Schachtschneider/Candeias 2013; Quentin 2019; Weeks 2020).

Finally, while I realise that to suggest a scheme to end extreme poverty on a global scale as part of one's PhD research might seem presumptuous – and I fully realise that the scheme we discussed is still oversimplified and more importantly utopian in the pejorative sense when it comes to its implementation prospects – I am convinced that we will not be able to overcome the injustices and devastations of today's society if its intellectual opposition submits to the imaginative neutering that some might demand of it. Research with a transformative aspiration needs to be bold in order to cut through the contemporary ideological background noise that emanates from “[t]he silent compulsion of economic relations” (Marx 1982: 899). I argue that it is worthwhile to make this argument concretely to illustrate that the costs of ending extreme poverty on a global scale would actually be quite limited (for instance they are easily exceeded by the inflationary effect recent price gouging by companies has had, cf. Hayes/Jung 2022; Bivens 2022).

While I would argue that the paper makes a number of meaningful points and provides data that is relevant to ongoing debates on climate protection and (global) carbon justice, it sadly was the least successful one in terms of public reception. Although it was featured in the *Independent* (Stone 2022) – a reputable news media – a cascade similar to the one on the paper on the ecological limits of work failed to manifest. This might be explained by the fact that the publication of the paper happened shortly after Russian troops had invaded Ukraine. With much of the public's and media's attention understandably captivated by the war, climate policy had a much harder time generating attention. This also became apparent when the IPCC released its latest report (IPCC 2022) around the same time and, despite its explosive content, largely

sustainability. The effect is that, since income taxation is progressive in Germany, well-off households profit particularly strongly from these deductions whereas poor households that pay little income taxes or do not possess a car for long-distance commutes (but are strongly affected by effectively regressive consumption-based taxation such as carbon pricing in other areas) actually lose out. In effect, the global poor do not get protected from additional climate change while the German poor are insufficiently shielded and serve as an argumentative decoy to justify further tax cuts for those that need them the least (cf. Bach et al. (2019)).

received a fairly muted response, limited to smaller side columns. In addition, although some politicians and executives of human rights and global justice organisations expressed sympathies to the approach, they were unwilling to broach the issue publicly in the context of rampant energy price inflation, weakening its public significance.²³¹

Several lines of research suggest themselves to explore the intersection of emissions reductions, global justice and other forms of progressive policy further, two of which I want to briefly explore in the following.

Methodological Considerations

First of all, the approach developed by Luiz Garcia and me can be developed further in several respects. Rather than, for instance, simply accepting the UBA's (2020a: 8) suggested carbon price of 195 euro per ton of CO_{2eq} one might, for instance, scrutinise the assumptions that led the UBA to derive this price. Increasing or decreasing the yearly discount rate of the economic costs of emissions by one percent, for instance, already leads to radically different results (e.g. according to the UBA (2020a), a one percent discount rate returns a cost of €195 per ton whereas a discount rate of zero returns a price of €80). In recent years, discounting has become more and more of a disputed practice with Nicholas Stern, an established figure of environmental economics, calling discounting “essentially discrimination by date of birth” as damages to future generations are weighed less and less as the occurrence of the damage becomes more temporarily remote (Stern 2022: 1279).²³² While one could thus opt for the much higher carbon price of €80 per ton provided by the UBA (€700 by the year 2030), the UBA on the other hand arguably inflates the costs of carbon by its application of an equity weighting approach (UBA 2020a: 10). This essentially assumes that a unit of housing destroyed due to climate change is worth the price of a unit of housing in Western Europe – no matter where the destruction takes place. While it is true that the utility derived from a unit of housing is the same no matter where you are, the price of a house in Faisalabad is likely much lower than a house in Cologne. Whereas it certainly seems fair to illustrate the high costs of climate change by

²³¹ Despite the fact that the green inflation caused by more ambitious carbon taxation would be rather limited compared to the surge in energy price we see at the moment and that the funds raised would be distributed back to the population in full, this is understandable – after all, taking a stance for higher carbon taxation in a situation in which many do not know how to pay their bills might be easily weaponised by political opponents by omitting the demand for carbon dividends in their attacks.

²³² Stern's (2022) argument that the classical reasoning for discounting in economic literature – that future generations will be much richer than today's, being able to foot the bill for ecological devastations more easily – is becoming increasingly precarious as the objective basis for their future prosperity could well be gambled away by us in the here and now, also seems rather convincing.

costing greenhouse gas emissions with a price that corresponds to the value the utility lost would have in Germany, critiques thus might nonetheless point out that this arguably can also be considered a normatively informed inflation of the projected costs of climate change. Engaging with the debate on carbon pricing can serve as an interest point of departure for a more theoretical debate on the value we ascribe to the needs of future generations and the way ostensibly technical assumptions express and implement normative assessments.

A more conservative approach that might bypass these normative issues could be to base the carbon pricing not on the social costs of emissions but rather on the level that is required to reach a certain steering effect, e.g. to reshape the market to induce quicker adaption by companies by setting a carbon price that sufficiently exceeds avoidance costs.²³³ A more fundamental advancement of the approach might even strive to include resource use or other ecologically relevant factors into a tax-and-dividend scheme or might supplement the more punitive approach of tax-and-dividend with a scheme that rewards the provision of ecosystem services such as protecting natural carbon sinks or biodiversity (for an introduction how different ecosystem services might be priced, see Dasgupta 2021).²³⁴

Designing a Global Marshall Plan

In addition, the potential implications of a global tax-and-dividend scheme deserve further exploration: how might such a scheme for instance be designed so that it is sustainable even when it succeeds in inducing rapid decarbonisation or at least in converging emissions at a lower level, for instance by the inclusion of additional funding sources (see above) as its original funding base erodes? Would such a scheme lead to rampant inflation, particularly in the Global South, as household incomes expand dynamically?²³⁵ Since most net contributions would come from the wealthy countries of the Global North would national currencies quickly be replaced by more inflation-resistant currencies such as the US dollar or euro?

A tax-and-dividend scheme based on contemporary emissions also fails to account for the enormous disproportions in historical emissions: Jason Hickel (2020) makes a reasonable point

²³³ Although, as indicated in the paper, this is unlikely to lead to substantially lower numbers with the range described by the IPCC starting from 135 dollar to 6,050 dollar per ton in 2030 (IPCC (2018: 152)).

²³⁴ Carbon dividends can be considered an income deriving from a universal basic asset, i.e. the atmosphere (cf. Boyce (2019: 84)) – from this perspective, such an approach would merely expand the number of natural assets used to generate income.

²³⁵ Earlier research by Egger et al. (2019) suggests that this issue might not be as pressing as economic capacities in the Global South are strongly underutilised which means that positive income shocks translate into rapid economic growth but hardly raise (oftentimes already high) inflation rates.

that out of the 686.1 gigatons of CO₂ overshoot that was already dumped in our atmosphere, the US contributed 378.9 gigatons and Germany 72.9 gigatons. Priced at 195 euro per ton, this would amount to a climate debt of more than 14 trillion euro for Germany alone, more than four times the yearly GDP of Germany. Against this backdrop, an ambitious agenda of global reparation and redistribution becomes tangible, consisting – at the very least – of a complete debt relief for the countries of the Global South and the release of all patents that prevent these countries from meeting the health needs of their population and from leapfrogging to a sustainable economy (Paul 2021; Paul/Gebrial 2021).

In addition, a global funding vehicle inspired by the historic Marshall Plan might be established to pay for ambitious climate protection and climate adaptation projects as well as the establishment of green and universal basic services such as health care, energy, transport and education systems.²³⁶ This would not only be justifiable on humanitarian grounds or by referencing the need to make sure that rising living standards in the Global South do not lead to a massive aggravation of our ecological crises – it would also massively accelerate and broaden technological development. This not only applies to the rollout of green technologies, which is currently mostly limited by funding constraints rather than a lack of research (Puttfarcken 2021; Jacobson et al. 2022), and which might massively profit from economy of scale effects on a global level to drive down the costs of sustainable technologies and to increase the efficiency of their application. It would also support research and development of technology more broadly: all too often, policy making to boost potentials for innovation takes the form of hundreds of millions of euros in subsidies being showered upon industry leaders or a limited number of public research institutions that are considered “elite” – in an application of the Matthew effect to public policy. While this sort of funding does yield results, it neglects the much more basic prerequisites that have to be ensured in order for human beings to contribute scientific and technological advances: every child that starves to death or perishes due to some pathogen that might easily have been conquered with modern health technologies or is forced to toil at a young age because they lack access to adequate education and social security systems, might potentially have produced an answer to one of the urgent challenges we face.²³⁷ The destitution that torments large parts of the Global South is not just inhumane – it is a violation of the potentiality of humanity.

²³⁶ One might also conceive of a hybrid approach, with tax-and-dividend schemes being established in culturally and politically relative homogenous contexts and state-financed funding lines for international cooperation.

²³⁷ As Bertrand Russel once commented: “Whoever will observe how many of our poets have been men of private means will realize how much poetic capacity must have remained undeveloped through poverty; for it

John McDonnell, the Shadow Chancellor of UK's Labour Party from 2015 to 2020, is right in pointing out that it would "be the height of moral irresponsibility" if those economies that have profited from carbon emissions for the longest time were to withhold their support from those in the Global South that have to suffer the consequences of this wealth-building (McDonnell 2019).²³⁸ Besides green technologies, this support should also come in the form of automation technologies if the expansion of free time is not to be mistaken as a normative aspiration limited to people from the Global North. In two reports, Oxfam (Karimli et al. 2016; Coffey et al. 2020), a network of charities fighting global poverty, has for instance highlighted the significant time spent on (mostly unpaid) reproductive work in the Global South, demanding access to time- and labour-saving technologies to help fight global and gender inequality. But it is not just reproductive work that demands depressingly long working hours – due to low wages and labour standards, automation potentials are also left unexploited (Chang/Huynh 2016) and paid working hours are exceedingly long in the Global South as well. The price workers have to pay is harrowing, with the World Health Organisation and the International Labour Organization jointly reporting that long working hours (more than 55 hours per week) led to an additional 745,000 deaths from stroke and heart diseases in 2016 (Pega et al. 2021).

But even when extra-long working hours do not lead to immediate death, it is a manifestation of global inequality that workers in Cambodia and Myanmar should have to work more than 1,000 hours (or 70 percent) more every year than workers in Denmark and Germany (Feenstra et al. 2015). A detailed proposal for a global Marshall Plan would have to deal with a number of important details – e.g. what conditions would be linked to funding (e.g. strengthening democratic processes and decent social and labour standards), how accountability might be ensured etc. – that I cannot engage with here.²³⁹ However, some basic governance and

would be absurd to suppose that the rich are better endowed by nature with the capacity for poetry" (Russel (1919: 104)). Surely the same applies to inventive talent in regards to technology.

²³⁸ And the argument based on carbon reparations does not even take into account the colonial origins of much of the Global North's wealth (cf. Keynes (1963); Marx (1982: 915); Inikori (2003); Acemoglu et al. (2005); Inikori (2009); Craemer (2015)).

²³⁹ Given the prominence of technology transfer in contemporary discussions of global justice and development, such a scheme would also need to reflect on the issues that might arise from transplanting technologies from the contexts in which they were developed to substantially different conditions. While Marx and Engels, for instance, were still quite adamant that an emancipated society could only be realised by making advanced productive forces universally accessible (without which, they argued, "*want* is merely made general, and with *want* the struggle for necessities would begin again, and all the old filthy business would necessarily be restored" (Marx/Engels (2008: 54)), some scepticism about such an unabashed embrace of the universal emancipatory potentials of technologies seems warranted. Drawing on Feenberg (2002), one might, for instance, reflect how capitalist social relations, but also cultural paradigms, are reified in the concrete forms technologies that take today (see my discussion of Feenberg in chapter 4). Accordingly, the question of whether and how these technologies would need to be adapted to different cultural settings should be taken seriously.

investment principles could be drawn from the principles I put forward in my final policy papers below on how to ensure decent working conditions and climate protection domestically, and how to establish a democratically governed public investment agency to expand public investment and provide a Universal Basic Dividend.

However, this challenge is not specific to the Global South, as the emancipatory appropriation of today's technologies is likely to require a substantial reconfiguration of many technologies, regardless of the region in which this appropriation is going to take place. This too follows from the social determinedness of technology design as discussed in chapter four: the pursuit of alternative social ends will require differently designed technologies.

In any case, it seems inappropriate to me to glorify the technological backwardness in terms of productivity of large parts of the Global South, coerced by under-investment and punitive patent regimes, as some kind of deliberate choice. Of course, economic development in the Global South need not mimic the historical development of the Global North (indeed, from an ecological perspective, it even must not) and, more fundamentally, people (whether in the Global South or the Global North) should be free *not* to make use of certain technological potentials – but unless we make them readily available to all, we ought not misconstrue ox ploughs and manual sewing as expressions of human freedom.

5.4 TRANSFORM: How to Accelerate Automation and Democratise its Ownership

The final two policy papers (Appendices E and F), *Drawing the Line: A strategy to leverage higher wages and eco-taxation to spur innovation* and *TRANSFORM Germany: A proposal for a public investment agency to boost productivity, green the economy, and build democratic wealth*, are dedicated to bring together a number of issues that I have touched upon throughout the dissertation: the relatively slow productivity growth of the past decades, the politically problematic lack of self-efficacy of workers, the fact that automation might exacerbate social polarisation and ecological crisis and finally the need to develop a political project that might transform automation from an accelerant of crisis to an emancipatory force. The drafts reproduced in Appendices E and F have been accepted for publication by Autonomy but have not yet been copy-edited and formatted. The final versions will also include a table of contents, an executive summary for decision-makers and an introduction by Autonomy's Director of Research outlining the relevancy of the papers to international readers, despite its focus on Germany.

Personal Assessment

The policy papers on TRANSFORM tie together several lines of thought that I have developed throughout my research: the need to shape how automation and technological development takes place, rather than accepting its effects, be they positive or negative, as “natural”; the demand for a more democratic governance of innovation and investment and an understanding of emancipation that focuses on the conscious intervention into economic conditions more generally; and the need to reconcile the embrace of the emancipatory potentials afforded by technological development with ecological sustainability. As such, they aspire to offer answers to some of the challenges I identified in chapter 4 in particular. The concern that technological development might speed up our suicidal drive towards climate meltdown is met by the suggestion to reshape the market conditions that all companies are subjected to and by the provision of public funding to reduce the ecological burdens of economic activities. Similarly, an ambitious agenda to raise wages is supplemented by a demand for public funding for investment into labour-saving technologies. Worries about the distributive effects of automation are transformed into an argument for a Universal Basic Dividend. The lack of self-efficacy is addressed through a call for increased democratisation in the governance of both public investment and individual companies.

On a more detailed level, my emphasis on minimum costs for pollution and a minimum wage for labour is not just meant to disrupt business models that are socially and ecologically unsustainable and to foster (and enforce) innovation on a company level. The focus on minimum wage policy in particular is also intended as a reaction to my discussion of the relationship between automation and wages in chapter 4, namely that increased unemployment exerts a downwards pressure on wages, which in turn increases the relative costs of automation (Grossmann 1929; Suedekum 2018; Schaupp 2021). Rather than accepting a mechanism that both hampers technological development and encourages the creation of particularly bad jobs, enshrining strong minimum wages that rise in tandem with productivity would maintain economic incentives to invest into labour-saving technologies under conditions favourable to workers. Making public funding for the necessary investments triggered by higher wages conditional on the introduction of a four-day working week in turn ensures that employment figures remain strong in the foreseeable future.

Rediscovering productivity-oriented wage policies as a key driver of innovation and other elements of the post-war Swedish model of macroeconomics and applying it to questions of how to manage automation in particular, is a significant contribution to research of these policy papers. So too is the transfer of the debate on Social Wealth Funds – which have been relatively well-discussed in the UK – to the German context, making the connection to (democratically governed) public investment in technological innovation. Finally, my emphasis on public investment as a tool to accelerate investment across the economy, rather than giving even more of an advantage to a limited number of front-runner businesses, adds an alternative perspective on how public innovation support might be directed to be more inclusive and to yield results across the whole of the economy. In the following I will highlight three aspects that might have been developed even further.

Exploring Economic Democracy

One of the main objectives of the policy papers was to illustrate how more democratic control might be introduced into the economy, using public investment as a lever. I opted for a fairly conservative approach in this respect, focusing on expanding (mostly generalizing) existing democratic mechanisms such as the election of the management board of public bodies in Germany and by suggesting the expansion of the gold standard of co-determination on the level of the supervisory board to most private companies and additional funding for existing forms of democratic enterprises such as cooperatives.

But the argument about democracy in the economy in general and the workplace in particular might have been explored further both in terms of possible forms of deepening democracy and their justification. A more detailed discussion of possible ways to justify economic democracy might for instance draw on normative arguments that justify it in terms of the dignity of workers or by highlighting the tensions therein of a society which is democratically organised in the political sphere, yet withholds basic democratic rights to its members in the economic sphere where they spend a large part of their waking hours and which forms the basis of their livelihoods (Naphtali 1928; Vilmar 1975; Meine et al. 2011; Demirović 2018; Georg et al. 2020; Mayrhofer/Wiese 2020).²⁴⁰

Instead of risking that this curious mix of democratic procedures and heteronomy might eventually undermine democracy – either because people simply lose confidence in democracy because they feel powerless in their everyday lives or because this lack of self-efficacy translates into support for the authoritarian right, as discussed in chapter 4 –, democracy might be advanced substantially by transforming workplaces into schools of democracy, endowing citizens with a whole new sense of confidence (Negt 2011). In addition, the instrumental justification provided for economic democracy in TRANSFORM in terms of the better economic performance of companies might be theoretically enriched by a more fundamental discussion of the epistemic potentials of more inclusive innovation processes in the workplace, as for instance initiated by Felix Gerlsbeck and Lisa Herzog (2020). Additional attention might also be paid to how public investment policy and democracy in the workplace might be conceptually connected, e.g. whether, and how, the demands of those workers whose jobs are particularly threatened by the transformation towards a more sustainable economy might be met and how public and individual interests might be balanced in such a process (Löw-Ber 1981; Cooley 2016; Urban 2019; Dörre et al. 2020).²⁴¹

In terms of possible instruments to deepen democracy in the economy and the workplace, a less conservative, more experimental approach might also be advanced. The democratic governance of TRANSFORM might for instance be deepened by supplementing the democratic elections of its administrative board with forms of participatory budgeting that have become more and

²⁴⁰ See Frey et al. (2020b) for a more detailed discussion of economic democracy, particularly in relation to innovation processes and its relevancy for TA research.

²⁴¹ One of the most interesting effects of the historic New Deal was that it emboldened a trade union movement that recently had suffered a series of defeats. The changing regulatory framework and the demonstrated capacity (and willingness) of the state to effectively intervene into economic affairs opened up a space of possibility that in turn spurred on activists across the country, with the government and the labour movement developing a mutually reinforcing dynamic. For a detailed discussion of this historic example, see Lehndorff (2020).

more popular on a municipal level, allowing citizens to directly influence the establishment of specific funding channels. Other instruments might be used to expand existing rights of works councils and the supervisory boards to intervene into business operations in the interest of the wider public (Lawrence et al. 2020; DGB 2022) – or they might endeavour to open up the supervisory boards even beyond a full parity of worker and shareholder representatives (with the TRANSFORM shareholder representatives expected to serve as proxies for the public interest) to ensure that the board’s composition better reflects its actual stakeholders.

To illustrate this, imagine an international agribusiness. While its workers and shareholders all have a clear stake in the way the company conducts its business, so might many others: the population living nearby its production plants might have a legitimate interest that the company pays its taxes to the municipality, provides jobs as well as demand to the local economy and goes about its business without causing too much local pollution. On a national level, these stakeholders might make their voice heard by casting their vote in TRANSFORM elections or contacting the respective members on the supervisory board or parliamentarian if they feel a need to do so. This option could even be strengthened by a partial devolution of TRANSFORM’s structure.

However, some of the people most affected by the business might not have a vote in its operation, however remote – for instance the underaged slave whose labour is exploited by some outside supplier that this business is using to keep prices of its products low. Or the peasant farmer in the Global South whose livelihood depends on the businesses’ fertilizers or hybrid seeds. TRANSFORM might offer special funding to companies willing to experiment with a supervisory board structure that accounts for the highly complex stakeholder structures of modern companies, for instance by committing one third of its board to workers representatives, one third to shareholder representatives and one third to representatives of other stakeholder groups. Only conducting a comprehensive stakeholder-analysis of business operations, leading up to such a decision would likely be an enlightening exercise for many companies.

Conversely, one might also challenge the notion that giving the population greater control over public investment would help advance socially desirable objectives in the first place. This might be particularly questionable when it comes to sustainability: might not a Universal Basic Dividend provide the wrong incentive, tying individual interests even closer to a deeply exploitative system by democratising some of the spoils of exploitation (Berry 2018)? Would people really support keeping investment socially and ecologically sustainable if that would

curtail their own dividends? Or would democratic governance of investment ultimately change little as it would turn all recipients of the dividend into shareholders who care only for short-term profits? While this concern should not be taken lightly, there is reason to believe that the public would be more reasonable in directing investment than the large majority of today's shareholding class.

As strong public support for climate action (UBA 2022) illustrates, there is substantial awareness that something needs to change in the way we live and work – thus there is a good chance that public deliberation about investment criteria would strengthen ecologically sustainable investment practices. At the same time, the vast majority of the population would be ill-advised if they would argue against economic redistribution, decent working conditions and/or increased democratic participation in the workplace. After all, they stand to benefit from these policies. Finally, there is also growing evidence that environmental, social and governance criteria (ESG) do not negatively affect the performance of companies. A meta study concluded “that the business case for ESG investing is empirically very well-founded”, with 90 percent of studies reporting no negative effects of ESG investing on corporate financial performance (Friede et al. 2015: 210). Whatever the result, it would already be a significant improvement to make the principles that should guide investment in our economy subject of public deliberation (Corneo 2017). Even if the results of such deliberation would not differ much from the investment decisions today's equity owners take – which is doubtful – these decisions would at the very least carry greater democratic legitimacy.

The Realm of Freedom at Home

As expounded in chapter 4, the emancipatory promise that the development of the productive forces in general and automation in particular holds according to Critical Theory is, that it might constrain the realm of necessity characterised by necessity, external expediency and mundane considerations (Marx 1991: 958–959). This characterisation does not only apply to forms of work that is performed as waged labour but also to private care work.²⁴² Yet, most literature dealing with the emancipatory potentials of automation reproduces a common bias of the debate on automation which is mostly preoccupied with waged labour (Hester/Stronge 2020). This

²⁴² That the realm of necessity also extends to private care work is particularly evident if one considers that the fact whether certain care tasks are being remunerated is almost entirely indifferent towards the concrete content of these tasks (e.g. the tasks performed by stay-at-home parents vs. the ones performed by baby minders).

focus is on the one hand understandable due to the centrality of wage labour for the livelihoods of people and its oftentimes strong heteronomy that invigorates its critiques. On the other hand, we actually spend more time on unpaid work than paid work (Schwarz/Schwahn 2016); but far stronger economic imperatives exist to automate paid labour than unpaid labour – while high wages in particular decrease the relative costs of automation and incentivise investment into labour-saving technologies, no such business case immediately exists within the private household (Fortunati 2018).²⁴³ In spite of this, or precisely for this reason, it is consistent that emancipatory thinking on automation should also turn towards automation in the private home (Hayden 2000; Hester/Srnicek 2018; Roberts 2018; Roberts et al. 2019; Hester/Srnicek 2023).

After having presented a concept on how public investment might accelerate the adoption of automation in the economy, another policy paper might investigate how automation in the private household could be supported. A proposal might be modelled after the policy suggested by the German Federal Minister of Labour and Social Affairs, Hubertus Heil, to offer vouchers for private households who make use of cleaning services or other forms of domestic help that would subsidise these services by 40 percent until up to 2,000 euro annually (MDR 2021). This scheme might be expanded to also cover spending on labour-saving household appliances. This would effectively decrease the relative costs of automation for the private household and boost investment into businesses manufacturing household appliances, accelerating technological development and driving down prices.

Of course, there will be people arguing that just as workers derive their sense of purpose from paid labour, an increase in home automation would lead to a moral devaluation of private care work (which apparently is deemed worse than the fact that today's society categorically withholds fair economic recognition from this kind of work in the first place) and a loss of purpose, potentially even leading to infantilization (cf. Grunwald 2019a: 88–89). Without being able to engage with this question in great detail here, I want to lean on Pollock's answer provided to this kind of concerns: if our present education system fails at empowering people to introduce a vacuum robot into their home without having to suffer a crisis of identity, it clearly needs to be reformed.

This is not mere uncharitable hyperbole: full automation – whether in the workplace or at home – is simply technologically unfeasible (see my discussion of automation potentials in chapter

²⁴³ A case can be made however that a reduction of unpaid work might make it easier for women to participate in the labour market, e.g. Karimli et al. (2016); C. Frey (2019: 155–163); Coffey et al. (2020).

2). Even a substantial subsidy for home automation would likely not remove the practical challenges that automation technologies face (such as high and spatially distributed manual dexterity requirements and demands for emotional intelligence and pattern recognition) entirely, particularly since most homes are far less structured environments than the average workplace and thus more difficult to navigate.

Even if these practical challenges could unexpectedly be overcome entirely, full automation would still most likely be unaffordable to private households. Accordingly, the notion that a moderate increase in home automation might lead to individual and societal degeneration itself seems hyperbolic. In a charitable interpretation, this hyperbole is meant to convey the belief that humans need to be challenged to flourish and thus ought not be liberated from external expediency and mundane considerations all too much. This position might lend itself well to a philosophy dedicated to Hegel's project of *Verklärung* (see chapter 4); from the point of view of a theory dedicated to human liberation, it appears dubious however. After all, doing the dishes can hardly be considered the conclusion – or even starting point – of human flourishing. Insofar as challenges should be welcomed (and we should maintain a critical stance towards this injunction that oftentimes echoes the imperatives of social conditions that are set up to extract as much effort as possible from the individual), one might as well trust that freed from the yoke of mundane considerations, humans would set themselves much more interesting challenges than those aforementioned. Lastly, and more banally, individuals would of course be free to forego the subsidy if they find vacuuming, dish washing or any other form of unpaid work meditative and relaxing. After all, people today have access to a vast variety of frozen and microwavable foods, yet many prefer to do their own cooking if they can find the time. In other words: the home is just another, yet often neglected, arena in which new technological potentials get realised and have to be appropriated.

Shaping the Labour Market through Public Works Projects

The policy papers in Appendices E and F are largely aimed at accelerating automation adoption with its labour market impacts being compensated by working time reduction. As illustrated in my papers on a four-day working week in the German economy, I am convinced that a reduction to a 30-hour working week alone would be sufficient to reconcile even a decade of accelerated technological development and strong employment numbers. There exists yet another labour market instrument to prevent unemployment however: public works projects. They were central

to the historic New Deal – which provided a role model for TRANSFORM in terms of its level of ambition – and they might be well suited to advance certain policy goals in addition to advancing a policy of full employment: turning back the clock on the austerity the public sector was subjected to in the past decades would for instance generate hundreds of thousands of jobs and improve the public services we all depend on. According to Heintze et al. (2020), reaching the staffing levels of Sweden and Denmark in education, care and the cultural sector alone would generate more than three million additional full time jobs (around four million jobs assuming a 30-hour working week).

But it is not just public service provision that has been lacking in the past decades: where private companies fail to deliver – or fail to do so efficiently or at the necessary scale – the state could also directly employ labour to speed up the necessary transformation towards a more sustainable society with hundreds of thousands of publicly trained craftspersons²⁴⁴ refurbishing houses with insulation and new heating systems and building new ones to provide decent quality and sustainable public housing to all that need or want it. More could busy themselves expanding our collective mobility systems, adapting cities to be more resilient against heatwaves and floods and setting up solar panels and wind turbines across the country. And, sadly, there will be an increased need for human labour to fight the consequences of climate change that are already locked in: to evacuate and care for fellow citizens who have to flee their homes due to fires or floods, to clean up and to rebuild. When faced with ecological disasters, the paralysis caused by austerity is no longer a simple inconvenience – it is outright deadly; maintaining decent staffing levels might make the difference whether sufficient disaster relief might be provided in time or not. Lastly, to slow down and revert emissions, a public works programme might be established that focuses on afforestation and other forms of nature-based solutions to sequester carbon, redirecting the technological potentials we have achieved to mend some of the damage we have done (Griscom et al. 2017; Bastin et al. 2019; Dinerstein et al. 2020; Falk et al. 2020; UNEP 2021a).

Such public works projects might be consolidated in the form of a Civilian Climate Corps – a successor to the historic Civilian Conservation Corps (Leighninger 2007; Maher 2008; Lehndorff 2020) – as suggested by Alexandria Ocasio-Cortez and others in the US (Yoder 2021). Aside from creating hundreds of thousands of dedicated jobs for climate protection, climate change prevention and adaption and the restoration and enhancement of our

²⁴⁴ The switch to clean and renewable energy alone has a projected potential to generate a net increase of more than half a million jobs in Germany (cf. supplementary information to Jacobson et al. (2022)). This figure does not account for a shorter working week.

ecosystems, the state might also reform and expand existing structures such as the “voluntary ecological year” to for instance allow workers to take paid time off their regular work to receive basic training and volunteer with the Climate Corps – increasing public exposure to and identification with its work and providing a temporal and organisational context to increase ecological consciousness.²⁴⁵

²⁴⁵ Phil Jones has suggested a similar „right to a liveable planet“ as part of his work on Universal Workers’ Rights, cf. Jones (2022: 26–27).

Closing Remarks

Having already discussed the papers in detail, I would like to conclude this chapter with a very brief overarching résumé. As stated in the introduction to this chapter, I turned towards policy papers because I am convinced that this publication type corresponds best to the problem-oriented approach of TA research and the notion that the societal impacts of automation are largely due to regulation and economic policy, as developed in chapter 4. Accordingly, I have discussed various aspects of working time reduction as well as redistributive climate protection policy and public investment policy. Overall, I believe that these papers substantially expanded on the academic debate on how to manage automation by putting some of the concepts of the debate into more concrete terms and by promoting a decidedly emancipatory perspective on the issue.

There is, however, a clear downside to Critical Theory's constitutive claim to contribute to societal progress: rather than being content with having presented research that succeeds by its own standards – for example, by being rigorous or innovative – its true criterion of success, whether the societal progress it envisages actually occurs, is largely beyond its control. It can only hope that the research it puts out there happens to fall on fertile ground and eventually bears fruit.²⁴⁶ I am content with the fact that I have been able to help sketch out the basic contours of a progressive technopolitics of automation, and in so doing, however remotely, to contribute to the formation of the intellectual infrastructure from which emancipatory political projects in Britain, Spain and hopefully eventually also Germany might draw. As the debates on how to manage automation are much more advanced in the trade unions and parts of the Labour Party in the UK, I was also more than happy to make a small contribution to the visibility of progressive policies in Germany, broadening the variety of options to manage automation. In particular, the experience of introducing this perspective on automation into the public sphere through media appearances, talks and workshops with stakeholders – and seeing the stimulation that it enacts within our collective imagination – has been personally rewarding.

²⁴⁶ The allegory of the “message in a bottle” comes to mind that has repeatedly been linked to the Frankfurt School (not least by Horkheimer and Adorno themselves).

6 Conclusion

This book began by invoking a spectre haunting late-capitalist society: the spectre of technological unemployment. True to TA's central commitment of "supporting, strengthening and enhancing reflexivity in all epistemic and social fields of reasoning and decision-making on shaping the scientific and technological advance, on the usage of its outcomes and on dealing with the consequences to present and future society" (Grunwald 2019b: 90), much of the volume was devoted to demystifying this spectre.

Epistemic Reflexivity

This demystification proceeded in four steps: first, I discussed in detail the state of the art of research on automation and its impact on the labour market. I concluded that the very notion of technological unemployment is in fact an oversimplification. Rather, I argued, that technological unemployment should be understood as a complex phenomenon emerging from the interaction between technological development and the labour market (itself shaped by macroeconomic trends), and not as an intrinsic property of technological development as such. Furthermore, I discussed two competing approaches to the discussion of the subject of automation in contemporary research: studies focusing on the technological potentials for automation on the one hand and macroeconomic projections trying to grasp its labour market effects on the other hand. While acknowledging the immediate usefulness of macroeconomic projections for economic policy, I highlighted the methodological and, perhaps even more importantly, normative limitations of studies that follow this approach. In contrast, studies that focus on the potential for automation at the technological level can be considered too abstract and thus both limited in their relevance and leading to needless automation anxiety. These studies, on the other hand, have the merit that they make do with relatively limited sets of assumptions and are best suited to inform an open debate about what technological potentials might be exploited by competing technopolitical projects.

Discursive Reflexivity

In a second step, I reconstructed the dominant discourse of the social partners on automation in Germany and demonstrated that it frames automation predominantly as a tool for increasing global competitiveness, while concerns regarding ecological sustainability and automation

anxiety are largely marginalised. The successful implementation of Industry 4.0 as a strategic initiative to promote a discourse focused on the economic potentials of technological development was a prime example of this: it opened up a relatively wide space for heterogeneous social actors to link their specific agendas to the issue of technological development, thereby helping to mediate the interests of employers, the government and the trade unions.

However, this inclusivity does not translate into a pluralistic range of policies regarding automation that would represent qualitatively distinct approaches to automation. Rather, this inclusivity comes at the cost of actors involved in this technocorporatist process having to subordinate their respective interests to the predetermined objective of the Industry 4.0: the increased competitiveness of the German economy. Finally, I provided a materialist interpretation of the prevalence of the Industry 4.0 discourse by reflecting its fit to the economic imperatives to which economic actors are subjected to in a capitalist economy.

Politico-Economic Reflexivity

In a third step, I moved beyond both the marginalisation of the negative social impacts of automation and a restrictive perspective on automation that focuses on a narrow understanding of its competitive potentials only. I did so by first discussing the political economy of automation in order to gain a better understanding as to why automation takes place under current economic conditions – and why it does not. This allowed me to reconstruct both the drivers of automation in capitalist economies (i.e. the quest for temporary extra surplus-value leading to competitive pressure within sectors) and its limiting factors (e.g. low wages rendering automation unattractive). This reconstruction made it clear that, under current conditions, automation is driven by economic rationality on the business-level and is relatively ignorant of normative issues such as social and ecological sustainability.

However, this does not mean that automation would not affect these issues. In the second part of my theoretical chapter, I presented an argument as to how automation might contribute to socioeconomic, political and ecological destabilisation. Most notably, I argued that humanity is facing an economic and ecological double crisis, which implies that the dominant strategy of managing the labour market effects of automation through economic growth will exacerbate societal risks in the long term.

From this bleak prospect, I started to explore basic features of an approach to automation that would point beyond today's predicaments. Having extensively discussed the interdependence of the impacts of technological development and social conditions, I followed Adorno in identifying the overcoming of the powerlessness of most people through a politics of collective self-emancipation as a necessary precondition for any progressive project. I thus pursued the notion of a reorientation away from the assessment of the likely impacts of automation and towards the conscious transformation of socioeconomic conditions as the core of a technopolitical project committed to harnessing automation in the interests of shared prosperity, ecological sustainability and increased leisure. Emphasising the determining role of social conditions in technological development in this way not only underlines the social conditionality of automation anxiety – it also points towards an alternative technopolitics that could dispel it for good and endow automation with different ends.

Beyond Reflexivity: Broadening the Horizon of Policy Making

In a fourth step, I presented a variety of policy options that decision-makers might consider in order to begin to implement such a technopolitical project, discussing a number of policy papers that I developed throughout my doctoral research and how they can be expanded on. In line with Critical Theory's emphasis on the importance of free time for human flourishing, much of my discussion was focused on ways to facilitate the implementation of a shorter working week. Another common theme was how to reconcile accelerated technological development and social and ecological sustainability, e.g. how higher wages, more ambitious environmental policies and public investment might be combined to foster (and enforce) innovation. By developing concrete proposals as to how the economic framework, within which technological development is carried out, can be changed, and how increased productivity might be translated into real improvements to peoples' lives, I hope to have contributed to the development of a politics of technological transformation that might instil hope and a sense of desire for a better life – something that is often lacking in policy debates about automation (Feenberg 2002; Weeks 2011; Srnicek/Williams 2015; Urry 2016).

As a whole, this book represents a critical extension of much of the contemporary debate on automation, both in terms of its normative trajectory as well as in terms of policy. It also introduces the debate on automation in Germany to an international readership and in turn adapts an emancipatory discourse on automation that has been developed in Anglophone

literature in recent years (e.g. Srnicek/Williams 2015; Mason 2016; Roberts et al. 2017; Roberts et al. 2019; Spencer/Slater 2020) to the German context, bringing it into dialogue with Critical Theory in particular. As a result, I have put forward a perspective on automation that differs from the dominant discourse on automation by highlighting its emancipatory potentials while at the same time steering clear of naïve techno-optimism by emphasising the social determinedness of the impacts of automation (implying the need for far-reaching societal transformation in order to realise automation’s emancipatory potentials). I also introduced ecological boundaries into the discussion, which have to be acknowledged even by the most ardent proponents of automation if they want to develop a technopolitics fit for the 21st century.

Since I have already discussed possible ways of advancing the debate on automation extensively in the last chapter, I would like to address possible objections to the undertaking of this book instead. The first one concerns its pertinence in general: after all, the German economy – and many other developed economies for that matter – seems to be facing an acute labour shortage. Can the impacts of automation really be considered a pressing issue of our time, given this context? Even if one accepts that fears of technological unemployment may not be justified at the moment, these fears cannot be dismissed in the abstract: even if employment figures are strong right now, a radically different labour market could be only one recession away, particularly if businesses were to use it to modernise their production capacities (cf. my discussion of jobless recoveries in chapter 4.2). Whether automation leads to technological unemployment depends, under current conditions, on the constant twists and turns of capitalist economy. Being prepared for what might happen if the labour market swings the other way is a basic requirement of precautionary thinking. Leaving the reflection of the impacts of technology to a time when negative effects have already materialised represents precisely the kind of organised irresponsibility that is contrary to the kind of reflected reasoning about the impacts of technology that TA seeks to promote.

Moreover, the recent commotion regarding artificial intelligence applications such as “Midjourney” and “ChatGPT” illustrates how quickly automation anxiety can take hold – despite constant complaints about a looming shortage of skilled labour and even amongst skilled sections of the population.²⁴⁷ As I argued in chapter 4.2, even the mere fear of technological unemployment – however potentially unjustified – can become problematic if it

²⁴⁷ It is particularly interesting, that this latest generation of AI-powered, generative software can be seen as emulating a form of creativity that was until recently considered an insurmountable challenge for automation (see my discussion of engineering bottlenecks in chapter 2.3).

is not translated into progressive technopolitical demands. And all this is quite apart from the fact that today's strong employment figures are achieved on the back of a growth-oriented economic strategy, attaining social pacification today at the cost of increased socioeconomic upheaval for future generations (cf. my discussion of the economic and ecological double crisis humanity is facing today in chapter 4.2). Finally, as I have argued, an active management of automation and a transformation of the economy to this effect is not just essential to counteract the potentially detrimental impacts automation might have – it is also necessary to unleash its emancipatory potential.

This brings me to the second potential objection that might be raised to the basic approach I have taken in my research: its normative character. This issue already dominates much of my introduction. I hope to have shown that a perspective on automation informed by Critical Theory, and a Marxist critique of political economy more generally, is capable of increasing the reflexivity of the debate on automation, particularly by highlighting the socioeconomic embeddedness of technological development. At the very minimum, such a transparently normative approach could be considered a contribution to a more pluralist debate, in theoretical as well as in policy terms. More than that, since the potential impacts of automation and the fears accompanying them are largely socially determined, radical social critique is needed to address them comprehensively. It is this radical critique that reconciles TA's commitment to enhanced reflexivity (or more ambitiously: Enlightenment) and Critical Theory's conviction that "the freeing of man from superstitious belief in evil forces, in demons and fairies, in blind fate – in short, the emancipation from fear" requires the denunciation of contemporary social conditions and the stunted forms of rationality that they tend to give rise to (Horkheimer 2004: 126). In other words, the most adequate way to dispel the spectre of technological unemployment is to show that it is not some transhistorical demon haunting humanity, but rather a creature whose existence is predicated on antagonistic social conditions that humanity might yet overcome.

This points to a consequential and final objection: questioning my attempt to move beyond the mere reinterpretation of the issue of automation through a detailed and exploratory engagement with policy. Not only might this be considered a departure from the usual discursive form of scholarship found in doctoral research, but it also falls short of the Frankfurt School's aspiration to transform the totality of capitalist social conditions as a whole. As I have shown in chapter five however, Adorno and Horkheimer were aware that Critical Theory's focus on a radical critique of capitalism was ultimately insufficient and needed to be complemented by a scientific

discussion of tangible steps forward to leverage the objective productive potentials of society to enable a dignified life for all (Adorno/Bloch 1978; Horkheimer 1985).

In the face of the multiple and exacerbating crises of our time, I am convinced that forms of research that actively explore ways to transform our economy for the better are a necessary extension of social critique. As such, I consider my engagement with policy issues a fruitful concretisation of the line of thought developed in chapters two to four; a concretisation that has also allowed me, true to TA's character as a mode of scientific advisory practice, to engage in continuous and extensive transdisciplinary interactions with a range of stakeholders including trade unionists, journalists, political actors and environmental activists. It also provided me with a topical form of scientific expression to take my earlier, somewhat stark discussion of automation in a more propositional, even utopian direction: after all, the productive potentials of late capitalist society ought not be discussed merely in terms of societal risks, but rather should be appreciated as constituting an immense potential for a better life for all.

As such, my discussion of ways to implement a shorter working week and the socialisation of the fruits of automation might form part of a broad intellectual development reappropriating a sense of the utopian potentials objectified in the technological marvels of our time – and an acute awareness that a profound transformation of our economic conditions is required to fully realise them. A technopolitical project that redeems these potentials in the interest of the common good and in an ecologically sustainable way may fall short of some of the most exuberant imaginaries stimulated by automation, which can promise a society of fully automated luxury for all (Bastani 2019). However, by replacing the anarchy of unchained capitalist economies with democratic deliberation and the conscious design of technological development, the vision put forward here would constitute something that is achieved endlessly in individual areas of society and yet is lacking at the level of the whole: Progress.

References

- Acemoglu, D., Johnson, S. & Robinson, J. (2005) The Rise of Europe: Atlantic Trade, Institutional Change, and Economic Growth. *American Economic Review* **95** (3), pp. 546–579.
- Acemoglu, D. & Restrepo, P. (2020) Robots and Jobs: Evidence from US Labor Markets. *Journal of Political Economy* **128** (6), pp. 2188–2244.
- Adam, B. (2011) Towards a Twenty-First-Century Sociological Engagements with the Future. *Insights* **4** (11), pp. 1–18.
- Adorno, T. W. (1972a) Gesellschaftstheorie und empirische Forschung. In: Adorno, T. W. (ed.) *Soziologische Schriften I*. Suhrkamp, Frankfurt am Main, pp. 538–546.
- Adorno, T. W. (1972b) Soziologie und empirische Forschung. In: Adorno, T. W. (ed.) *Soziologische Schriften I*. Suhrkamp, Frankfurt am Main, pp. 196–216.
- Adorno, T. W. (1972c) Spätkapitalismus oder Industriegesellschaft? Einleitungsvortrag zum 16. Deutschen Soziologentag. In: Adorno, T. W. (ed.) *Soziologische Schriften I*. Suhrkamp, Frankfurt am Main, pp. 354–370.
- Adorno, T. W. (1977) Spengler nach dem Untergang. In: Adorno, T. W. (ed.) *Kulturkritik und Gesellschaft I/II*. Suhrkamp, Frankfurt am Main, pp. 47–71.
- Adorno, T. W. (1998) Fortschritt. In: Adorno, T. W. (ed.) *Stichworte: Kritische Modelle 2*. Suhrkamp, Frankfurt am Main, pp. 29–50.
- Adorno, T. W. (2006) *Zur Lehre von der Geschichte und von der Freiheit*. Suhrkamp, Frankfurt am Main.
- Adorno, T. W. (2019) *Aspekte des neuen Rechtsradikalismus: Ein Vortrag*. Suhrkamp, Frankfurt am Main.
- Adorno, T. W. (2021) *Minima Moralia: Reflexionen aus dem beschädigten Leben*. Suhrkamp, Frankfurt am Main.
- Adorno, T. W. & Becker, H. (1999) Education for maturity and responsibility. *History of the Human Sciences* **12** (3), pp. 21–34.
- Adorno, T. W. & Bloch, E. (1978) Etwas fehlt... Über die Widersprüche der utopischen Sehnsucht. In: Bloch, E. (ed.) *Tendenz, Latenz, Utopie*. Suhrkamp, Frankfurt am Main, pp. 350–368.
- Adorno, T. W. & Gehlen, A. (1974) Ist die Soziologie eine Wissenschaft vom Menschen? Ein Streitgespräch. In: Grenz, F. (ed.) *Adornos Philosophie in Grundbegriffen: Auflösung einiger Deutungsprobleme. Mit einem Anhang: Theodor W. Adorno und Arnold Gehlen: Ist die Soziologie eine Wissenschaft vom Menschen? Ein Streitgespräch*. Suhrkamp, Frankfurt am Main, pp. 225–251.
- Adorno, T. W. & Horkheimer, M. (2020) Towards a New Manifesto? *New Left Review*. <https://newleftreview.org/issues/ii65/articles/theodor-adorno-max-horkheimer-towards-a-new-manifesto.pdf>. Accessed 3/15/2020.
- Ahlert, G., Distelkamp, M., Lutz, C., Meyer, B., Mönnig, A. & Wolter, M. I. (2009) Das IAB/INFORGE-Modell. In: Zika, G. & Schnur, P. (eds.) *Das IAB/INFORGE-Modell: Ein sektorales makroökonomisches Projektions- und Simulationsmodell zur Vorausschätzung des längerfristigen Arbeitskräftebedarfs*. W. Bertelsmann, Bielefeld, pp. 15–170.
- Albrecht, T. (2016) Gute Arbeit im digitalen Zeitalter. In: German Trade Union Confederation (ed.) *Dossier Digitalisierung: Zusammenstellung von (Gegenblende-)Artikeln 2010-2016*, Berlin, pp. 41–45.
- Albrecht, T. & Ammermüller, A. (2016) Kein Ende der Arbeit in Sicht. In: BMAS (ed.) *Digitalisierung der Arbeitswelt: Werkheft 01*, Berlin, pp. 40–46.
- Aldred, J. (2020) This pandemic has exposed the uselessness of orthodox economics. *The Guardian*. <https://www.theguardian.com/commentisfree/2020/jul/05/pandemic-orthodox-economics-covid-19>. Accessed 7/7/2020.

- Altwater, E. (2017) Kapitalozän. Der Kapitalismus schreibt Erdgeschichte. *LuXemburg* (2/3), 108-117.
- Anelli, M., Colantone, I. & Stanig, P. (2019) We Were the Robots: Automation and Voting Behavior in Western Europe. *Institute of Labor Economics*. <http://ftp.iza.org/dp12485.pdf>. Accessed 12/17/2020.
- Aristotle (1999) *Politics*. Batoche Books, Kitchener.
- Arlt, H.-J., Kempe, M. & Osterberg, S. (2017) *Die Zukunft der Arbeit als öffentliches Thema: Presseberichterstattung zwischen Mainstream und blinden Flecken*. Otto Brenner Stiftung, Frankfurt am Main.
- Assibong, P. A., Wogu, I. A. P., Sholarin, M. A., Misra, S., Damasevičius, R. & Sharma, N. (2020) The Politics of Artificial Intelligence Behaviour and Human Rights Violation Issues in the 2016 US Presidential Elections: An Appraisal. In: Sharma, N., Chakrabarti, A. & Balas, V. E. (eds.) *Data Management, Analytics and Innovation*. Springer Singapore, Singapore, pp. 295–309.
- Audickas, L. (2018) UK political party membership figures: August 2018. *House of Commons Library*. <https://commonslibrary.parliament.uk/uk-political-party-membership-figures-august-2018/>. Accessed 9/25/2019.
- Auffenberg, J., Becka, D., Evans, M., Kokott, N., Schleicher, S. & Braun, E. (2022) "Ich pflege wieder, wenn ...": Potenzialanalyse zur Berufsrückkehr und Arbeitszeitaufstockung von Pflegefachkräften. *Arbeitnehmerkammer Bremen*. https://www.arbeitnehmerkammer.de/fileadmin/user_upload/Downloads/Politik/Rente_Gesundheit_Pflege/Bundesweite_Studie_Ich_pflege_wieder_wenn_Langfassung.pdf. Accessed 7/15/2022.
- Autonomy (2019) 'Ecological Limits of Work' paper makes a media splash! *Autonomy Research*. <https://autonomy.work/portfolio/ecologicallimitscoverage/>. Accessed 8/29/2019.
- Autonomy (2020) UK polling: 63% support government exploring the idea of a four-day week. *Autonomy Research*. <https://autonomy.work/portfolio/4dayweekpolling/#1588759570965-9424737d-e0ba>. Accessed 11/24/2020.
- Autonomy (2021) Costing A 4 Day Week in the German Public Sector. *Autonomy Research*. <https://autonomy.work/portfolio/4dayweekgermany/>. Accessed 5/22/2022.
- Autonomy (2022) The world's biggest four-day week trial is underway. *Autonomy Research*. <https://autonomy.work/uk-4-day-week-trial/>. Accessed 6/24/2022.
- Autor, D. (2014) Polanyi's Paradox and the Shape of Employment Growth. In: Federal Reserve Bank Kansas City (ed.) *Re-Evaluating Labor Market Dynamics Economic Policy Symposium, Wyoming, August 21-23, 2014*, Kansas City, pp. 129–177.
- Autor, D. (2015a) Paradox of Abundance. In: Rangan, S. (ed.) *Performance and Progress*. Oxford University Press, Oxford, pp. 237–260.
- Autor, D. (2015b) Why Are There Still So Many Jobs? The History and Future of Workplace Automation. *Journal of Economic Perspectives* **29** (3), pp. 3–30.
- Autor, D. & Dorn, D. (2013) The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market. *American Economic Review* **103** (5), pp. 1553–1597.
- Autor, D. & Salomons, A. (2018) *Is Automation Labor-Displacing? Productivity Growth, Employment, and the Labor Share*. National Bureau of Economic Research, Cambridge (MA).
- Bach, S., Isaak, N., Kemfert, C. & Wägner, N. (2019) Lenkung, Aufkommen, Verteilung: Wirkungen von CO₂-Bepreisung und Rückvergütung des Klimapakets. *DIW aktuell* (24).
- BAnst PT (2018) Engagierter Ruhestand. *Bundesanstalt für Post und Telekommunikation (Deutsche Bundespost)*. https://www.banst-pt.de/fileadmin/banst/content/Versorgung/Merkblaetter_und_Formulare/30.10.2018_Engagierter_Ruhestand.pdf. Accessed 2/15/2019.

- Barrott, C., Brown, C. M. & Cumbers, A. et al. (2017) Alternative Models of Ownership: Report to the Shadow Chancellor of the Exchequer and Shadow Secretary of State for Business, Energy and Industrial Strategy. *Labour Party*. <https://labour.org.uk/wp-content/uploads/2017/10/Alternative-Models-of-Ownership.pdf>. Accessed 8/15/2019.
- Bastani, A. (2019) *Fully automated luxury communism: A manifesto*. Verso, London.
- Bastin, J.-F., Finegold, Y. & Garcia, C. et al. (2019) The global tree restoration potential. *Science (New York, N.Y.)* **365** (6448), pp. 76–79.
- Bauer, A. & Kastenhofer, K. (2019) Policy advice in technology assessment: Shifting roles, principles and boundaries. *Technological Forecasting and Social Change* **139**, pp. 32–41.
- BBC (2022) Four-day week campaign: MP submits bill to Parliament. *British Broadcasting Corporation*. <https://www.bbc.com/news/uk-england-merseyside-63026695>. Accessed 1/12/2023.
- BDA (2015a) Arbeitswelt 4.0 - Chancen nutzen, Herausforderungen meistern: Positionen der BDA zum Grünbuch "Arbeiten 4.0" des Bundesministeriums für Arbeit und Soziales. *Confederation of German Employers' Associations*. https://www.bmas.de/SharedDocs/Downloads/DE/Arbeitsmarkt/Arbeiten-4-0/stellungnahme-bda.pdf;jsessionid=2E4D52DFD30A88A950F8EDD4C166A793.delivery2-replication?__blob=publicationFile&v=1. Accessed 7/18/2020.
- BDA (2015b) Geschäftsbericht 2015. *Confederation of German Employers' Associations*. [https://www.arbeitgeber.de/www/arbeitgeber.nsf/res/63E0676447467B20C1257F1F00312553/\\$file/BDA_GB_2015.pdf](https://www.arbeitgeber.de/www/arbeitgeber.nsf/res/63E0676447467B20C1257F1F00312553/$file/BDA_GB_2015.pdf). Accessed 5/18/2018.
- BDA (2015c) Chancen der Digitalisierung nutzen: Positionspapier der BDA zur Digitalisierung von Wirtschaft und Arbeitswelt. *Confederation of German Employers' Associations*. [https://arbeitgeber.de/www/arbeitgeber.nsf/res/6308287022D75F36C1257FA2005707DD/\\$file/BDA_Chancen_Digitalisierung.pdf](https://arbeitgeber.de/www/arbeitgeber.nsf/res/6308287022D75F36C1257FA2005707DD/$file/BDA_Chancen_Digitalisierung.pdf). Accessed 5/18/2018.
- BDA (2016) Bedingungsloses Grundeinkommen. *Confederation of German Employers' Associations*. [https://www.arbeitgeber.de/www/arbeitgeber.nsf/res/2FB044F531DDA73CC12574F200330E8E/\\$file/BedingungslosesGrundeinkommen.pdf](https://www.arbeitgeber.de/www/arbeitgeber.nsf/res/2FB044F531DDA73CC12574F200330E8E/$file/BedingungslosesGrundeinkommen.pdf). Accessed 7/18/2018.
- Beck, U. (2012) 1973 - Steinkühlerpause erstreikt. *LabourNet*. <http://archiv.labournet.de/diskussion/arbeitsalltag/az/steinkuehlerpause.html>. Accessed 11/26/2019.
- Behringer, J., van Treeck, T. & Truger, A. (2020) How to reduce Germany's current account surplus? *Forum New Economy*. <https://ideas.repec.org/p/agz/wpaper/2008.html>. Accessed 1/15/2021.
- Benanav, A. (2019) Automation and the Future of Work-I. *New Left Review* (119), pp. 5–38.
- Benjamin, B. (2021) Developmental Aspiration at the End of Accumulation: The New International Economic Order and the Antinomies of the Bandung Era. *Mediations* (32.1), pp. 37–70.
- Benjamin, W. (2002) *The arcades project*. Harvard University Press, Cambridge (MA).
- Benjamin, W. (2006) *Walter Benjamin: Selected writings*. Harvard University Press, Cambridge (MA).
- Berry, C. (2018) Democratising Capital with Social Wealth Funds. In: McCann, D., Schifferes, S. & Lansley, S. et al. (eds.) *Social Wealth Funds in the UK*. Autonomy, London, pp. 71–72.
- Besley, T. & Hennessy, P. (2009) *Letter to Her Majesty The Queen: The Global Financial Crisis - Why Didn't Anybody Notice?* British Academy, London.
- Betz, G. (2016) *Fallacies in Scenario Reasoning*. Institut für Technikzukünfte, Karlsruhe.
- Birch, J. (2022) Expanding Remote Work Won't Inherently Empower Workers. It Could Do the Opposite. *Jacobin*. <https://jacobin.com/2022/02/work-from-home-covid-labor-organizing-collective-workpalce>. Accessed 3/13/2022.
- Bischoff, J. (2020) Eine kritische Theorie des neuen Rechtsradikalismus: Was eine Analyse von Theodor W. Adorno für uns bedeutet. *Sozialismus* **46** (9).

- Bivens, J. (2022) Corporate profits have contributed disproportionately to inflation. How should policymakers respond? *Economic Policy Institute*. <https://www.epi.org/blog/corporate-profits-have-contributed-disproportionately-to-inflation-how-should-policymakers-respond/>. Accessed 4/23/2022.
- Bivens, J. & Mishel, L. (2015) Understanding the historic divergence between productivity and a typical worker's pay: Why it matters and why it's real. *Economic Policy Institute*. <https://files.epi.org/2015/understanding-productivity-pay-divergence-final.pdf>. Accessed 12/20/2018.
- BMAS (2015) Green Paper Work 4.0: Re-Imagining Work. *Federal Ministry of Labour and Social Affairs*. https://www.bmas.de/SharedDocs/Downloads/DE/Publikationen/arbeiten-4-0-green-paper.pdf?__blob=publicationFile&v=1. Accessed 7/15/2019.
- BMAS (2017) White Paper Work 4.0: Re-Imagining Work. *Federal Ministry of Labour and Social Affairs*. https://www.bmas.de/SharedDocs/Downloads/EN/PDF-Publikationen/a883-white-paper.pdf?__blob=publicationFile&v=3. Accessed 7/15/2019.
- BMWi (2018) Monitoring-Report Wirtschaft DIGITAL 2018. *Federal Ministry for Economic Affairs and Energy*. <https://www.econstor.eu/bitstream/10419/182035/1/1029662312.pdf>. Accessed 2/15/2019.
- BMWi (2019) National Industrial Strategy 2030: Strategic guidelines for a German and European industrial policy. *Federal Ministry for Economic Affairs and Energy*. https://www.bmwi.de/Redaktion/EN/Publikationen/Industry/national-industry-strategy-2030.pdf?__blob=publicationFile&v=9. Accessed 3/20/2020.
- Boewe, J. (2016) "Arbeiten 4.0" - Agenda-Building für eine neue Flexibilisierungsoffensive. *Rosa-Luxemburg-Stiftung*. https://www.rosalux.de/fileadmin/rls_uploads/pdfs/Standpunkte/Standpunkte_38-2016.pdf. Accessed 10/21/2018.
- Boge, F. J. & Grünke, P. (2019) Computer simulations, machine learning and the Laplacean demon: Opacity in the case of high energy physics? <http://philsci-archive.pitt.edu/17637/>. Accessed 9/12/2020.
- Bonin, H., Gregory, T. & Zierahn, U. (2015) *Übertragung der Studie von Frey/Osborne (2013) auf Deutschland: Endbericht*. Zentrum für Europäische Wirtschaftsforschung, Mannheim.
- Bonneuil, C. & Fressoz, J.-B. (2017) *The shock of the anthropocene: The earth, history and us*. Verso, London.
- Bontrup, H.-J. (2016) Die Gewerkschaften sind mehr denn je gefordert. *Gegenblende*. <https://gegenblende.dgb.de/artikel/++co++48ec8d3c-c1de-11e6-985d-525400e5a74a>. Accessed 8/17/2020.
- Borup, M., Brown, N., Konrad, K. & van Lente, H. (2006) The sociology of expectations in science and technology. *Technology Analysis & Strategic Management* **18** (3-4), pp. 285–298.
- Boyce, J. K. (2019) *The case for carbon dividends*. Polity Press, Cambridge.
- BpB (2020) Voll- und Teilzeitbeschäftigte. *Bundeszentrale für politische Bildung*. <https://www.bpb.de/kurz-knapp/zahlen-und-fakten/soziale-situation-in-deutschland/61705/voll-und-teilzeitbeschaeftigte/>. Accessed 12/26/2020.
- BR Fernsehen (2022) beta stories - So funktioniert die 4-Tage-Woche. *Bayerischer Rundfunk*. <https://www.br.de/br-fernsehen/programmkalender/sendung-3363728.html>. Accessed 3/15/2022.
- Brand, U. & Wissen, M. (2018) *The limits to capitalist nature: Theorizing and overcoming the imperial mode of living*. Rowman & Littlefield International, London.
- Brandes, P. & Wattenhofer, R. (2016) Opening the Frey/Osborne Black Box: Which Tasks of a Job are Susceptible to Computerization? <http://arxiv.org/pdf/1604.08823v2>. Accessed 10/20/2020.

- Breimaier, S. (2017) Work 4.0: How Germany is shaping the future of work. *London School of Economics and Political Science*. <https://blogs.lse.ac.uk/businessreview/2017/03/22/work-4-0-how-germany-is-shaping-the-future-of-work/>. Accessed 2/11/2020.
- Briefs, U. (1988) Grüne Vorstellungen zur Arbeits- und Automationspolitik. In: Projektgruppe Automation und Qualifikation (ed.) *Politik um die Arbeit*. Argument, Berlin, pp. 147–158.
- Brinkmann, U. & Nachtwey, O. (2013) Postdemokratie, Mitbestimmung und industrielle Bürgerrechte. *Politische Vierteljahresschrift* **54** (3), pp. 506–533.
- Brödner, P. (2018) Industrie 4.0 und Big Data – wirklich ein neuer Technologieschub? In: Hirsch-Kreinsen, H., Ittermann, P. & Niehaus, J. (eds.) *Digitalisierung industrieller Arbeit*. Nomos, Baden-Baden, pp. 323–346.
- Brown, N., Rappert, B., Webster, A. & Adam, B. (2000) *Contested Futures: A Sociology of Prospective Techno-Science*. Taylor and Francis, Florence.
- Brownlee, J. (2019) How Much Training Data is Required for Machine Learning? <https://machinelearningmastery.com/much-training-data-required-machine-learning/>. Accessed 12/22/2019.
- Bulle, R. J. (2018) The climate lobby: a sectoral analysis of lobbying spending on climate change in the USA, 2000 to 2016. *Climatic Change* **149** (3-4), pp. 289–303.
- Brzeski, C. & Burk, I. (2015) *Die Roboter kommen: Folgen der Automatisierung für den deutschen Arbeitsmarkt*. ING DiBa, Frankfurt am Main.
- Bücker, T. (2022) *Alle_Zeit: Eine Frage von Macht und Freiheit*. Ullstein, Berlin.
- Bundestag (2018) Antwort der Bundesregierung auf die Kleine Anfrage der Abgeordneten Jessica Tatti, Susanne Ferschl, Matthias W. Birkwald, weiterer Abgeordneter und der Fraktion DIE LINKE: Produktivität, Arbeit und Einkommen im Zeitalter der Digitalisierung. *Drucksache* (19/3686).
- Bundestag (2022) Antwort der Bundesregierung auf die Kleine Anfrage der Abgeordneten Susanne Ferschl, Gökyay Akbulut, Matthias W. Birkwald, weiterer Abgeordneter und der Fraktion DIE LINKE: Homeoffice als Arbeitsform. *Drucksache* (20/4120).
- Burgis, B. (2019) You Deserve to Live Close to Where You Work. *Jacobin*. <https://jacobin.com/2019/11/live-close-to-work-beto-orourke-public-affordable-housing>. Accessed 12/26/2019.
- Burrell, J. (2016) How the machine ‘thinks’: Understanding opacity in machine learning algorithms. *Big Data & Society* **3** (1).
- Butler, L. (2018) INTERVIEW: Technology, capitalism, and the future of the left: Nick Srnicek in conversation with Lise Butler. *Renewal: a Journal of Labour Politics* **26** (1), pp. 18–31.
- Butollo, F. & Engel, T. (2015) Industrie 4.0 - arbeits- und gesellschaftspolitische Perspektiven: Zwischen Dystopie und Euphorie. *Z - Zeitschrift Marxistische Erneuerung* (103), pp. 29–41.
- Butterwegge, C. (2020) Der Mythos vom „Aufstieg durch Bildung“. *Makronom*. <https://makronom.de/der-mythos-vom-aufstieg-durch-bildung-36961>. Accessed 10/7/2020.
- BVerfG (2019) *Judgment of the First Senate of 5 November 2019: - 1 BvL 7/16 -*.
- C. Frey (2019) *The technology trap: Capital, labor, and power in the age of automation*. Princeton University Press, Princeton.
- C. Frey, Berger, T. & Chen, C. (2018) Political machinery: did robots swing the 2016 US presidential election? *Oxford Review of Economic Policy* **34** (3), pp. 418–442.
- C. Frey & Osborne, M. (2013) The Future of Employment: How susceptible are jobs to computerisation? *Oxford Martin School*. <https://www.oxfordmartin.ox.ac.uk/downloads/academic/future-of-employment.pdf>. Accessed 12/8/2020.

- C. Frey & Osborne, M. (2018) Automation and the future of work – understanding the numbers. *Oxford Martin School*. <https://www.oxfordmartin.ox.ac.uk/blog/automation-and-the-future-of-work-understanding-the-numbers/>. Accessed 11/15/2018.
- Caffentzis, G. (2008) From the Grundrisse to Capital and Beyond: Then and Now. *Workplace: A Journal for Academic Labor* (15).
- Candeias, M. (ed.) (2021) *Klassentheorie - Vom Making und Remaking*. Argument, Hamburg.
- Candeias, M. & Krull, S. (eds.) (2022) *Spurwechsel: Studien zu Mobilitätsindustrien, Beschäftigungspotenzialen und alternativer Produktion eine Veröffentlichung der Rosa-Luxemburg-Stiftung*. VSA, Hamburg.
- Carchedi, G. & Roberts, M. (eds.) (2018) *World in Crisis: A Global Analysis of Marx's Law of Profitability*. Haymarket Books, Chicago.
- Chancel, L. & Piketty, T. (2015) Carbon and inequality: from Kyoto to Paris: Trends in the global inequality of carbon emissions (1998-2013) & prospects for an equitable adaptation fund. *Paris School of Economics*. <http://piketty.pse.ens.fr/files/ChancelPiketty2015.pdf>. Accessed 7/15/2021.
- Chang, J.-H. & Huynh, P. (2016) ASEAN in transformation: The future of jobs at risk of automation. *International Labour Organization*. https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/--act_emp/documents/publication/wcms_579554.pdf. Accessed 3/18/2019.
- change.org (2022) 8. Mai zum Feiertag machen! Was 77 Jahre nach Befreiung vom Faschismus getan werden muss! <https://www.change.org/p/8-mai-zum-feiertag-machen-was-77-jahre-nach-befreiung-vom-faschismus-getan-werden-muss-tagderbefreiung-bkagvat-bundesrat>. Accessed 3/21/2022.
- Clark, J. P. (2017) Creative Destruction: Emerging Technology and the Changing Course of Job Creation. In: LaGrandeur, K. & Hughes, J. J. (eds.) *Surviving the Machine Age: Intelligent Technology and the Transformation of Human Work*. Springer International Publishing, Cham, pp. 35–50.
- Coffey, C., Espinoza Revollo, P. & Harvey, R. et al. (2020) *Time to Care: Unpaid and underpaid care work and the global inequality crisis*. Oxfam, Oxford.
- Colander, D., Goldberg, M. & Haas, A. et al. (2009) The Financial Crisis and the Systemic Failure of Academic Economics. *Critical Review* **21** (2-3), pp. 249–267.
- Colantone, I. & Stanig, P. (2019) The Surge of Economic Nationalism in Western Europe. *Journal of Economic Perspectives* **33** (4), pp. 128–151.
- Cooley, M. (2016) *Architect or bee? The human price of technology*. Spokesman, Nottingham.
- Coote, A., Franklin, J. & Simms, A. (2010) 21 hours: Why a shorter working week can help us all to flourish in the 21st century. *New Economics Foundation*. https://neweconomics.org/uploads/files/f49406d81b9ed9c977_p1m6ibgje.pdf. Accessed 8/14/2019.
- Coote, A., Harper, A. & Stirling, A. (2021) *The case for a four-day week*. Polity Press, Cambridge.
- Corneo, G. (2017) Ein Staatsfonds, der eine soziale Dividende finanziert. *Free University Berlin*. <https://ideas.repec.org/p/zbw/fubsbe/201713.html>. Accessed 3/16/2020.
- Craemer, T. (2015) Estimating Slavery Reparations: Present Value Comparisons of Historical Multigenerational Reparations Policies. *Social Science Quarterly* **96** (2), pp. 639–655.
- Crutzen, P. J. (2002) Geology of mankind. *Nature* **415** (6867), pp. 23.
- Dao, M. C., Das, M., Koczan, Z. & Lian, W. (2017) Why Is Labor Receiving a Smaller Share of Global Income? Theory and Empirical Evidence. *International Monetary Fund*. <https://www.imf.org/~media/Files/Publications/WP/2017/wp17169.ashx>. Accessed 7/1/2019.
- Dasgupta, P. (ed.) (2021) *The economics of biodiversity: the Dasgupta review*. HM Treasury, London.

- Dauth, W., Findeisen, S., Suedekum, J. & Woessner, N. German Robots - The Impact of Industrial Robots on Workers. *Institute for Employment Research (IAB)*.
<https://doku.iab.de/discussionpapers/2017/dp3017.pdf>. Accessed 9/20/2017.
- Decker, O. & Brähler, E. (eds.) (2020) *Autoritäre Dynamiken: Alte Ressentiments - neue Radikalität*. Psychosozial-Verlag, Gießen.
- Decker, O., Schuler, J., Yendell, A., Schließler, C. & Brähler, E. (2020) Das autoritäre Syndrom: Dimensionen und Verbreitung der Demokratie-Feindlichkeit. In: Decker, O. & Brähler, E. (eds.) *Autoritäre Dynamiken: Alte Ressentiments - neue Radikalität*. Psychosozial-Verlag, Gießen, pp. 179–209.
- Demirovic, A. (2018) Autoritärer Populismus als neoliberale Krisenbewältigungsstrategie. *PROKLA. Zeitschrift für kritische Sozialwissenschaft* **48** (190), pp. 27–42.
- Demirović, A. (2000) *Der nonkonformistische Intellektuelle: Die Entwicklung der Kritischen Theorie zur Frankfurter Schule*. Suhrkamp, Frankfurt am Main.
- Demirović, A. (ed.) (2018) *Wirtschaftsdemokratie neu denken*. Westfälisches Dampfboot, Münster.
- Dengler, K. & Matthes, B. (2015) *Folgen der Digitalisierung für die Arbeitswelt: Substituierbarkeitspotenziale von Berufen in Deutschland*. Institut für Arbeitsmarkt-und Berufsforschung (IAB), Nuremberg.
- Destatis (2021a) Bestand an gemeldeten offenen Arbeitsstellen in Deutschland im Jahresdurchschnitt von 2011 bis 2021. *Federal Employment Agency*.
<https://de.statista.com/statistik/daten/studie/2903/umfrage/jahresdurchschnittswerte-des-bestands-an-offenen-arbeitsstellen/>. Accessed 8/1/2022.
- Destatis (2021b) Saldo der Außenhandelsbilanz (Differenz zwischen Exporten und Importen von Waren) von Deutschland von 1991 bis 2020 (in Milliarden Euro). *Federal Statistical Office of Germany*. <https://de.statista.com/statistik/daten/studie/37793/umfrage/exportueberschuss-in-deutschland-seit-1999/>. Accessed 7/13/2021.
- Destatis (2022) Deutschland - Anzahl der Flugreisen 2019. *ARD-DeutschlandTREND*.
<https://de.statista.com/statistik/daten/studie/1032081/umfrage/umfrage-zur-anzahl-der-flugreisen-in-deutschland/>. Accessed 6/27/2022.
- DGB (2014) *DGB-Index Gute Arbeit. Der Report 2014*. Institut DGB-Index Gute Arbeit, Berlin.
- DGB (2015a) Arbeit 4.0: Der Mensch im Mittelpunkt: Stellungnahme des Deutschen Gewerkschaftsbundes (DGB) zum Grünbuch "Arbeiten 4.0" des Bundesministeriums für Arbeit und Soziales. *German Trade Union Confederation*.
https://www.bmas.de/SharedDocs/Downloads/DE/Arbeitsmarkt/Arbeiten-4-0/stellungnahme-dgb.pdf;jsessionid=2E4D52DFD30A88A950F8EDD4C166A793.delivery2-replication?__blob=publicationFile&v=1. Accessed 7/15/2020.
- DGB (2015b) Digitalisierung der Arbeitswelt: Kommentar des DGB-Bundesvorstands zum Positionspapier der Bundesvereinigung der Deutschen Arbeitgeberverbände (BDA) zur Digitalisierung von Wirtschaft und Arbeitswelt. *German Trade Union Confederation*.
<https://www.dgb.de/themen/++co++49569078-262c-11e5-a4fc-52540023ef1a>. Accessed 7/15/2020.
- DGB (2016) Grundlegende Anforderungen an ein Weißbuch „Arbeiten 4.0“: Arbeitspapier des DGB-Bundesvorstands. *German Trade Union Confederation*. <https://www.dgb.de/++co++99e7f51c-54b2-11e6-b7ca-525400e5a74a>. Accessed 7/15/2020.
- DGB (2017a) Geschäftsbericht 2014-2017. *German Trade Union Confederation*.
<https://bundeskongress.dgb.de/++co++450aa514-4f0e-11e8-9708-52540088cada>. Accessed 7/15/2020.
- DGB (2017b) Stellungnahme des DGB-Bundesvorstands zum "Weißbuch Arbeiten 4.0" des Bundesarbeitsministeriums. *German Trade Union Confederation*.

- <https://www.dgb.de/themen/++co++8e9c0996-4066-11e7-84ed-525400e5a74a>. Accessed 7/15/2020.
- DGB (2019) Digitalisierung: Menschen wünschen sich mehr Mitbestimmung. *German Trade Union Confederation*. <https://www.dgb.de/themen/++co++f488605c-997d-11e9-8e2a-52540088cada>. Accessed 3/11/2021.
- DGB (ed.) (2022) *Betriebliche Mitbestimmung für das 21. Jahrhundert: Gesetzesentwurf für ein modernes Betriebsverfassungsgesetz*. Bund-Verlag, Frankfurt am Main.
- DHM (2019) Der Kampf um den Achtstundentag. *Deutsches Historisches Museum*. <https://www.dhm.de/lemo/kapitel/weimarer-republik/industrie-und-wirtschaft/achtstundentag.html>. Accessed 8/25/2019.
- Dieckhoff, C., Appelrath, H.-J., Fishedick, M., Grunwald, A. & Höffler, F. (2014) *Zur Interpretation von Energieszenarien*. acatech - Deutsche Akademie der Technikwissenschaften, München.
- Dierkes, M., Hoffmann, U. & Marz, L. (1996) *Visions of technology: Social and institutional factors shaping the development of new technologies*. Campus, Frankfurt am Main.
- Dinda, S. (2004) Environmental Kuznets Curve Hypothesis: A Survey. *Ecological Economics* **49** (4), pp. 431–455.
- Dinerstein, E., Joshi, A. R. & Vynne, C. et al. (2020) A "Global Safety Net" to reverse biodiversity loss and stabilize Earth's climate. *Science advances* **6** (36).
- Dörre, K. (2013) System permanenter Bewährungsproben. *Hans-Böckler-Stiftung*. <https://www.boeckler.de/de/magazin-mitbestimmung-2744-system-permanenter-bewaehrungsproben-5345.htm>. Accessed 5/5/2018.
- Dörre, K. (2016) Die neue Konfliktformation. Klassen-Kämpfe in fragmentierten Arbeitsbeziehungen. *Industrielle Beziehungen* (3), pp. 348–365.
- Dörre, K. (2018) Europe, capitalist Landnahme and the economic-ecological double crisis. In: Rosa, H. & Henning, C. (eds.) *The good life beyond growth: New perspectives*. Routledge Taylor & Francis Group, London, New York, pp. 241–250.
- Dörre, K. (2019a) Die Gewerkschaften - progressive Akteure einer Nachhaltigkeitsrevolution? *spw - Zeitschrift für sozialistische Politik und Wirtschaft* (233), pp. 38–46.
- Dörre, K. (2019b) Neosozialismus: oder: acht Thesen zu einer überfälligen Diskussion. In: Dörre, K. & Schickert, C. (eds.) *Neosozialismus: Solidarität Demokratie und Ökologie vs. Kapitalismus*. oekom, München, pp. 17–32.
- Dörre, K. (2019c) Risiko Kapitalismus. In: Dörre, K., Rosa, H., Becker, K., Bose, S. & Seyd, B. (eds.) *Große Transformation? Zur Zukunft moderner Gesellschaften*. Springer Fachmedien, Wiesbaden, pp. 3–33.
- Dörre, K. (2020) Sozialismus - nachhaltig, ökologisch und sozial, aber nur in Maßen digital. *spw - Zeitschrift für sozialistische Politik und Wirtschaft* (240), pp. 26–31.
- Dörre, K. & Becker, K. (2018) Nach dem raschen Wachstum: Doppelkrise und große Transformation. In: Schröder, L. & Urban, H.-J. (eds.) *Gute Arbeit: Ökologie der Arbeit - Impulse für einen nachhaltigen Umbau*. Bund-Verlag, Frankfurt am Main, pp. 35–58.
- Dörre, K., Holzschuh, M. & Köster, J. (eds.) (2020) *Abschied von Kohle und Auto?: Sozial-ökologische Transformationskonflikte um Energie und Mobilität*. Campus, Frankfurt am Main.
- Durán, J. M. (2017) Varying the Explanatory Span: Scientific Explanation for Computer Simulations. *International Studies in the Philosophy of Science* **31** (1), pp. 27–45.
- Durán, J. M. & Formanek, N. (2018) Grounds for Trust: Essential Epistemic Opacity and Computational Reliabilism. *Minds and Machines* **28** (4), pp. 645–666.
- DW (2020) Weniger arbeiten für das Klima. *Deutsche Welle*. <https://www.dw.com/de/weniger-arbeiten-f%C3%BCr-das-klima/l-53911366>. Accessed 7/1/2020.

- Ebert, A. & Rahner, S. (2017) Warum das bedingungslose Grundeinkommen keine Antwort auf den digitalen Wandel ist. In: BMAS (ed.) *Sozialstaat im Wandel: Werkheft 04*, Berlin, pp. 174–181.
- Edelman (2020) Trust Barometer 2020: Pressemitteilung Deutschland. *Edelman Deutschland*.
https://www.edelman.de/sites/g/files/aatuss401/files/2020-01/Pressemitteilung_Edelman%20Trust%20Barometer%202020_K.pdf. Accessed 1/25/2020.
- Edwards, M. A. & Roy, S. (2017) Academic Research in the 21st Century: Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hypercompetition. *Environmental engineering science* **34** (1), pp. 51–61.
- Egger, D., Haushofer, J., Miguel, E., Niehaus, P. & Walker, M. (2019) *General Equilibrium Effects of Cash Transfers: Experimental Evidence from Kenya*. National Bureau of Economic Research, Cambridge (MA).
- Elbe, I. (2008) *Marx im Westen: Die neue Marx-Lektüre in der Bundesrepublik seit 1965*. Akademie-Verlag, Berlin.
- EPTA (2016) The Future of Labour in the Digital Era: Ubiquitous Computing, Virtual Platforms, and Real-Time Production. *European Parliamentary Technology Assessment Network*.
epub.oewar.ac.at/ita/ita-projektberichte/EPTA-2016-Digital-Labour.pdf. Accessed 8/15/2019.
- Eurostat (2020) Majority commuted less than 30 minutes in 2019. *Eurostat*.
<https://ec.europa.eu/eurostat/de/web/products-eurostat-news/-/ddn-20201021-2>. Accessed 11/26/2020.
- Falk, J., Gaffney, O. & Bhowmik, A. K. et al. (2020) Exponential Roadmap 1.5.1. *Exponential Roadmap Initiative*. https://exponentialroadmap.org/wp-content/uploads/2020/03/ExponentialRoadmap_1.5.1_216x279_08_AW_Download_Singles_Small.pdf. Accessed 10/22/2021.
- Fazlovic, A. (2019) „Keine Industriepolitik ist auch keine Lösung“. *Makronom*.
<https://makronom.de/jens-suedekum-keine-industriepolitik-ist-auch-keine-loesung-31970>. Accessed 8/14/2019.
- Feenberg, A. (2002) *Transforming technology: A critical theory revisited*. Oxford University Press, New York.
- Feenstra, R. C., Inklaar, R. & Timmer, M. P. (2015) The Next Generation of the Penn World Table. *American Economic Review* **105** (10), pp. 3150–3182.
- Fisahn, A. (2019) Paradigmenwechsel durch eine neue Industriepolitik?: Altmaiers «Nationale Industriestrategie 2030» bricht mit der marktradikalen Ideologie und birgt progressive Ansätze in sich. *Rosa-Luxemburg-Stiftung*.
<https://www.rosalux.de/publikation/id/40309/paradigmenwechsel-durch-eine-neue-industriepolitik/>. Accessed 5/5/2019.
- Flechtheim, O. K. (1972) *Futurologie: Der Kampf um die Zukunft*, Vom Autor gekürzte und überarb. Ausg. Fischer-Taschenbuch, Frankfurt am Main.
- Fortunati, L. (2018) Robotization and the domestic sphere. *New Media & Society* **20** (8), pp. 2673–2690.
- Foster, J. B. (2000) *Marx's ecology: Materialism and nature*. Monthly Review Press, New York.
- Foster, J. B. (2011) Capitalism and Degrowth: An Impossibility Theorem. *Monthly Review* **62** (8), pp. 26–33.
- Frase, P. (2016) *Four futures: Visions of the world after capitalism*. Verso, London.
- Frayne, D. (2015) *The refusal of work: The theory and practice of resistance to work*. Zed Books, London.
- Freud, A. (1936) *Das Ich und die Abwehrmechanismen*. Internationaler Psychoanalytischer Verlag, Vienna.

- Frey, P. (2018) Vom Unabgegoltene der Automation: Einige Gedanken zur gegenwärtigen Automationsdebatte aus Sicht kritischer Technikfolgenabschätzung. In: Hawel, M., Heinemann, S., Kaiser, N., Killius, L. & Schröder, M. (eds.) *Work in Progress. Work on Progress Hrsg.: M. Hawel: Beiträge kritischer Wissenschaft. Doktorand*innenjahrbuch 2018*. VSA, Hamburg, pp. 79–90.
- Frey, P. (2019) A four-day working week will not only improve wellbeing – it could save the planet. *World Economic Forum*. <https://www.weforum.org/agenda/2019/06/a-shorter-working-week-isnt-a-luxury-its-an-ecological-necessity/>. Accessed 6/29/2019.
- Frey, P. (2021a) Visions of Automation: A Comparative Discussion of Two Approaches. *Societies* **11** (2).
- Frey, P. (2021b) Zeit für Veränderung! Costing a shorter working week in Germany's public sector. *Autonomy Research*. <https://autonomy.work/wp-content/uploads/2021/10/ZFV7.pdf>. Accessed 10/22/2021.
- Frey, P. & Garcia, L. (2022) Toll Gates and Money Pumps: Why carbon taxation could be a simple, fair and transformative policy instrument. *Autonomy Research*. <https://autonomy.work/wp-content/uploads/2022/03/CARBON-TAX-v6.pdf>. Accessed 4/28/2022.
- Frey, P., Jones, P., Khurana, I., Kikuchi, L. & Stronge, W. (2020a) Time For Change: the four-day week as a strategy for unemployment. *Autonomy Research*. <https://autonomy.work/wp-content/uploads/2020/07/Time-for-Change-REPORT.pdf>. Accessed 8/28/2020.
- Frey, P. & Schaupp, S. (2020a) Editorial: The politics of techno-futures. *BEHEMOTH* **13** (1), pp. 1–6.
- Frey, P. & Schaupp, S. (2020b) Futures of digital industry: techno-managerial or techno-political utopia? *BEHEMOTH* **13** (1), pp. 98–108.
- Frey, P., Schaupp, S. & Wenten, K.-A. (2021) Towards Emancipatory Technology Studies. *Nanoethics* **15** (1), pp. 19–27.
- Frey, P. & Schneider, C. (2019a) Concrete Utopias of Digitalization Compared: The Case of the Post-Work and the Maker Movements. In: Meyer, U., Schaupp, S. & Seibt, D. (eds.) *Digitalization in Industry*. Springer International Publishing, Cham, pp. 135–152.
- Frey, P. & Schneider, C. (2019b) Klimaschutz durch eine kürzere Arbeitswoche. *Zentrum Emanzipatorische Technikforschung*. <https://content.emancipatory.technology/wp-content/uploads/2020/08/free-day-for-future.pdf>. Accessed 12/14/2019.
- Frey, P. & Schneider, C. (2019c) The Shorter Working Week: a powerful tool to drastically reduce carbon emissions. *Autonomy Research*. <https://autonomy.work/wp-content/uploads/2019/05/Fridays4FutureV2.pdf>. Accessed 11/28/2019.
- Frey, P., Schneider, C. & Wadehul, C. (2020b) Demokratisierung von Technik ohne Wirtschaftsdemokratie? *TATuP - Zeitschrift für Technikfolgenabschätzung in Theorie und Praxis* **29** (3), pp. 30–35.
- Freytag, T. (2018) Emanzipation und das politische Subjekt in der kritischen Theorie. In: Demirovic, A., Lettow, S., Maihofer, A. & Bromberg, S. (eds.) *Emanzipation: Zu Geschichte und Aktualität eines politischen Begriffs*. Westfälisches Dampfboot, Münster, pp. 57–72.
- Friede, G., Busch, T. & Bassen, A. (2015) ESG and financial performance: aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance & Investment* **5** (4), pp. 210–233.
- Fuchs, C. (2015) *Reading Marx in the information age: A media and communication studies perspective on Capital, volume 1*. Routledge Taylor & Francis Group, New York, London.
- Fuchs, C. (2017) *Marx lesen im Informationszeitalter: Eine medien- und kommunikationswissenschaftliche Perspektive auf "Das Kapital. Band 1"*. Unrast, Münster.
- Fuchs, C. (2018) Industry 4.0: The Digital German Ideology. *tripleC: Communication, Capitalism & Critique. Open Access Journal for a Global Sustainable Information Society* **16** (1), pp. 280–289.

- Gallie, D. & Paugam, S. (eds.) (2000) *Welfare regimes and the experience of unemployment in Europe*. Oxford University Press, Oxford.
- Generalitat Valenciana (2022) RESOLUCIÓN 2022/7734. *Conselleria de Economía Sostenible, Sectores Productivos, Comercio y Trabajo*. https://dogv.gva.es/datos/2022/08/24/pdf/2022_7734.pdf. Accessed 8/24/2022.
- Georg, A., Guhlemann, K. & Peter, G. (eds.) (2020) *Humanisierung der Arbeit 4.0: Prävention und Demokratie in der digitalisierten Arbeitsgesellschaft*. VSA, Hamburg.
- Gerlsbeck, F. & Herzog, L. (2020) The epistemic potentials of workplace democracy. *Review of Social Economy* **78** (3), pp. 307–330.
- German, J. (1903) Die Grenzen für die Automatisierung des Produktionsprozesses. *Die Neue Zeit* (21/2), pp. 468–473.
- Gerten, D., Heck, V. & Jägermeyr, J. et al. (2020) Feeding ten billion people is possible within four terrestrial planetary boundaries. *Nature Sustainability* **3** (3), pp. 200–208.
- Goldin, I., Koutroumpis, P., Lafond, F. & Winkler, J. (2021) Why is productivity slowing down? *Oxford Martin School*. <https://www.oxfordmartin.ox.ac.uk/downloads/academic/ProductivitySlowdown.pdf>. Accessed 7/13/2021.
- Goalsbee, A. (2021) The Battles to Come Over the Benefits of Working From Home. *The New York Times*. <https://www.nytimes.com/2021/07/20/business/remote-work-pay-bonus.html>. Accessed 8/26/2021.
- Goos, M., Manning, A. & Salomons, A. (2014) Explaining Job Polarization: Routine-Biased Technological Change and Offshoring. *American Economic Review* **104** (8), pp. 2509–2526.
- Gorz, A. (1985) *Paths to Paradise: On The Liberation From Work*. Pluto Press, London.
- Gorz, A. (1989) *Critique of economic reason*. Verso, London.
- Grabka, M. M. & Goebel, J. (2018) Einkommensverteilung in Deutschland: Realeinkommen sind seit 1991 gestiegen, aber mehr Menschen beziehen Niedrigeinkommen. *DIW Wochenbericht* (21), pp. 449–459.
- Grabka, M. M. & Schröder, C. (2019) The Low-Wage Sector in Germany Is Larger Than Previously Assumed. *DIW Weekly Report* (14), pp. 117–124.
- Graetz, G. & Michaels, G. (2017) Is Modern Technology Responsible for Jobless Recoveries? *American Economic Review* **107** (5), pp. 168–173.
- Graham, L. R. (1993) *Science in Russia and the Soviet Union: A short history*. Cambridge University Press, Cambridge.
- Gramsci, A. (1971) *Selections from the prison notebooks of Antonio Gramsci*. International Publishers, New York.
- Gramsci, A. (2007) *Prison notebooks. Volume III*. Columbia University Press, New York.
- Gransche, B. (2015) *Vorausschauendes Denken: Philosophie und Zukunftsforschung jenseits von Statistik und Kalkül*. transcript, Bielefeld.
- Griscom, B. W., Adams, J. & Ellis, P. W. et al. (2017) Natural climate solutions. *Proceedings of the National Academy of Sciences of the United States of America* **114** (44), pp. 11645–11650.
- Groll, F. (2010) Was kann, darf, muss wachsen, wenn der Ressourcenverbrauch stark zurückgehen muss? *Memorandum Gruppe*. <https://www.alternative-wirtschaftspolitik.de/kontext/controllers/document.php/449.0/2/03c37422a6b8846f01e92b0186c8e8>. Accessed 6/2/2020.
- Grossmann, H. (1929) *Das Akkumulations- und Zusammenbruchsgesetz des kapitalistischen Systems*. Hirschfeld, Leipzig.
- Grünke, P. (2020) Chess, Artificial Intelligence, and Epistemic Opacity. *Információs Társadalom* **19** (4), pp. 7–17.

- Grunwald, A. (2010) *Technikfolgenabschätzung - eine Einführung*, Zweite, grundlegend überarbeitete und wesentlich erweiterte Auflage. Edition Sigma, Berlin.
- Grunwald, A. (2012a) *Ende einer Illusion: Warum ökologisch korrekter Konsum uns nicht retten wird*. oekom, München.
- Grunwald, A. (2012b) *Technikzukünfte als Medium von Zukunftsdebatten und Technikgestaltung*. KIT Scientific Publishing, Karlsruhe.
- Grunwald, A. (2014) The hermeneutic side of responsible research and innovation. *Journal of Responsible Innovation* **1** (3), pp. 274–291.
- Grunwald, A. (2015) Die hermeneutische Erweiterung der Technikfolgenabschätzung. *Technikfolgenabschätzung, Theorie und Praxis* **24** (2), pp. 65–69.
- Grunwald, A. (2018a) Diverging pathways to overcoming the environmental crisis: A critique of eco-modernism from a technology assessment perspective. *Journal of Cleaner Production* **197**, pp. 1854–1862.
- Grunwald, A. (2018b) Technikfolgenabschätzung und Demokratie. *TATuP - Zeitschrift für Technikfolgenabschätzung in Theorie und Praxis* **27** (1), pp. 40–45.
- Grunwald, A. (2018c) Technikzukünfte als Forschungsgegenstand der Geistes- und Sozialwissenschaften. In: Böhn, A. & Metzner-Szigeth, A. (eds.) *Wissenschaftskommunikation, Utopien und Technikzukünfte*. KIT Scientific Publishing, pp. 103–113.
- Grunwald, A. (2018d) Transformative Wissenschaft als honest broker ? Das passt! *GAIA - Ecological Perspectives for Science and Society* **27** (1), pp. 113–116.
- Grunwald, A. (2019a) *Der unterlegene Mensch: Die Zukunft der Menschheit im Angesicht von Algorithmen, künstlicher Intelligenz und Robotern*. riva, München.
- Grunwald, A. (2019b) *Technology assessment in practice and theory*. Routledge, London, New York.
- Grunwald, A. (2021) Wie transformativ kann, darf oder soll TA sein? In: Lindner, R., Decker, M. & Ehrensperger, E. et al. (eds.) *Gesellschaftliche Transformationen*. Nomos, Baden-Baden, pp. 67–80.
- Grunwald, A. & Kopfmüller, J. (2022) *Nachhaltigkeit*. Campus, Frankfurt am Main, New York.
- Gür-Şeker, D. (2021) *Künstliche Intelligenz und die Zukunft der Arbeit: Die digitale Transformation in den (sozialen) Medien*. Otto Brenner Stiftung, Frankfurt am Main.
- Guterres, A. (2021) UN Secretary-General's Foreword. In: UNEP (ed.) *Making Peace with Nature: A scientific blueprint to tackle the climate, biodiversity and pollution emergencies*. United Nations Environment Programme, Nairobi, p. 4.
- Haberl, H., Wiedenhofer, D. & Virág, D. et al. (2020) A systematic review of the evidence on decoupling of GDP, resource use and GHG emissions, part II: synthesizing the insights. *Environmental Research Letters* **15** (6), pp. 1–42.
- Habermas, J. (1970) Technology and Science as "Ideology". In: Habermas, J. (ed.) *Toward a rational society: Student protest, science, and politics*. Beacon, Boston, pp. 81–217.
- Habermas, J. (2020) Moralischer Universalismus in Zeiten politischer Regression. Jürgen Habermas im Gespräch über die Gegenwart und sein Lebenswerk. *Leviathan* **48** (1), pp. 7–28.
- Haipeter, T. (2020) Digitalisation, unions and participation: the German case of 'industry 4.0'. *Industrial Relations Journal* **51** (3), pp. 242–260.
- Haraldsson, G. & Kellam, J. (2021) Going Public: Iceland's Journey to a Shorter Working Week. *Autonomy Research*. https://autonomy.work/wp-content/uploads/2021/06/ICELAND_4DW.pdf. Accessed 6/28/2021.
- Harvey, D. (2021) Rate and Mass. *New Left Review*. <https://newleftreview.org/issues/ii130/articles/david-harvey-rates-and-mass>. Accessed 3/12/2022.

- Hayden, D. (2000) *The grand domestic revolution: History of feminist designs for American homes, neighborhoods, and cities*. MIT Press, Cambridge (MA).
- Hayes, C. & Jung, C. (2022) Prices and Profits after the Pandemic. *Institute for Public Policy Research*. <https://www.ippr.org/files/2022-08/prices-and-profits-after-the-pandemic-june22.pdf>. Accessed 7/15/2022.
- Heintze, Cornelia, Ötsch, R. & Troost, A. (2020) Die Beschäftigungslücke in der sozialen Infrastruktur: Ungeddeckte Bedarfe für eine gute Versorgung mit öffentlichen und gemeinwohlorientierten Dienstleistungen in Deutschland. *Rosa-Luxemburg-Stiftung*. https://www.rosalux.de/fileadmin/rls_uploads/pdfs/Studien/Studien_2-20_Beschaefigungsluecke.pdf. Accessed 7/28/2020.
- Hester, H. & Srnicek, N. (2018) The Crisis of Social Reproduction and the End of Work. <https://www.bbvaopenmind.com/wp-content/uploads/2018/03/BBVA-OpenMind-Helen-Hester-Nick-Srnicek-The-Crisis-of-Social-Reproduction-and-the-End-of-Work.pdf>. Accessed 3/15/2021.
- Hester, H. & Srnicek, N. (2023) *After Work: A History of the Home and the Fight for Free Time*. Verso, London.
- Hester, H. & Stronge, W. (2020) Towards Post-Work Studies: Identifying Misconceptions in an Emerging Field. *Autonomy Research*. <https://autonomy.work/portfolio/post-workmisconceptions2/>. Accessed 9/6/2020.
- Hickel, J. (2020) Quantifying national responsibility for climate breakdown: an equality-based attribution approach for carbon dioxide emissions in excess of the planetary boundary. *The Lancet Planetary Health* **4** (9), e399–e404.
- Hickel, J. & Kallis, G. (2020) Is Green Growth Possible? *New Political Economy* **25** (4), pp. 469–486.
- Hilmer, R., Kohlrausch, B., Müller-Hilmer, R. & Gagné, J. (2017) Einstellung und soziale Lebenslage: Eine Spurensuche nach Gründen für rechtspopulistische Orientierung, auch unter Gewerkschaftsmitgliedern. *Hans-Böckler-Stiftung*. https://www.boeckler.de/de/faust-detail.htm?sync_id=HBS-006633. Accessed 10/15/2022.
- Hirsch, J. (1995) *Der nationale Wettbewerbsstaat: Staat, Demokratie und Politik im globalen Kapitalismus*. Edition ID-Archiv, Berlin.
- Hirsch-Kreinsen, H. (2016) "Industry 4.0" as promising technology: Emergence, semantics and ambivalent character. *TU Dortmund University*. <https://eldorado.tu-dortmund.de/bitstream/2003/35303/1/Promising%20final.pdf>. Accessed 4/11/2020.
- Hofbauer, J., Gerold, S., Klaus, D. & Wukovitsch, F. (2023) Erwerbsarbeit. In: Görg, C., Madner, V. & Muhar, A. et al. (eds.) *APCC Special Report Strukturen für ein klimafreundliches Leben*. Springer, Berlin, Heidelberg.
- Hoffmann, M. & Paulsen, R. (2020) Resolving the 'jobs-environment-dilemma'? The case for critiques of work in sustainability research. *Environmental Sociology* **6** (4), pp. 343–354.
- Hoffmann, R. (2015) Arbeit der Zukunft - Gute Arbeit in digitalen Zeiten: Anforderungen an eine moderne Arbeitspolitik. *German Trade Union Confederation*. <https://www.dgb.de/++co++e0c0a8ca-8236-11e5-a641-52540023ef1a/Arbeit-der-Zukunft-Gute-Arbeit-in-digitalen-Zeiten.pdf>. Accessed 7/15/2020.
- Hoffmann, R. (2018) Gewerkschaftspolitische Herausforderungen aus der Perspektive des DGB. *WSI-Mitteilungen* **71** (6), pp. 513–517.
- Hoffmann, R. & Suchy, O. (2016) Aussichten für die Arbeit der Zukunft. *Hans-Böckler-Stiftung*. <https://www.dgb.de/themen/++co++6bf120e0-2bf2-11e6-badc-525400e5a74a>. Accessed 4/26/2019.
- Hofmann, J. (2019) #FairWandel: sozial - ökologisch - demokratisch - nur mit uns! *IG Metall*. https://www.igmetall.de/download/20190704_06_29_Rede_J_rgNEU4_7_9227470b624fed62d0aac98b23f99f6d5f485feb.pdf. Accessed 4/1/2020.

- Holz, H. H. (2013) Max Horkheimer: Eclipse of Reason. In: Hubig, C., Huning, A. & Ropohl, G. (eds.) *Nachdenken über Technik: Die Klassiker der Technikphilosophie und neuere Entwicklungen*. Editon Sigma, Berlin, pp. 180–183.
- Horkheimer, M. (1978) Ein neuer Ideologiebegriff? In: Lenk, K. (ed.) *Ideologie: Ideologiekritik u. Wissenssoziologie*. Luchterhand, Darmstadt, pp. 235–255.
- Horkheimer, M. (1985) Zur Kritik der gegenwärtigen Gesellschaft. In: Horkheimer, M. (ed.) *Vorträge und Aufzeichnungen 1949-1973*. Suhrkamp, Frankfurt am Main, pp. 324–332.
- Horkheimer, M. (1988) Die gegenwärtige Lage der Sozialphilosophie und die Aufgaben eines Instituts für Sozialforschung. In: Horkheimer, M. (ed.) *Schriften 1931-1936*. Suhrkamp, Frankfurt am Main, pp. 20–35.
- Horkheimer, M. (2002) Traditional and Critical Theory. In: Horkheimer, M. (ed.) *Critical theory: Selected essays*. Continuum, London, pp. 188–243.
- Horkheimer, M. (2004) *Eclipse of reason*. Continuum, London.
- Horkheimer, M. & Adorno, T. W. (eds.) (2009) *Dialectic of enlightenment: Philosophical fragments*. Stanford University Press, Stanford.
- Horn, G. A. (2019) Industriepolitik, jetzt aber richtig. *IPG Journal*. <https://www.ipg-journal.de/schwerpunkt-des-monats/rettet-den-kapitalismus-vor-sich-selbst/artikel/industriepolitik-jetzt-aber-richtig-3536/>. Accessed 8/14/2021.
- Huber, M. (2019) Ecological Politics for the Working Class. *Catalyst*. <https://catalyst-journal.com/2019/07/ecological-politics-for-the-working-class>. Accessed 3/15/2021.
- Humphreys, P. (2011) Computational Science and Its Effects. In: Carrier, M. & Nordmann, A. (eds.) *Science in the Context of Application*. Springer Netherlands, Dordrecht, pp. 131–142.
- IAB MAKRO (2021) IAB-Arbeitszeitrechnung: Durchschnittliche Arbeitszeit und ihre Komponenten in Deutschland. *Institute for Employment Research (IAB)*. http://doku.iab.de/arbeitsmarktdaten/AZ_Komponenten.xlsx. Accessed 6/5/2021.
- IAQ (2019) Erwerbsquoten und Erwerbstätigenquoten alte und neue Bundesländer, nach Geschlecht 1960 – 2018. *Institute for Work, Skills and Training (IAQ)*. http://www.sozialpolitik-aktuell.de/tl_files/sozialpolitik-aktuell/_Politikfelder/Arbeitsmarkt/Datensammlung/PDF-Dateien/tabIV31.pdf. Accessed 1/10/2020.
- IAQ (2021) Registrierte Arbeitslose und Stille Reserve 2000 - 2020. *Institute for Work, Skills and Training (IAQ)*. https://www.sozialpolitik-aktuell.de/files/sozialpolitik-aktuell/_Politikfelder/Arbeitsmarkt/Datensammlung/PDF-Dateien/abbIV34.pdf. Accessed 8/10/2021.
- Ibbetson, C. (2019) Do employers support a four day working week. *YouGov*. <https://yougov.co.uk/topics/economy/articles-reports/2019/09/23/business-backs-four-day-working-week>. Accessed 8/24/2020.
- IFR (2022) Robot Density nearly Doubled globally. *International Federation of Robotics*. <https://ifr.org/ifr-press-releases/news/robot-density-nearly-doubled-globally#downloads>. Accessed 1/12/2022.
- ILO & OECD (2015) The Labour Share in G20 Economies: Report prepared for the G20 Employment Working Group. *International Labour Organization; Organisation for Economic Co-operation and Development*. <https://www.oecd.org/g20/topics/employment-and-social-policy/The-Labour-Share-in-G20-Economies.pdf>. Accessed 3/22/2020.
- Im, Z. J., Mayer, N., Palier, B. & Rovny, J. (2019) The “losers of automation”: A reservoir of votes for the radical right? *Research & Politics* 6 (1).
- IMF (2019) Germany 2019 Article IV Consultation-Press Release; Staff Report; and Statement by the Executive Director for Germany. *International Monetary Fund*.

- <https://www.imf.org/en/Publications/CR/Issues/2019/07/09/Germany-2019-Article-IV-Consultation-Press-Release-Staff-Report-and-Statement-by-the-47093>. Accessed 7/10/2019.
- InfluenceMap (2019) *Big Oil's Real Agenda on Climate Change: How the oil majors have spent \$1bn since Paris on narrative capture and lobbying on climate*. InfluenceMap, London.
- InfluenceMap (2021) *A Review of CA100+ Company Disclosures on Industry Association Lobbying*. InfluenceMap, London.
- Inikori, J. E. (2003) Africans and the Industrial Revolution in England - A Roundtable Response. *International Journal of Maritime History* **15** (2), pp. 330–361.
- Inikori, J. E. (2009) *Africans and the Industrial Revolution in England*. Cambridge University Press, Cambridge.
- IPCC (2018) Global Warming of 1.5°C: An IPCC Special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. *Intergovernmental Panel on Climate Change*. https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf. Accessed 9/30/2020.
- IPCC (2019) IPCC Press Release: Choices made now are critical for the future of our ocean and cryosphere. *Intergovernmental Panel on Climate Change*. <https://www.ipcc.ch/site/assets/uploads/2019/09/srocc-P51-press-release.pdf>. Accessed 7/30/2020.
- IPCC (2021) Climate Change 2021: The Physical Science Basis. Working Group I contribution the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. *Intergovernmental Panel on Climate Change*. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report.pdf. Accessed 8/9/2021.
- IPCC (2022) Climate Change 2022: Mitigation of Climate Change. Working Group III Contribution to the IPCC Sixth Assessment Report. *Intergovernmental Panel on Climate Change*. https://report.ipcc.ch/ar6wg3/pdf/IPCC_AR6_WGIII_FinalDraft_FullReport.pdf. Accessed 7/15/2022.
- Jacobs, J. (2021) A Portrait of the Automation Susceptible Individual: Skills-Biased Technological Change and the American Conscience. *SSRN Electronic Journal*.
- Jacobson, M. Z., Krauland, A.-K. von & Coughlin, S. J. et al. (2022) Low-cost solutions to global warming, air pollution, and energy insecurity for 145 countries. *Energy & Environmental Science* (15), pp. 3343–3359.
- Jäger, F., Rosenow, R. & Thomé, H. (2017) Tachelesstellungnahme im Sanktionsverfahren: Az.: 1 BvL 7/16. *Tacheles: Interessensvertretung für Einkommensschwache - Erwerbslosen und Sozialhilfevereine*. https://tacheles-sozialhilfe.de/fa/redakteur/Aktuelles/Tacheles_Stellungnahme_an_BVerfG_25.02.2017_lz2.pdf. Accessed 4/11/2020.
- Jaimovich, N. & Siu, H. (2012) *Job Polarization and Jobless Recoveries*. National Bureau of Economic Research, Cambridge (MA).
- Jasanoff, S. & Kim, S.-H. (2009) Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea. *Minerva* **47** (2), pp. 119–146.
- Jay, M. (1996) *The Dialectical Imagination: A History of the Frankfurt School and the Institute of Social Research, 1923-1950*. University of California Press, Berkeley.
- Jessop, B. (1983) The capitalist state and the rule of capital: Problems in the analysis of business associations. *West European Politics* **6** (2), pp. 139–162.

- Jones, P. (2022) Universal Workers' Rights. *Autonomy Research*. <https://autonomy.work/wp-content/uploads/2022/04/universal-workers-rights-v2.pdf>. Accessed 5/1/2022.
- Jump, R. C. & Stronge, W. (2020) The Day After Tomorrow: Stress tests, affordability and the roadmap to the four day week. *Autonomy Research*. https://autonomy.work/wp-content/uploads/2020/12/2020_DEC01_DATv5.pdf. Accessed 4/4/2021.
- Kagermann, H., Helbig, J., Hellinger, A. & Wahlster, W. (2013) *Recommendations for implementing the strategic initiative INDUSTRIE 4.0: Securing the future of German manufacturing industry; final report of the Industrie 4.0 Working Group*. Platform Industrie 4.0, Frankfurt am Main.
- Kajitani, S., McKenzie, C. & Sakata, K. (2017) Use it Too Much and Lose it? The Effect of Working Hours on Cognitive Ability. *Panel Data Research Center at Keio University*. <https://www.pdrc.keio.ac.jp/uploads/DP2016-008.pdf>. Accessed 8/15/2019.
- Kajitani, S., McKenzie, C. & Sakata, K. (2020) Use it Too Much and Lose Everything? The Effects of Hours of Work on Health. *Panel Data Research Center at Keio University*. https://www.pdrc.keio.ac.jp/uploads/DP2016-009_en.pdf. Accessed 3/28/2020.
- Kalff, Y. (2019) Labor Democracy in Digitalizing Industries: Emancipating or “Sandboxing” Participation in Discourses on Technology and New Forms of Work? In: Meyer, U., Schaupp, S. & Seibt, D. (eds.) *Digitalization in Industry*. Springer International Publishing, Cham, pp. 29–60.
- Kalkuhl, M., Knopf, B. & Edenhofer, O. (2021) CO2-Bepreisung: Mehr Klimaschutz mit mehr Gerechtigkeit. *Mercator Research Institute on Global Commons and Climate Change*. https://www.mcc-berlin.net/fileadmin/data/C18_MCC_Publications/2021_MCC_Klimaschutz_mit_mehr_Gerechtigkeit.pdf. Accessed 2/6/2022.
- Kaltenborn, B. (2019) Auswirkungen der Digitalisierung auf die Erwerbstätigkeit in Deutschland: Literaturstudie. *Hans-Böckler-Stiftung*. https://www.boeckler.de/fpdf/HBS-007454/p_fofoe_WP_157_2019.pdf. Accessed 11/15/2020.
- Kamerāde, D., Wang, S., Burchell, B., Balderson, S. U. & Coutts, A. (2019) A shorter working week for everyone: How much paid work is needed for mental health and well-being? *Social science & medicine* **241**, pp. 112353.
- Kampeter, S. (2019) *Sozialpartnerschaft 4.0: Tarifpolitik für die Arbeitswelt von morgen*. Campus, Frankfurt am Main.
- Kant, I. (1996) An answer to the question: What is enlightenment? (1784). In: Kant, I., Gregor, M. J. & Wood, A. W. (eds.) *Immanuel Kant: Practical philosophy*. Cambridge University Press, Cambridge, pp. 11–22.
- Karimli, L., Kidder, T., Rost, L. & Samman, E. (2016) Factors and Norm Influencing Unpaid Care Work: Household survey evidence from five rural communities in Colombia, Ethiopia, the Philippines, Uganda and Zimbabwe. *Oxfam*. <https://oxfamilibrary.openrepository.com/bitstream/10546/620145/1/er-household-care-survey-wecare-151116-en.pdf>. Accessed 11/15/2021.
- Kassam, A. (2021) Spain to launch trial of four-day working week. *The Guardian*. <https://www.theguardian.com/world/2021/mar/15/spain-to-launch-trial-of-four-day-working-week>. Accessed 3/24/2021.
- Kautsky, K. (1902) Krisentheorien. *Die Neue Zeit* (20/2), pp. 37–47.
- Keil, D. & Wissel, J. (eds.) (2019) *Staatsprojekt Europa: Eine staatstheoretische Perspektive auf die Europäische Union*. Nomos, Baden-Baden.
- Keynes, J. M. (1924) *A tract on monetary reform*. Macmillan, London.
- Keynes, J. M. (1963) Economic Possibilities for our Grandchildren. In: Keynes, J. M. (ed.) *Essays in persuasion*. Norton, New York, pp. 358–373.

- Klump, R. (1985) *Wirtschaftsgeschichte der Bundesrepublik Deutschland: Zur Kritik neuer wirtschaftshistorischer Interpretationen aus ordnungspolitischer Sicht*. Steiner-Verlag, Wiesbaden.
- Kohlrausch, B. (2018) Abstiegsängste in Deutschland: Ausmaß und Ursachen in Zeiten des erstarkenden Rechtspopulismus. *Hans-Böckler-Stiftung*. https://www.boeckler.de/fpdf/HBS-006804/p_fofoe_WP_058_2018.pdf. Accessed 5/3/2019.
- Konicz, T. (2016) *Kapitalkollaps: Die finale Krise der Weltwirtschaft*. konkret, Hamburg.
- Kosmoprolet (2009) Thesen zur Krise. *Kosmoprolet*. <https://www.kosmoprolet.org/de/thesen-zur-krise>. Accessed 12/15/2018.
- Kosow, H. & León, C. D. (2015) Die Szenariotechnik als Methode der Experten- und Stakeholdereinbindung. In: Niederberger, M. & Wassermann, S. (eds.) *Methoden der Experten- und Stakeholdereinbindung in der sozialwissenschaftlichen Forschung*. Springer Fachmedien, Wiesbaden, pp. 217–242.
- Krengel, R. (1962) *Arbeitszeit und Produktivität: Untersuchungsergebnisse wissenschaftlicher Forschungsinstitute*. Duncker & Humblot, Berlin.
- Krings, B.-J., Moniz, A. B. & Frey, P. (2021) Technology as enabler of the automation of work? Current societal challenges for a future perspective of work / A tecnologia como facilitadora da automação do trabalho? Desafios sociais atuais para uma visão do futuro do trabalho. *Revista Brasileira de Sociologia - RBS* 9 (21), pp. 206–229.
- Krohs, U. (2008) How Digital Computer Simulations Explain Real-World Processes. *International Studies in the Philosophy of Science* 22 (3), pp. 277–292.
- Krüger, M. & Frey, P. (2020) Neutralität, Objektivität, Normativität: Elemente einer kritischen Theorie der Technikfolgenabschätzung. In: Nierling, L. & Torgersen, H. (eds.) *Die neutrale Normativität der Technikfolgenabschätzung*. Nomos, Baden-Baden, pp. 57–76.
- Krull, S. & Steinrücke, M. (2020) Arbeitszeitverkürzung - die soziale Seite einer ökologischen Transformation. *Z - Zeitschrift Marxistische Erneuerung* (124), pp. 101–106.
- Kunkel, K. (2020) Gewerkschaftliche Arbeitszeit- und Leistungs politik - altes Terrain mit neuen Fragen. In: Stütze, I. (ed.) *Work-Work-Balance: Marx, die Poren des Arbeitstags und neue Offensiven des Kapitals*. Dietz, Berlin, pp. 93–113.
- Kurz, C. & Rieger, F. (2013) *Arbeitsfrei: Eine Entdeckungsreise zu den Maschinen, die uns ersetzen*. Riemann, München.
- Kurz, R. (1986) Die Krise des Tauschwertes: Produktivkraft Wissenschaft, produktive Arbeit und kapitalistische Reproduktion. *Marxistische Kritik* (1), pp. 7–48.
- Laukhuf, A., Runschke, B., Spies, S. & Stohr, D. (2019) Beschäftigungseffekte der Digitalisierung in Branchen: Ein Literaturüberblick. *Hans-Böckler-Stiftung*. https://www.boeckler.de/pdf/p_fofoe_WP_162_2019.pdf. Accessed 1/10/2020.
- Lawrence, M., Buller, A., Balnes, J. & Hager, S. (2020) Commoning the Company. *Common Wealth*. https://uploads-ssl.webflow.com/5e2191f00f868d778b89ff85/5e98856284fcbfe6ad28bb58_CW_Commoning%20the%20Company.pdf. Accessed 7/29/2020.
- Lehndorff, S. (2020) *"New Deal" means being prepared for conflict: What we can learn from the New Deal of the 1930s*. VSA, Hamburg.
- Leighninger, R. D. (2007) *Long-range public investment: The forgotten legacy of the New Deal*. University of South Carolina Press, Columbia.
- Lenhard, P. (2016) Staatskapitalismus und Automation. *Zeitschrift für kritische Theorie* 22 (42/43), pp. 47–75.
- Leontief, W. (1986) *Input-output economics*. Oxford University Press, New York.

- Leopoldina, acadtech & Union der deutschen Akademien der Wissenschaften (2021) Digitalisierung und Demokratie.
https://www.leopoldina.org/uploads/tx_leopublication/2021_Stellungnahme_Digitalisierung_und_Demokratie_web_01.pdf. Accessed 2/2/2022.
- Liebig, S. (2019) Arbeitszeitverkürzung für eine nachhaltigere Wirtschaft? In: Dörre, K., Rosa, H., Becker, K., Bose, S. & Seyd, B. (eds.) *Große Transformation? Zur Zukunft moderner Gesellschaften*. Springer Fachmedien, Wiesbaden, pp. 211–228.
- Liebig, S. (2021) *Arbeitszeitverkürzung als Konvergenzpunkt?* Campus, Frankfurt am Main.
- Lohoff, E. & Trenkle, N. (2013) *Die große Entwertung: Warum Spekulation und Staatsverschuldung nicht die Ursache der Krise sind*. Unrast, Münster.
- Lösch, A., Grunwald, A., Meister, M. & Schulz-Schaeffer, I. (eds.) (2019) *Socio-Technical Futures Shaping the Present: Empirical Examples and Analytical Challenges*. Springer Fachmedien, Wiesbaden.
- Löw-Beer, P. (1981) *Industrie und Glück: Der Alternativplan von Lucas Aerospace. Mit einem Beitrag von Alfred Sohn-Rethel: Produktionslogik gegen Aneignungslogik*. Wagenbach, Berlin.
- Löwenthal, L. (1933) Zugtier und Sklaverei: Zum Buch Lefebvres des Noettes', L'attelage. Le cheval de selle à travers les âges ". *Zeitschrift für Sozialforschung* 2 (2), pp. 198–212.
- Lukács, G. (1971) *History and class consciousness: Studies in Marxist dialectics*. Merlin Press, London.
- Luxemburg, R. (1919) *Die Krise der Sozialdemokratie (Juniusbroschüre)*. Rote Fahne, Berlin.
- Maher, N. M. (2008) *Nature's new deal: The Civilian Conservation Corps and the roots of the American environmental movement*. Oxford University Press, Oxford, New York.
- Maito, E. E. (2018) The tendency of the rate of profit to fall since the nineteenth century and a world rate of profit. In: Carchedi, G. & Roberts, M. (eds.) *World in Crisis: A Global Analysis of Marx's Law of Profitability*. Haymarket Books, Chicago, pp. 129–156.
- Manyika, J., Chui, M. & Miremadi, M. et al. (2017) A future that works: AI, automation, employment, and productivity. *McKinsey Global Institute*.
https://www.mckinsey.com/~media/McKinsey/Featured%20Insights/Digital%20Disruption/Harnessing%20automation%20for%20a%20future%20that%20works/MGI-A-future-that-works_Full-report.ashx. Accessed 1/10/2020.
- Marcuse, H. (1941) Some social implications of modern technology. *Zeitschrift für Sozialforschung* 9 (3), pp. 414–439.
- Marcuse, H. (1955) *Reason and revolution: Hegel and the rise of social theory*. Routledge & Paul, London.
- Marcuse, H. (1969) *An Essay on liberation*. Beacon Press, Boston.
- Marcuse, H. (1970) Repressive Tolerance. In: Wolff, R. P., Moore, B. & Marcuse, H. (eds.) *A Critique of pure tolerance*. Beacon Press, Boston, pp. 81–117.
- Marcuse, H. (2007) *One-dimensional man: Studies in the ideology of advanced industrial society*. Routledge, London.
- Marcuse, H. (2013) The Problem of Social Change in the Technological Society. In: Marcuse, H. & Kellner, D. (eds.) *Towards a Critical Theory of Society: Collected Papers of Herbert Marcuse, Volume 2*. Routledge, pp. 35–57.
- Martens, H. (2020) Arbeit und Demokratie - von der Demokratisierung der Arbeit zur Demokratisierung der Wirtschaft?: Ein Essay zur jüngsten Debatte. In: Georg, A., Guhlemann, K. & Peter, G. (eds.) *Humanisierung der Arbeit 4.0: Prävention und Demokratie in der digitalisierten Arbeitsgesellschaft*. VSA, Hamburg, pp. 179–204.
- Marx, K. (1904) *A Contribution to the Critique of Political Economy*. Charles H. Kerr & Company, Chicago.

- Marx, K. (1910) *Value, price and profit: Addressed to working men*. Charles H. Kerr & Company, Chicago.
- Marx, K. (1942) Karl Marx on India. *The New Internationalist* (8/6), pp. 192.
- Marx, K. (1969) *Theories of surplus value: Part II*. Lawrence & Wishart, London.
- Marx, K. (1970) *Critique of Hegel's 'Philosophy of Right'*. Cambridge University Press, Cambridge.
- Marx, K. (1973) *The Poverty of Philosophy*. Progress Publishers, Moscow.
- Marx, K. (1978) The Eighteenth Brumaire of Louis Bonaparte. In: Tucker, R. (ed.) *The Marx-Engels reader*. Norton, New York, 594-617.
- Marx, K. (1982) *Capital I: A critique of political economy*. Penguin Books in association with New Left Review, London.
- Marx, K. (1991) *Capital III: A critique of political economy*. Penguin Books in association with New Left Review, London.
- Marx, K. (1993) *Grundrisse: Foundations of the critique of political economy (rough draft)*. Penguin Books, London.
- Marx, K. (2008a) *Marx-Engels-Werke Band 25: Das Kapital. Dritter Band: Der Gesamtprozess der kapitalistischen Produktion*. Dietz, Berlin.
- Marx, K. (2008b) Theses on Feuerbach. In: Marx, K. & Engels, F. (eds.) *The German ideology: Including "Theses on Feuerbach" and "Introduction to the critique of political economy"*. Prometheus Books, Amherst, 569-575.
- Marx, K. (2018) *Kritik des Kapitalismus: Schriften zu Philosophie, Ökonomie, Politik und Soziologie*. Suhrkamp, Berlin.
- Marx, K. & Engels, F. (2008) The Germany Ideology. In: Marx, K. & Engels, F. (eds.) *The German ideology: Including "Theses on Feuerbach" and "Introduction to the critique of political economy"*. Prometheus Books, Amherst, pp. 27–568.
- Marx, K. & Engels, F. (2017) *The Communist Manifesto*. Pluto Press, London.
- Mason, P. (2016) *PostCapitalism: A guide to our future*. Penguin Books, London.
- Matousek, M. (2018) Elon Musk says humans are underrated and that he regrets using so many robots to build the Model 3. *Business Insider*. <https://www.businessinsider.com/elon-musk-says-model-3-production-mistake-was-using-robots-2018-4>. Accessed 4/23/2018.
- Matuschek, I. (2016) Industrie 4.0, Arbeit 4.0 – Gesellschaft 4.0?: Eine Literaturstudie. *Rosa-Luxemburg-Stiftung*. https://www.rosalux.de/fileadmin/rls_uploads/pdfs/Studien/Studien_02-2016_Industrie_4.0.pdf. Accessed 1/10/2020.
- Mayhew, F. (2019) National newspaper ABCs: Mail titles see slower year-on-year circulation decline as bulk sales distortion ends. *Press Gazette*. <https://pressgazette.co.uk/national-newspaper-abcs-mail-titles-see-year-on-year-circulation-lift-as-bulk-sales-distortion-ends/>. Accessed 12/12/2019.
- Mayrhofer, J. & Wiese, K. (2020) *Escaping the growth and jobs treadmill: a new policy agenda for post-coronavirus Europe*. European Environmental Bureau; European Youth Forum, Brussels.
- McCray, W. P. (2013) *The Visioneers: How a Group of Elite Scientists Pursued Space Colonies, Nanotechnologies, and a Limitless Future*, Course Book. Princeton University Press, Princeton.
- McDonnell, J. (2019) John McDonnell speech on the economy and Labour's plans for sustainable investment. *Labour Party*. <https://labour.org.uk/press/john-mcdonnell-speech-economy-labours-plans-sustainable-investment/>. Accessed 7/2/2019.
- MDR (2021) Ampel will Anstellung von Haushaltshilfen bezuschussen. *Mitteldeutscher Rundfunk*. <https://www.mdr.de/nachrichten/deutschland/politik/familien-alleinerziehende-bonus-haushaltshilfe-100.html>. Accessed 3/2/2022.
- Meadows, D. H., Randers, J. & Meadows, D. L. (2009) *The limits to growth: The 30-year update*. Earthscan, London.

- Meine, H., Schumann, M. & Urban, H.-J. (eds.) (2011) *Mehr Wirtschaftsdemokratie wagen!* VSA, Hamburg.
- Metz, R. (2015) Volkswirtschaftliche Gesamtrechnungen. In: Rahlf, T. (ed.) *Deutschland in Daten: Zeitreihen zur historischen Statistik*. Bundeszentrale für Politische Bildung, Bonn, pp. 186–199.
- Meyer, M., Wing, L., Schenkel, A. & Meschede, M. (2021) Krankheitsbedingte Fehlzeiten in der deutschen Wirtschaft im Jahr 2020. In: Badura, B., Ducki, A., Schröder, H. & Meyer, M. (eds.) *Fehlzeiten-Report 2021: Betriebliche Prävention Stärken - Lehren Aus der Pandemie*. Springer, Berlin, Heidelberg, pp. 441–538.
- Meyer, U. (2019a) The emergence of an envisioned future. Sensemaking in the case of “Industrie 4.0” in Germany. *Futures* **109**, pp. 130–141.
- Meyer, U. (2019b) The Institutionalization of an Envisioned Future: Sensemaking and Field Formation in the Case of “Industrie 4.0” in Germany. In: Lösch, A., Grunwald, A., Meister, M. & Schulz-Schaeffer, I. (eds.) *Socio-Technical Futures Shaping the Present: Empirical Examples and Analytical Challenges*. Springer Fachmedien, Wiesbaden, pp. 111–138.
- Mikfeld, B. (2017) Digitale Transformation und die Arbeitswelt der Zukunft: Diskurse über den Wandel von Wirtschaft, Gesellschaft und Arbeit im digitalen Zeitalter. *Hans-Böckler-Stiftung*. https://www.boeckler.de/fpdf/HBS-006600/p_AdZ_dp_Mai_2017.pdf. Accessed 3/4/2019.
- Mokyr, J., Vickers, C. & Ziebarth, N. L. (2015) The History of Technological Anxiety and the Future of Economic Growth: Is This Time Different? *Journal of Economic Perspectives* **29** (3), pp. 31–50.
- Moore, H. A. (2020) Burning Earth, Changing Europe: How the Racist Right exploits the Climate Crisis and what we can do about it. *Rosa-Luxemburg-Stiftung*. <https://www.rosalux.eu/kontext/controllers/document.php/436.4/2/3ef20f.pdf>. Accessed 6/6/2021.
- Moore, J. W. (ed.) (2016) *Anthropocene or Capitalocene? Nature, history, and the crisis of capitalism*. PM Press, Oakland.
- Müller-Jentsch, W. (2009) Gewerkschaften als intermediäre Organisationen. In: Müller-Jentsch, W. (ed.) *Arbeit und Bürgerstatus*. VS Verlag für Sozialwissenschaften, Wiesbaden, pp. 51–86.
- Muro, M., Maxim, R. & Whiton, J. (2020) The robots are ready as the COVID-19 recession spreads. *Brookings Institution*. <https://www.brookings.edu/blog/the-avenue/2020/03/24/the-robots-are-ready-as-the-covid-19-recession-spreads/>. Accessed 4/2/2020.
- Murray, N. & Stronge, W. (2021) Claim the Commute. *Autonomy Research*. <https://autonomy.work/wp-content/uploads/2021/06/Autonomy-claim-the-commute-2021-v9.pdf>. Accessed 3/1/2022.
- Nachtwey, O. (2016) *Die Abstiegs-gesellschaft: Über das Aufbegehren in der regressiven Moderne*. Suhrkamp, Berlin.
- Nachtwey, O. (2018) *Germany's hidden crisis: Social decline in the heart of Europe*. Verso, London.
- Nachtwey, O. & Seidl, T. (2017) Die Ethik der Solution und der Geist des digitalen Kapitalismus. *Institute for Social Research*. <https://www.ifs.uni-frankfurt.de/publikationsdetails/ifs-oliver-nachtwey-und-timo-seidl-die-ethik-der-solution-und-der-geist-des-digitalen-kapitalismus.html?file=files%2FContent%2FPublikationen%2Fifs+Working+Papers%2Fifs-WP-11.pdf&fileKey=aed072b907add57b3570306ff9d375e1>. Accessed 1/22/2018.
- Naidu, S., Rodrik, D. & Zucman, G. (2020) Economics after Neoliberalism: Introducing the EfiP Project. *AEA Papers and Proceedings* **110**, pp. 366–371.
- Naphtali, F. (1928) *Wirtschaftsdemokratie, ihr Wesen, Weg und Ziel*. Verlagsgesellschaft d. Allgem. Deutschen Gewerkschaftsbundes, Berlin.
- Negt, O. (2011) Keine Zukunft der Demokratie ohne Wirtschaftsdemokratie. In: Meine, H., Schumann, M. & Urban, H.-J. (eds.) *Mehr Wirtschaftsdemokratie wagen!* VSA, Hamburg, pp. 7–13.

- Niebel, T. (2019) Wachstumsperspektiven der digitalen Transformation: Wird der ökonomische Mehrwert der Digitalisierung in der Volkswirtschaftlichen Gesamtrechnung angemessen abgebildet? *Hans-Böckler-Stiftung*. https://www.boeckler.de/fpdf/HBS-007203/p_fofoe_WP_142_2019.pdf. Accessed 8/14/2019.
- Nierling, L. & Torgersen, H. (2019) Normativität in der Technikfolgenabschätzung. *TATuP - Zeitschrift für Technikfolgenabschätzung in Theorie und Praxis* **28** (1), pp. 11–14.
- Nierling, L. & Torgersen, H. (eds.) (2020) *Die neutrale Normativität der Technikfolgenabschätzung*. Nomos, Baden-Baden.
- N-TV (2022) Zukunft der Arbeit: "Weniger Arbeitszeit kann zu mehr Output führen". *N-TV*. <https://www.n-tv.de/wirtschaft/Weniger-Arbeitszeit-kann-zu-mehr-Output-fuehren-article23420293.html>. Accessed 6/28/2022.
- Nuffield Council on Bioethics (2012) *Emerging biotechnologies: technology, choice and the public good*. Nuffield Council on Bioethics, London.
- Nye, D. E. (2006) *Technology matters: Questions to live with*. MIT Press, Cambridge (MA).
- OECD (2012) *OECD Employment Outlook 2012*. Organisation for Economic Co-operation and Development, Paris.
- OECD (2017) *Getting Skills Right: Skills for Jobs Indicators*. OECD Publishing, Paris.
- OECD (2019) *GDP per hour worked (indicator)*. OECD Publishing, Paris.
- Oxfam (2015) Extreme Carbon Inequality: Why the Paris climate deal must put the poorest, lowest emitting and most vulnerable people first. *Oxfam*. <https://oxfamilibrary.openrepository.com/bitstream/handle/10546/582545/mb-extreme-carbon-inequality-021215-en.pdf?sequence=9>. Accessed 4/16/2020.
- Oxfam (2020) Confronting Carbon Inequality: Putting climate justice at the heart of the COVID-19 recovery. *Oxfam*. <https://oxfamilibrary.openrepository.com/bitstream/handle/10546/621052/mb-confronting-carbon-inequality-210920-en.pdf>. Accessed 11/4/2020.
- Panitch, L. (1981) Trade unions and the capitalist state. *New Left Review* **125** (1), pp. 21–43.
- PAQ (1975) *Automation in der BRD: Probleme der Produktivkraftentwicklung (II)*. Projektgruppe Automation und Qualifikation. Argument, Berlin.
- PAQ (1987) *Widersprüche der Automationsarbeit: Probleme der Produktivkraftentwicklung (II)*. Projektgruppe Automation und Qualifikation. Argument, Berlin.
- Pariser, E. (2011) *The filter bubble: What the Internet is hiding from you*. Penguin Press, New York.
- Parodi, O., Waitz, C. & Bachinger, M. et al. (2018) Insights into and Recommendations from Three Real-World Laboratories: An Experience-Based Comparison. *GAIA - Ecological Perspectives for Science and Society* **27** (1), pp. 52–59.
- Parrique, T., Barth, J. & Briens, F. et al. (2019) Decoupling debunked: Evidence and arguments against green growth as a sole strategy for sustainability. *European Environmental Bureau*. <https://eeb.org/wp-content/uploads/2019/07/Decoupling-Debunked.pdf>. Accessed 3/1/2020.
- Patel, R. & Moore, J. W. (2017) *A History of the World in Seven Cheap Things: A Guide to Capitalism, Nature, and the Future of the Planet*. University of California Press, Berkeley.
- Paul, H. K. (2021) Towards Reparative Climate Justice: from Crises to Liberations. *Common Wealth*. https://uploads-ssl.webflow.com/5e2191f00f868d778b89ff85/6071e27f9e138da86620f637_CW_GND-Reparations-Harpreet.pdf. Accessed 11/3/2021.
- Paul, H. K. & Gebrial, D. (2021) Perspectives on a Global Green New Deal. *Rosa-Luxemburg-Stiftung*. <https://global-gnd.com/wp-content/uploads/2021/03/GGND-Booklet-DIGITAL-withlink-single.pdf>. Accessed 4/4/2022.

- Paul, K. I. & Moser, K. (2009) Unemployment impairs mental health: Meta-analyses. *Journal of Vocational Behavior* **74** (3), pp. 264–282.
- Pega, F., Náfrádi, B. & Momen, N. C. et al. (2021) Global, regional, and national burdens of ischemic heart disease and stroke attributable to exposure to long working hours for 194 countries, 2000–2016: A systematic analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury. *Environment international* **154**.
- Perez, C. (2003) *Technological revolutions and financial capital: The dynamics of bubbles and golden ages*. Elgar, Cheltenham.
- Pfeiffer, S. (2015) Warum reden wir eigentlich über Industrie 4.0?: Auf dem Weg zum digitalen Despotismus. *Mittelweg* **36** **24** (6), pp. 14–36.
- Pfeiffer, S. (2017) The Vision of "Industrie 4.0" in the Making - a Case of Future Told, Tamed, and Traded. *Nanoethics* **11** (1), pp. 107–121.
- Pfeiffer, S. & Suphan, A. (2015) Der AV-Index. Lebendiges Arbeitsvermögen und Erfahrung als Ressourcen auf dem Weg zu Industrie 4.0. *University of Hohenheim*. <https://www.sabine-pfeiffer.de/files/downloads/2015-Pfeiffer-Suphan-final.pdf>. Accessed 8/20/2016.
- Pierenkemper, T. (2015) Arbeit, Einkommen und Lebensstandard. In: Rahlf, T. (ed.) *Deutschland in Daten: Zeitreihen zur historischen Statistik*. Bundeszentrale für Politische Bildung, Bonn, pp. 142–153.
- Platform London (2021) Stop the Clock: The Environmental Benefits of a Shorter Working Week. https://issuu.com/4dayweekglobal/docs/stop_the_clock_-_carbon. Accessed 2/15/2022.
- Polanyi, K. (2010) *The great transformation: The political and economic origins of our time*. Beacon Press, Boston.
- Pollock, F. (1941) State Capitalism. *Zeitschrift für Sozialforschung* **9** (2), pp. 200–225.
- Pollock, F. (1956) Die wirtschaftlichen und sozialen Folgen der Automatisierung. In: Eler, F. (ed.) *Revolution der Roboter: Untersuchungen über Probleme der Automatisierung ; eine Vortragsreihe der Arbeitsgemeinschaft Sozialdemokratischer Akademiker München*. Isar Verlag, München, pp. 65–105.
- Pollock, F. (1957) *Automation: A study of its economic and social consequences*. Praeger, New York.
- Pollock, F. (1964) *Automation: Materialien zur Beurteilung der ökonomischen und sozialen Folgen*, Vollständig überarbeitete und auf dem letzten Stand gebrachte Neuauflage. Europäische Verlagsanstalt, Frankfurt am Main.
- Popper, K. R. (1992) *Die offene Gesellschaft und ihre Feinde*. J.C.B. Mohr, Tübingen.
- Postone, M. (1993) *Time, labor, and social domination: A reinterpretation of Marx's critical theory*. Cambridge University Press, Cambridge.
- Prenner, C. (2018) Does productivity pay off? The link between productivity and pay in the EU. *Hans-Böckler-Stiftung*. https://www.boeckler.de/pdf/v_2018_10_26_prenner.pdf. Accessed 1/29/2019.
- Puttfarcken, L. (2021) Ergebnisse des Weltklimarats. *Deutsches Klima Konsortium*. <https://klimasimulationen.de/weltklimarat/#5zukunft>. Accessed 8/14/2021.
- Quentin, C. (2019) Integrating Tax Justice with FALC: Funding Truly Universal Basic Income Schemes. *Autonomy Research*. <https://autonomy.work/portfolio/fully-automated-luxury-communists-guide-tax-justice-david-quentin/>. Accessed 8/30/2019.
- QuickBooks (2019) 2019 Worldwide Lunch Break Survey - Who Has the Best and Worst Breaks? <https://quickbooks.intuit.com/time-tracking/resources/lunch-break-survey/>. Accessed 5/26/2021.
- Raja Workplace (2021) What is your 'Dream Job'? <https://www.rajaworkplace.co.uk/dream-job>. Accessed 12/14/2021.

- Rathgeb, P. & Tassinari, A. (2022) How the Eurozone disempowers trade unions: the political economy of competitive internal devaluation. *Socio-Economic Review* **20** (1), pp. 323–350.
- Redeker, N. (2019) Unlocking Europe’s Piggy Bank Policy Paper: Corporate Saving, Labor Power and Policies for Investment. *Hertie School: Jacques Delors Centre*. https://hertieschool-f4e6.kxcdn.com/fileadmin/user_upload/20191213_Piggy_Bank_Redeker.pdf. Accessed 4/15/2020.
- Regeringskansliet (2015) Working Hours Act (Arbetstidslagen). *Swedish Ministry of Employment*. <https://www.government.se/government-policy/labour-law-and-work-environment/1982673-working-hours-act-arbetstidslagen/>. Accessed 11/26/2019.
- Reuter, M., Buchwitz, M. & Hilboll, A. et al. (2014) Decreasing emissions of NOx relative to CO2 in East Asia inferred from satellite observations. *Nature Geoscience* **7** (11), pp. 792–795.
- Rifkin, J. (1995) *The end of work: The decline of the global labor force and the dawn of the post-market era*. Putnam, New York.
- Ritchie, H. & Roser, M. (2019) CO2 and other Greenhouse Gas Emissions. *Our World in Data*. <https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions>. Accessed 7/20/2019.
- Roach, S. (2018) Ten years on: What have we learned from quantitative easing? *World Economic Forum*. <https://www.weforum.org/agenda/2018/08/qe-turns-ten/>. Accessed 8/25/2018.
- Roberts, C. (2018) A crisis of care or a crisis of work? *IPPR Progressive Review* **25** (3), pp. 301–311.
- Roberts, C., Lawrence, M. & King, L. (2017) Managing automation: Employment, inequality and ethics in the digital age. *Institute for Public Policy Research*. <http://www.ippr.org/publications/managing-automation>. Accessed 1/10/2020.
- Roberts, C., Parkes, H., Statham, R. & Rankin, L. (2019) The future is ours: Women, automation and equality in the digital age. *Institute for Public Policy Research*. <https://www.ippr.org/files/2019-07/the-future-is-ours-women-automation-equality-july19.pdf>. Accessed 3/15/2021.
- Roberts, M. (2009) The Great Recession: Profit cycles, economic crisis. A Marxist view. <https://files.libcom.org/files/The%20Great%20Recession%20-%20Profit%20cycles,%20economic%20crisis.pdf>. Accessed 9/20/2019.
- Roberts, M. (2014) Tendencies, triggers and tulips - The causes of the crisis: the rate of profit, overaccumulation and indebtedness. <https://thenextrecession.wordpress.com/2021/05/30/the-productivity-crisis/>. Accessed 6/2/2018.
- Roberts, M. (2015) Robots and AI: utopia or dystopia? - part two. <https://thenextrecession.wordpress.com/2015/08/29/robots-and-ai-utopia-or-dystopia-part-two/>. Accessed 3/12/2019.
- Roberts, M. (2020a) A Marxist theory of inflation. <https://thenextrecession.wordpress.com/2020/08/21/a-marxist-theory-of-inflation/>. Accessed 8/22/2020.
- Roberts, M. (2020b) A world rate of profit: a new approach. <https://thenextrecession.wordpress.com/2020/07/25/a-world-rate-of-profit-a-new-approach/>. Accessed 8/2/2020.
- Roberts, M. (2020c) More on a world rate of profit. <https://thenextrecession.wordpress.com/2020/09/20/more-on-a-world-rate-of-profit/>. Accessed 9/21/2020.
- Roberts, M. (2021a) The productivity crisis. <https://thenextrecession.wordpress.com/2021/05/30/the-productivity-crisis/>. Accessed 6/2/2021.
- Roberts, M. (2021b) The rate and the mass of profit. <https://thenextrecession.wordpress.com/2021/08/25/the-rate-and-the-mass-of-profit/>. Accessed 8/25/2021.

- Rodgers, S. (2019) Four-day working week becomes Labour policy. *LabourList*.
<https://labourlist.org/2019/09/four-day-working-week-becomes-labour-policy/>. Accessed 10/24/2019.
- Roose, K. (2019) The Hidden Automation Agenda of the Davos Elite. *The New York Times*.
<https://www.nytimes.com/2019/01/25/technology/automation-davos-world-economic-forum.html>. Accessed 2/14/2019.
- Ropohl, G. (2013) Karl Marx: Das Kapital. Erster Band; ders.: Grundrisse der Kritik der politischen Ökonomie; ders.: Zur Kritik der politischen Ökonomie. In: Hubig, C., Huning, A. & Ropohl, G. (eds.) *Nachdenken über Technik: Die Klassiker der Technikphilosophie und neuere Entwicklungen*. Editon Sigma, Berlin, pp. 276–281.
- Rosa-Luxemburg-Stiftung (2020) Online Conference "Working time reduction and climate crisis".
<https://www.rosalux.eu/en/topic/23.events.html?id=1207>. Accessed 10/21/2020.
- Rosa-Luxemburg-Stiftung (2021) Jetzt reicht's: Sabbat für Alle!
https://www.rosalux.de/veranstaltung/es_detail/6MS73/jetzt-reicht%E2%80%99s-sabbat-fuer-alle. Accessed 4/13/2021.
- Ruschig, U. (2016) Zum Begriff der Technik bei Horkheimer und Adorno. *Zeitschrift für kritische Sozialtheorie und Philosophie* 3 (1), pp. 182–208.
- Russel, B. (1919) *Proposed Roads to Freedom: Socialism, Anarchism and Syndicalism*. Henry Holt and Company, New York.
- Samol, P. (2007) Arbeit ohne Wert: Über das Scheitern der "Dienstleistungsgesellschaft" und wie es mit der Unterscheidung von produktiver und unproduktiver Arbeit zusammenhängt. *Zeitschrift Krisis*. <https://www.krisis.org/2007/arbeit-ohne-wert/>. Accessed 12/28/2019.
- Sauer, D. & Detje, R. (2019) Rechtspopulismus im Betrieb - Erscheinungsformen, Hintergründe, politischer Umgang. *WSI-Mitteilungen* 72 (3), pp. 159–167.
- Schachtschneider, U. & Candeias, M. (2013) Kontrovers: Ökologisches Grundeinkommen. *Luxemburg* (2), pp. 60–67.
- Schäfer, C. (2016) Ohne bessere Umverteilung viel schlechtere Zukunftsaussichten!: Expertise für die Kommission "Arbeit der Zukunft". *Hans-Böckler-Stiftung*.
https://www.boeckler.de/pdf/adz_expertise_schaefer_einkommen.pdf. Accessed 9/3/2017.
- Schaupp, S. (2021) *Technopolitik von unten: Algorithmische Arbeitssteuerung und kybernetische Proletarisierung*. Matthes & Seitz, Berlin.
- Schildt, G. (2008) *Das Sinken des Arbeitsvolumens im Industriezeitalter, Deutschland 1882-2000*. GESIS Data Archive, Köln.
- Schiølin, K. (2020) Revolutionary dreams: Future essentialism and the sociotechnical imaginary of the fourth industrial revolution in Denmark. *Social Studies of Science* 50 (4), pp. 542–566.
- Schneider-Petsinger, M., Wang, J., Yu, J. & Crabtree, J. (2019) *US-China Strategic Competition: The Quest for Global Technological Leadership*. Royal Institute of International Affairs, London.
- Schorsch, J. (2019) Die Heilkraft des Sabbat im Anthropozän: Ein Plädoyer, Mensch und Schöpfung Atempausen zu gönnen. In: Herpich, R. & Schnabel, P. R. (eds.) *Reformation. Globalisierung. Eine Welt: Die Verantwortung von Kirche und Religion für die Zukunft*. Wichern, Berlin, pp. 217–226.
- Schot, J. & Rip, A. (1997) The past and future of constructive technology assessment. *Technological Forecasting and Social Change* 54 (2-3), pp. 251–268.
- Schroeder, W. (2017) Industrie 4.0 und der rheinische kooperative Kapitalismus. *wiso direkt* (03), pp. 1–4.
- Schubert, K. & Klein, M. (2011) *Das Politiklexikon: Begriffe, Fakten, Zusammenhänge*. Bundeszentrale für Politische Bildung, Bonn.

- Schulzen, T. (2019) Tarifpolitischer Jahresbericht 2018: Kräftige Lohnzuwächse und mehr Selbstbestimmung bei der Arbeitszeit. *Hans-Böckler-Stiftung*.
https://www.boeckler.de/pdf/p_ta_jb_2018.pdf. Accessed 9/1/2019.
- Schumpeter, J. A. (1942) *Capitalism, socialism and democracy*. Harper, New York, London.
- Schwab, K. (2017) *The fourth industrial revolution*. Crown Business, New York.
- Schwab, K. (2018) The global competitiveness report 2018. *World Economic Forum*.
<https://www3.weforum.org/docs/GCR2018/05FullReport/TheGlobalCompetitivenessReport2018.pdf>. Accessed 10/18/2019.
- Schwandt, M. (2010) *Kritische Theorie: Eine Einführung*. Schmetterling, Stuttgart.
- Schwarz, N. & Schwahn, F. (2016) Entwicklung der unbezahlten Arbeit privater Haushalte: Bewertung und Vergleich mit gesamtwirtschaftlichen Größen. *Federal Statistical Office of Germany*.
https://www.destatis.de/DE/Methoden/WISTA-Wirtschaft-und-Statistik/2016/02/unbezahlte-arbeit-022016.pdf?__blob=publicationFile. Accessed 12/5/2019.
- Schwellnus, C., Pak, M., Pionnier, P.-A. & Crivellaro, E. (2018) *Labour share developments over the past two decades: The role of technological progress, globalisation and "winner-takes-most" dynamics*. OECD Publishing, Paris.
- Schwemmler, M. & Wedde, P. (2018) Alles unter Kontrolle? *Friedrich-Ebert-Stiftung*.
<http://library.fes.de/pdf-files/wiso/14087.pdf>. Accessed 3/1/2019.
- Segbers, F. (2001) Der Sabbat - Erinnerung an eine humane Alternative. *Neue Wege: Beiträge zu Religion und Sozialismus* **95** (12), pp. 342–350.
- SG Gotha (2016) Beschluss vom 02.08.2016. openJur 2021, 10946. Sozialgericht Gotha.
<https://openjur.de/u/2327549.html>. Accessed 2/12/2021.
- Sitte, P. & Scheele, J. (2017) Drei Brüche und die Antworten der Linken. *nd.Genossenschaft*.
<https://www.nd-aktuell.de/artikel/1064088.drei-brueche-und-die-antworten-der-linken.html>. Accessed 9/21/2017.
- Smith, J. E. (2020) *Smart Machines and Service Work: Automation in an Age of Stagnation*. Reaktion Books, London.
- Smith, R. (2015) *Green Capitalism: the God that Failed*. World Economics Association, Bristol.
- Solow, R. M. (2010) Written Statement. In: COMMITTEE ON SCIENCE AND TECHNOLOGY (ed.) *BUILDING A SCIENCE OF ECONOMICS FOR THE REAL WORLD: HEARING BEFORE THE SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT*. US Government Printing Office, Washington DC, pp. 14–15.
- Solty, I. (2013) The Crisis Interregnum: From the New Right-Wing Populism to the Occupy Movement. *Studies in Political Economy* (91), pp. 85–112.
- Sovacool, B. K., Heffron, R. J., McCauley, D. & Goldthau, A. (2016) Energy decisions reframed as justice and ethical concerns. *Nature Energy* **1** (5), pp. 1–6.
- SPD (2021) Das Zukunftsprogramm der SPD: Aus Respekt vor Deiner Zukunft. *Social Democratic Party of Germany*. <https://www.spd.de/fileadmin/Dokumente/Beschluesse/Programm/SPD-Zukunftsprogramm.pdf>. Accessed 8/9/2021.
- Special Eurobarometer (2017) *Attitudes towards the impact of digitisation and automation on daily life*. European Commission, Brussels.
- Spencer, D., Cole, M., Joyce, S., Whittaker, X. & Stuart, M. (2021) *Digital automation and the future of work*. European Parliament, Brussels.
- Spencer, D. & Slater, G. (2020) No automation please, we're British: technology and the prospects for work. *Cambridge Journal of Regions, Economy and Society* **13** (1), pp. 117–134.
- Spiegel (2018) Folgen der Digitalisierung: Gewerkschaften lehnen bedingungsloses Grundeinkommen ab. *DER SPIEGEL*. <https://www.spiegel.de/wirtschaft/soziales/gewerkschaften-lehnen-bedingungsloses-grundeinkommen-ab-a-1205467.html>. Accessed 8/8/2018.

- Srnicek, N. (2015) 4 Reasons Why Technological Unemployment Might Really Be Different This Time. *Novara Media*. <https://novaramedia.com/2015/03/30/4-reasons-why-technological-unemployment-might-really-be-different-this-time/>. Accessed 3/31/2016.
- Srnicek, N. & Williams, A. (2015) *Inventing the future: Postcapitalism and a world without work*. Verso, London.
- Staab, P. & Prediger, L. J. (2019) Digitalisierung und Polarisierung: Kurzfassung einer Metastudie zu den Auswirkungen des digitalen Wandels auf Sozialstruktur und Betriebe. *Forschungsinstitut für gesellschaftliche Weiterentwicklung*. http://www.fgw-nrw.de/fileadmin/user_upload/FGW-Studie-I40-19-Staab-2019_07_16-komplett-web.pdf. Accessed 1/28/2020.
- Stähler, N. (2020) *The impact of aging and automation on the macroeconomy and inequality*. Deutsche Bundesbank, Frankfurt am Main.
- Standing, G. (2020) *Battling eight giants: Basic income now*. I.B. Tauris, London.
- Stern, D. I. (2004) The Rise and Fall of the Environmental Kuznets Curve. *World Development* **32** (8), pp. 1419–1439.
- Stern, D. I. (2017) The Environmental Kuznets Curve. In: Stern, D. I. (ed.) *Oxford Research Encyclopedia of Environmental Science*. Oxford University Press, Oxford.
- Stern, N. (2022) A Time for Action on Climate Change and a Time for Change in Economics. *The Economic Journal* **132** (644), pp. 1259–1289.
- Stirling, A. (2019) Time for Demand: Boosting productivity with public investment, minimum wages and paid holiday. *New Economics Foundation*. <https://neweconomics.org/2019/08/time-for-demand>. Accessed 8/14/2019.
- Stone, J. (2022) Carbon tax could eradicate extreme poverty, economists say. *The Independent*. <https://www.independent.co.uk/climate-change/news/carbon-tax-dividend-poverty-b2040618.html>. Accessed 3/22/2022.
- Streeck, W. (1999) *Korporatismus in Deutschland: Zwischen Nationalstaat und Europäischer Union*. Campus, Frankfurt am Main.
- Streeck, W. (2017) *Buying time: The delayed crisis of democratic capitalism*. Verso, London.
- Strobl, N. (2021) Umweltschutz von rechts - Ökofaschismus. In: FARN (ed.) *Die extreme Rechte zwischen Klimawandelleugnung und Klimanationalismus*. Fachstelle Radikalisierungsprävention und Engagement im Naturschutz, Berlin, pp. 6–9.
- Stronge, W. & Lewis, K. (2021) *Overtime: Why we need a shorter Working week*. Verso, London.
- Stronge, W., Lewis, K., Lawrence, M., Siravo, J. & Oikonomidis, S. (2019) The Future of Work and Employment Policies in the Comunitat Valenciana: Research and Proposals for a Transitional Strategy. *Autonomy Research*. https://autonomy.work/wp-content/uploads/2020/01/FutureOfWorkComVal_Eng_DGTL.pdf. Accessed 3/1/2020.
- Süddeutsche Zeitung (2022) Forscher: Vier-Tage-Woche ist definitiv möglich. *Süddeutsche Zeitung*. <https://www.sueddeutsche.de/wirtschaft/arbeit-karlsruhe-forscher-vier-tage-woche-ist-definitiv-moeglich-dpa.urn-newsml-dpa-com-20090101-221021-99-205191>. Accessed 1/10/2023.
- Suedekum, J. (2018) Digitalisierung und die Zukunft der Arbeit: Was ist am Arbeitsmarkt passiert und wie soll die Wirtschaftspolitik reagieren? *Institute of Labor Economics*. <http://ftp.iza.org/sp90.pdf>. Accessed 12/15/2020.
- Susskind, D. (2017) A Model of Technological Unemployment. *University of Oxford*. <https://ideas.repec.org/p/oxf/wpaper/819.html>. Accessed 8/15/2018.
- tagesschau (2022) Debatte um 1. Mai: Sollten Feiertage nachgeholt werden? *tagesschau.de*. <https://www.tagesschau.de/inland/feiertage-nachholen-debatte-101.html>. Accessed 5/1/2022.
- tagesschau (2023) IG Metall fordert Vier-Tage-Woche. *tagesschau.de*. <https://www.tagesschau.de/wirtschaft/stahlindustrie-tarife-igmetall-101.html>. Accessed 4/5/2023.

- Technikradar (2018) *TechnikRadar 2018: Was die Deutschen über Technik denken*. acatech, München.
- Tetens, H. (2013) *Wissenschaftstheorie: Eine Einführung*. Beck, München.
- Tillar, J. (2022) 42-Stunden-Woche? Warum die Vier-Tage-Woche besser sein könnte. *Capital*.
<https://www.capital.de/karriere/42-stunden-woche--warum-die-vier-tage-woche-besser-sein-koennte-31978578.html>. Accessed 7/25/2022.
- Tily, G. (2017) Global (G4) QE topping \$10 trillion shows policy stance is self-defeating. *Trades Union Congress*. <https://www.tuc.org.uk/blogs/global-g4-qe-topping-10-trillion-shows-policy-stance-self-defeating>. Accessed 10/13/2017.
- Timcke, S. (2020) The One-Dimensionality of Econometric Data: The Frankfurt School and the Critique of Quantification. *tripleC: Communication, Capitalism & Critique. Open Access Journal for a Global Sustainable Information Society* **18** (1), pp. 429–443.
- Troost, A. & Ötsch, R. (2019) CO2-Preis: Weder Superheld noch Superschurke. *Standpunkte* (8/2019), pp. 1–13.
- TUC (2018) A Future that Works for Working People. *Trades Union Congress*.
<https://www.tuc.org.uk/sites/default/files/FutureofWorkReport1.pdf>. Accessed 4/3/2019.
- Tyfield, D., Lave, R., Randalls, S. & Thorpe, C. (2017) Introduction: beyond crisis in the knowledge economy. In: Tyfield, D. (ed.) *The Routledge handbook of the political economy of science*. Routledge, London, pp. 1–18.
- UBA (2019) Arbeitszeitverkürzung - gut fürs Klima?: Treibhausgasminderung durch Suffizienzpolitiken im Handlungsfeld "Erwerbsarbeit". *German Environment Agency*.
https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2019-09-05_texte_105-2019_energieverbrauchsreduktion_ap1_erwerbszeitreduzierung_final.pdf. Accessed 1/19/2021.
- UBA (2020a) Methodenkonvention 3.1 zur Ermittlung von Umweltkosten: Kostensätze Stand 12/2020. *German Environment Agency*.
https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2020-12-21_methodenkonvention_3_1_kostensaetze.pdf. Accessed 1/19/2021.
- UBA (2020b) Rohstoffproduktivität. *German Environment Agency*.
<https://www.umweltbundesamt.de/daten/ressourcen-abfall/rohstoffe-als-ressource/rohstoffproduktivitaet#ein-erweiterter-produktivitaetsindikator-die-gesamtrohstoffproduktivitaet>. Accessed 9/16/2020.
- UBA (2022) Umweltbewusstsein in Deutschland. *German Environment Agency*.
<https://www.umweltbundesamt.de/themen/nachhaltigkeit-strategien-internationales/umweltbewusstsein-in-deutschland>. Accessed 6/20/2022.
- UCS (2012) A Climate of Corporate Control: How Corporations Have Influenced the U.S. Dialogue on Climate Science and Policy. *Union of Concerned Scientists*.
<https://www.ucsusa.org/sites/default/files/2019-09/a-climate-of-corporate-control-report.pdf>. Accessed 5/12/2020.
- Ugucioni, J. & Sharpe, A. (2016) *Decomposing the Productivity-Wage Nexus in Selected OECD Countries, 1986-2013*. Centre for the Study of Living Standards, Ottawa.
- Ulber, D. (2020) *Vorgaben des EuGH zur Arbeitszeiterfassung*. Bund-Verlag, Frankfurt am Main.
- UNEP (2021a) *Ecosystem Restoration for People, Nature and Climate: Becoming #GenerationRestoration*. United Nations Environment Programme, Nairobi.
- UNEP (ed.) (2021b) *Making Peace with Nature: A scientific blueprint to tackle the climate, biodiversity and pollution emergencies*. United Nations Environment Programme, Nairobi.
- Urban, H.-J. (2010) Wohlfahrtsstaat und Gewerkschaftsmacht im Finanzmarkt-Kapitalismus: Der Fall Deutschland. *WSI-Mitteilungen* **63** (9), pp. 443–450.

- Urban, H.-J. (2012) Crisis corporatism and trade union revitalisation in Europe. In: Lehndorff, S. (ed.) *A triumph of failed ideas: European models of capitalism in the crisis*. European Trade Union Inst, Brussels.
- Urban, H.-J. (2019) *Gute Arbeit in der Transformation: Über eingreifende Politik im digitalisierten Kapitalismus*. VSA, Hamburg.
- Urry, J. (2016) *What is the Future?* Polity Press, Cambridge.
- Valenduc, G. & Vendramin, P. (2016) *Work in the digital economy: sorting the old from the new*. European Trade Union Institute Brussels, Brussels.
- van Est, R. & Kool, L. (eds.) (2015) *Working on the robot society: Visions and insights from science concerning the relationship between technology and employment*. Rathenau Instituut, Den Haag.
- van Kevelaer, K.-H. & Hinrichs, K. (1985) Arbeitszeit und „Wirtschaftswunder“ —Rahmenbedingungen des Übergangs zur 40-Stunden-Woche in der Bundesrepublik Deutschland. *Politische Vierteljahresschrift* **26** (1), pp. 52–75.
- van Lente, H. & Rip, A. (1998) Expectations in Technological Developments: an Example of Prospective Structures to be Filled in by Agency. In: Disco, C. & van der Meulen, B. (eds.) *Getting New Technologies Together*. DE GRUYTER, Berlin, pp. 203–231.
- ver.di (2022) Tarifvertrag „Entlastung“ an NRW-Unikliniken ist großer Etappensieg der Beschäftigten. *German United Services Trade Union*. <https://nrw.verdi.de/presse/pressemitteilungen/++co++21765fc2-077d-11ed-9606-001a4a160116>. Accessed 7/25/2022.
- Vermeulen, B., Kesselhut, J., Pyka, A. & Saviotti, P. (2018) The Impact of Automation on Employment: Just the Usual Structural Change? *Sustainability* **10** (5), pp. 1661.
- Vilmar, F. (1975) Wirtschaftsdemokratie. Theoretische und praktische Ansätze, entwickelt auf der Basis des Gewerkschaftlichen Grundsatzprogramms in der BRD. In: Vilmar, F. (ed.) *Industrielle Demokratie in Westeuropa*. Rowohlt, Reinbek bei Hamburg, pp. 26–78.
- Vollset, S. E., Goren, E. & Yuan, C.-W. et al. (2020) Fertility, mortality, migration, and population scenarios for 195 countries and territories from 2017 to 2100: a forecasting analysis for the Global Burden of Disease Study. *The Lancet* **396** (10258), pp. 1285–1306.
- Wagner, P. (2016) *Progress: A Reconstruction*. Polity Press, Cambridge.
- Wagner, S. M. (2012) Environmental Policies and Lobbying by Automotive Makers in Europe. In: Ciravegna, L. (ed.) *Sustaining Industrial Competitiveness after the Crisis*. Palgrave Macmillan UK, London, pp. 201–225.
- Wark, M. (2021) *Capital Is Dead*. Verso, London.
- WBGU (2011) *Welt im Wandel - Gesellschaftsvertrag für eine Große Transformation*. Wissenschaftlicher Beirat Globale Umweltveränderungen, Berlin.
- WDR Fernsehen (2022) WDR Aktuell: 4-Tage-Woche in Großbritannien: Vorbild für Deutschland? *Westdeutscher Rundfunk*. <https://www.ardmediathek.de/video/Y3JpZDovL3dkci5kZS9CZWl0cmFnLTc3NDY1ZDJhLTFkMGItNGUyZC04MjBiLTNhNGY3NDBiY2U2NA>. Accessed 9/15/2022.
- Weber, E., Hausner, K. H. & Engelhard, H. (2020) Die Kosten der Arbeitslosigkeit sind 2019 leicht gestiegen. *Institute for Employment Research (IAB)*. <https://www.iab-forum.de/die-kosten-der-arbeitslosigkeit-sind-2019-leicht-gestiegen/>. Accessed 1/15/2021.
- Weber, H. (1986) Technokorporatismus. Die Steuerung des technologischen Wandels durch Staat, Wirtschaftsverbände und Gewerkschaften. In: Hartwich, H.-H. (ed.) *Politik und die Macht der Technik: 16. wissenschaftlicher Kongreß der DVPW, 7. bis 10. Oktober 1985 in der Ruhr-Universität Bochum*. Westdeutscher Verlag, Opladen, pp. 278–297.
- Weeks, K. (2009) "Hours for What We Will": Work, Family, and the Movement for Shorter Hours. *Feminist Studies* **35** (1), pp. 101–127.

- Weeks, K. (2011) *The Problem with Work: Feminism, Marxism, Antiwork Politics, and Postwork Imaginaries*. Duke University Press, Durham.
- Weeks, K. (2020) Anti/Postwork Feminist Politics and A Case for Basic Income. *tripleC: Communication, Capitalism & Critique. Open Access Journal for a Global Sustainable Information Society*, pp. 575–594.
- Wendl, M. (2012) Politische Ökonomie von Gut und Böse. *Hans-Böckler-Stiftung*.
<https://www.boeckler.de/de/magazin-mitbestimmung-2744-politische-oekonomie-von-gut-und-boese-5367.htm>. Accessed 5/5/2018.
- Werneke, F. (2019) Grundsatzrede des ver.di-Vorsitzenden Frank Werneke. *German United Services Trade Union*.
<https://www.verdi.de/++file++5d8c6b132193fb408d9c16e3/download/Grundsatzrede%20von%20Frank%20Werneke.pdf>. Accessed 4/1/2020.
- White, M. R. M. (1987) *Working hours: Assessing the potential for reduction*. International Labour Office, Geneva.
- Wikipedia (2020a) Henning Kagermann. *Wikimedia Foundation*.
https://de.wikipedia.org/wiki/Henning_Kagermann. Accessed 9/15/2020.
- Wikipedia (2020b) Ingrid Sehrbrock. *Wikimedia Foundation*.
https://de.wikipedia.org/wiki/Ingrid_Sehrbrock. Accessed 9/15/2020.
- Wolter, M. I. (2019) *Wirtschaft 4.0 und die Folgen für Arbeitsmarkt und Ökonomie: Szenario-Rechnungen im Rahmen der fünften Welle der BIBB-IAB-Qualifikations- und Berufsprojektionen*. Bundesinstitut für Berufsbildung, Bonn.
- Wolter, M. I., Mönnig, A. & Hummel, M. et al. (2016) *Economy 4.0 and its labour market and economic impacts: Scenario calculations in line with the BIBB-IAB qualification and occupational field projections*. Institute for Employment Research (IAB), Nuremberg.
- World Bank (2021a) CO2 emissions (kg per 2017 PPP \$ of GDP). *The World Bank*.
<https://data.worldbank.org/indicator/EN.ATM.CO2E.PP.GD.KD>. Accessed 8/8/2021.
- World Bank (2021b) GDP, PPP (constant 2017 international \$). *The World Bank*.
<https://data.worldbank.org/indicator/NY.GDP.MKTP.PP.KD?end=2018&start=1990>. Accessed 8/8/2021.
- World Bank (2021c) Total greenhouse gas emissions (kt of CO2 equivalent). *The World Bank*.
<https://data.worldbank.org/indicator/EN.ATM.GHGT.KT.CE>. Accessed 8/8/2021.
- World Commission on Environment and Development (1991) *Our common future*. Oxford University Press, Oxford.
- Worstell, T. (2019) Bigger Climate Change Then - Autonomy Says We Must All Be Poor To Beat It. *Continental Telegraph*. <https://www.continentaltelegraph.com/2019/05/bigger-climate-change-then-autonomy-says-we-must-all-be-poor-to-beat-it/>. Accessed 2/27/2022.
- Wright, E. O. (2010) *Envisioning real utopias*. Verso, London.
- Wright, O. (2015) Labour leadership contest: After 88 days of campaigning, how did Labour's candidates do? *The Independent*. <https://www.independent.co.uk/news/uk/politics/labour-leadership-contest-after-88-days-campaigning-how-did-labour-s-candidates-do-10495726.html>. Accessed 9/8/2020.
- WSI (2020) WSI Verteilungsmonitor: Löhne und Gehälter nach Bundesländern. *Institute of Economic and Social Research (WSI)*. <https://www.wsi.de/de/wsi-verteilungsmonitor-14559.htm>. Accessed 8/2/2020.
- Yoder, K. (2021) AOC's plan for a 1.5 million-strong Civilian Climate Corps, explained. *Grist*.
https://grist.org/politics/aocs-plan-for-a-1-5-million-strong-civilian-climate-corps-explained/?utm_campaign=sprout&utm_source=twitter&utm_medium=social&utm_content=1619193003. Accessed 5/3/2021.

- YouGov (2019) Survey Results - If money were not an issue, and you enjoyed your job, how many days a week would you ideally work? *YouGov*.
https://yougov.co.uk/opi/surveys/results?utm_source=twitter&utm_medium=daily_questions&utm_campaign=question_2#/survey/b0b89ed5-9340-11e9-9646-9fb0446daa0c/question/2b0d747c-9341-11e9-ad4f-7f98da3448af/toplines. Accessed 6/25/2019.
- Young, C. (2012) Losing a Job: The Nonpecuniary Cost of Unemployment in the United States. *Social Forces* **91** (2), pp. 609–634.
- ZDF (2020) "Wir mischen uns nicht ein": Altmaier zur Lufthansa-Rettung. *Zweites Deutsches Fernsehen*. <https://www.zdf.de/nachrichten/wirtschaft/wirtschaftsminister-altmaier-lufthansa-rettungspaket-100.html>. Accessed 7/2/2020.
- ZDF (2022) Weniger Work, mehr Life - Geht das? *Zweites Deutsches Fernsehen*.
<https://www.zdf.de/dokumentation/grauzone/work-life-balance-personalmangel-zuwanderung-102.html>. Accessed 8/13/2022.
- Zeit (2022a) Arbeit: Forscher: Vier-Tage-Woche ist definitiv möglich. *Die Zeit*.
<https://www.zeit.de/news/2022-10/21/forscher-vier-tage-woche-ist-definitiv-moeglich>.
 Accessed 1/10/2023.
- Zeit (2022b) Linkspartei: Neue Forderungen nach Ausgleich für Feiertage an Sonntagen. *Die Zeit*.
<https://www.zeit.de/arbeit/2022-04/arbeitszeiten-feiertage-sonntag-linke-forderung-ausgleich>.
 Accessed 4/26/2022.
- Zelik, R. (2020) *Wir Untoten des Kapitals: Über politische Monster und einen grünen Sozialismus*. Suhrkamp, Berlin.
- Zika, G. & Schnur, P. (eds.) (2009) *Das IAB/INFORGE-Modell: Ein sektorales makroökonomisches Projektions- und Simulationsmodell zur Vorausschätzung des längerfristigen Arbeitskräftebedarfs*. W. Bertelsmann, Bielefeld.
- Zwolinski, M. & Wertheimer, A. (2016) Exploitation. *Stanford Encyclopedia of Philosophy*.
<https://plato.stanford.edu/entries/exploitation/#MarxTheoExpl>. Accessed 8/30/2021.

Appendices

Appendix A: Zeit für Veränderung! Costing a Shorter Working Week in Germany's Public Sector

Appendix B: Mehr Zeit für Veränderung! Costing a Transformational Shorter Working Time Subsidy Scheme for the German Economy

Appendix C: The Ecological Limits of Work: on carbon emissions, carbon budgets and working time

Appendix D: Toll Gates and Money Pumps: Why carbon taxation could be a simple, fair and transformative policy instrument

Appendix E: Drawing the line: A strategy to leverage higher wages and eco-taxation to spur innovation

Appendix F: TRANSFORM Germany: A proposal for a public investment agency to boost productivity, green the economy, and build democratic wealth

ZEIT FÜR VERÄNDERUNG! COSTING A SHORTER WORKING WEEK IN GERMANY'S PUBLIC SECTOR



Autonomy

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Author

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Executive summary

- The notion of a shorter working week - or four-day working week - in Germany has found new momentum in political, trade union and broader, public spheres in recent years.
- This paper contributes an understanding of what the costs and benefits of such a policy would be, if it were implemented in the public sector (with no loss in pay).
- It finds that a 30-hour week in the public sector is not just desirable for worker wellbeing and for reducing the costs of burn out and presenteeism; a 30-hour week would also create hundreds of thousands of jobs and establish a new standard for all employment in Germany.
- A four-day week would create an estimated **610,000 new full-time equivalent jobs**.
- Such a policy is eminently affordable and achievable: on Autonomy's conservative calculations, a 30-hour week could cost around **€11bn**.
- This figure is only **4% of the total public sector wage bill, and 0.8% of the German government's recent spending budget in recent years.**¹
- Public sector employment takes up a relatively high proportion of employment (above 10%) in Germany - entailing that a 30-hour working week would benefit a significant chunk of the labour market.²
- We show the relative cost of such a transformative policy relative to other proposals being discussed in Germany today, such as NATO spending and tax reforms.

1 Taking the budget in 2018 as a benchmark (Destatis 2019b: 270).

2 Source: (Destatis 2019a: 83); total employment is: (IAB MAKRO 2021).

Deutsche Kurzfassung

- Arbeitszeitverkürzungen spielen in den letzten Jahren eine zunehmende Bedeutung in Tarifverhandlungen, aber auch in der breiteren öffentlichen und politischen Debatte.
- Diese Studie trägt zu einem besseren Verständnis der Kosten und Vorteile einer 30-Stunden-Woche (bei vollem Lohnausgleich) im Öffentlichen Dienst bei.
- Sie zeigt, dass eine 30-Stunden-Woche im Öffentlichen Dienst nicht nur vorteilhaft für das Wohlbefinden der Beschäftigten wäre - eine 30-Stunden-Woche würde außerdem Hunderttausende von Stellen schaffen und eine Vorbildfunktion für den gesamten Arbeitsmarkt ausüben.
- Eine 30-Stunden-Woche im Öffentlichen Dienst würde bis zu **610.000 neue Vollzeitstellen** schaffen.
- Ihre Einführung wäre bezahlbar und verhältnismäßig einfach umzusetzen: laut unseren Berechnungen würden sich die Kosten einer 30-Stunden-Woche auf um die **11 Milliarden Euro** belaufen.
- Damit belaufen sich die Kosten auf weniger als **4% des öffentlichen Personalhaushaltes und nur 0,8% der gesamten Staatsausgaben**.³
- Der öffentliche Beschäftigungssektor umfasst mehr als 10% des deutschen Arbeitsmarktes - die Einführung einer 30-Stunden-Woche in ihm würde entsprechend eine substantielle Lenkungswirkung entfalten.⁴
- Wir illustrieren die relativ geringen Kosten dieses transformativen Unterfangens indem wir sie in ein Verhältnis zu geplanten staatlichen Mehrausgaben für Rüstung und den fiskalischen Effekten gegenwärtig diskutierter Steuerreformen setzen.

³ Basierend auf dem öffentlichen Haushalt von 2018 (Destatis 2019b: 270).

⁴ Quelle: Destatis 2019a: 83; Gesamtbeschäftigung: IAB MAKRO 2021.

Introduction

In recent years, the issue of working time reductions has received increasing attention in Germany, with the option won for metalworkers by the powerful IG Metall union to temporarily reduce their 35-hour work week to a four-day-week. Coupled with the right to return to full-time work after two years, this was heralded as the start of a new age of working time reduction. Additionally, workers with caring duties were afforded a further increase in pay that could be exchanged for eight days 'special' leave a year - an agreement similar to the previous achievement of the small but militant railway and transport union EVG, which afforded railway sector workers the option to convert pay rises into extra vacation days.⁵

These advances fuelled enthusiasm to reintroduce working time issues into collective bargaining, with Germany's second largest trade union, ver.di, preparing a campaign for working time reductions in the public sector. This "renaissance of working time politics" (Schulten 2019: 25) follows several decades in which working time issues played only a minor role in collective bargaining, owing in part to the painful and lasting defeat of the IG Metall in its post-reunification attempt to harmonize the longer working hours of metalworkers in East Germany with the shorter hours in the West.⁶

1990 therefore marked the beginning of three decades of "lost" working time reductions, as illustrated in the graph below (Fig. 1). While pre-unification West Germany displayed a secular trend towards collective working time reductions, with the average agreed full-time work week falling from 48 hours in the 1950s to around 38 hours at the end of the 1980s, the period after reunification saw a slight increase in working time, followed by a stagnation of the full-time work week at around 38 hours.

⁵ This option has proven to be wildly popular (cf. Schulten (2019))

⁶ The harmonisation of working time has made substantial progress this year, however (IG Metall (2021)).

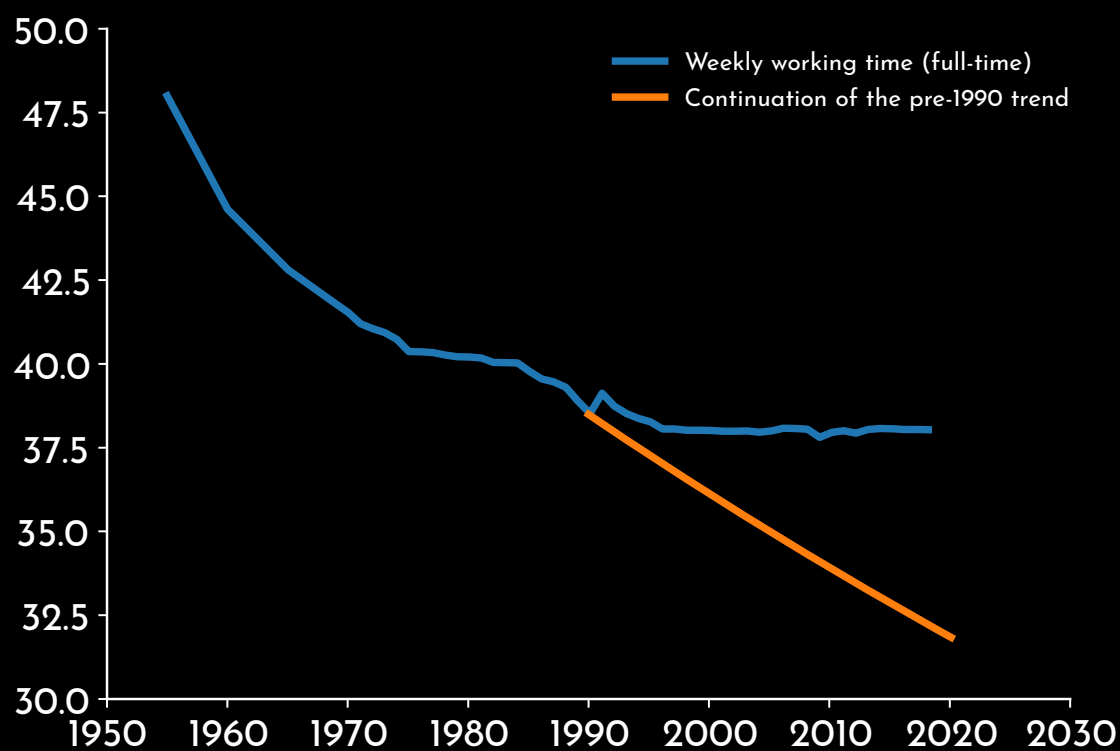


Fig. 1: Historic development of full-time work week⁷

⁷ The graph is based on data from Pollert et al. (2016) for the years 1955-1970, Allmendinger et al. (2005: 202-205) for the years 1970-1990 and IAB MAKRO (2021) for post-1990. I linearly interpolated missing data.

Losing collectivity

While recent achievements of the German trade union movement should be welcomed, given the numerous advantages working time reductions promise in terms of mental and physical well-being, gender equality, productivity, social justice and ecological sustainability (cf. Srnicek & Williams 2015; Stronge & Harper 2019), one specific downside of this renaissance should nevertheless be highlighted. Instead of *collective* working time reductions, more and more options are being established for *individual* working time reductions, which - absent the stronger bargaining position offered when workers act collectively - risk undermining the key demand that working time reductions should be introduced with no loss in pay. Individual working time reductions thus run the risk of becoming the privilege of high earners, rather than a way to ensure that all workers can benefit from past, present and/or future increases in productivity. This issue is all the more pressing as recent decades have witnessed a growing disconnect between increased productivity and hourly compensation.

Long overdue reductions

It is time for a renaissance of collective working time reductions – and as we illustrate in the following, the German government might face lower costs for introducing a four-day working week in the public sector than is often believed. This report builds on Autonomy's earlier research into working time reductions in the public sector (Jones et al. 2020; Jump & Stronge 2020). As we argued in "[Public Sector as Pioneer](#)", a shorter working week in the public sector comes at a modest cost, while offering the potential to create hundreds of thousands of jobs, major wellbeing and health advantages to workers and, perhaps most importantly, the means to establish a new "gold standard" for work in a more socially and ecologically sustainable economy (Jones et al. 2020). Additionally, as we show below, the costs of a shorter work week in the public sector can largely be met by the increased income tax revenue and social contributions accrued from the newly hired staff, coupled with reduced spending on unemployment support. This leaves the public sector uniquely positioned to act as a trailblazer for working time reductions.

A focus on the public sector as a role model should also be attractive to trade unions, given the significant portion of the labour market it occupies, and could therefore become an exemplar for wider change. It represents a significant chunk of the labour market, and thus could become an exemplar for wider change. At the same time, the vital importance of decent public services that also offer attractive employment opportunities has been forcefully proven in the recent Covid crisis. Last but not least, the substantial increase in hourly wages accompanying the introduction of a four-day work week with no loss in pay would go a long way to reverse the decoupling of real hourly earnings and labour productivity that has been particularly strong in Germany in the past decades (cf. Ugucioni & Sharpe 2016; Dao et al. 2017).

Costing a four-day week in Germany's public sector

In this paper, we introduce a new methodology to gain a better understanding of the costs of working time reductions, using the implementation of a 30-hour work week in the German public sector with no loss in pay as an example.

We do so using the following assumptions:

- The 30-hour work week will be introduced gradually over the course of a decade.
- Demand for public services will largely remain constant.⁸
- Workers contribute to financing a shorter work week by accepting that wages are only increased for this decade to compensate for inflation.⁹
- Finally, we assume that the introduction of working time reductions will induce average productivity increases of roughly 1.36% per annum. More detail on this is provided below.

Productivity assumptions

The above assumption refers to the well-established fact that while working time reductions can lead to substantial job creation, this job creation is not necessarily proportional to the reduction in working hours, as organisations adopt more efficient work processes, introduce new technologies and thereby make up for lost human labour (White 1987; Taddei 1997; Golden 2012). The recent example of [trials of working time reductions in Iceland's public sector](#) illustrates this powerfully: while public service provision remained the same, substantial reductions were realized without expanding staffing levels, as existing resources were used more effectively (Haraldsson & Kellam 2021). The yearly productivity increase rate is derived by applying the rule of thumb from economic literature "that the effect of a cut in

⁸ Some projections imply that public employment might shrink slowly in the 2020s, which would reduce the costs of working time reductions in the public sector. It is doubtful whether this is normatively desirable. Instead, an expansion of the public sector might be needed to provide decent care, education, other basic services as well as decent working conditions (cf. Heintze et al. (2020)). This seems particularly reasonable in light of the Covid pandemic and the importance of strong public services it reinforced.

⁹ Especially those who are currently working part-time and/or are unemployed stand to profit from substantial real-wage increases due to a redistribution of working times however.

working time is distributed more or less evenly between employment and productivity" (Bosch & Lehndorff 2001: 227).

Public sector employment in Germany

Public employment in Germany accounts for around five million jobs or just over four million (Destatis 2019a: 86) full time equivalent (FTE) positions in 2018. The total costs of public employment amount to almost 300 billion euros per year, or close to 70,000 euros per position (Destatis 2019b: 270)

To establish a baseline for comparison, we first project the wage costs that might be expected based on given levels of public employment and real wage increases in the past (i.e. wage increases on top of inflation compensation, which averaged around 1% per annum between the reunification and 2018 (WSI 2020).

Year	Yearly costs per FTE including social contributions, taxes and wage costs (1% real wage growth, euros)	Total full-time equivalent jobs (FTE)	Total wage costs for the public sector (euros, rounded to nearest billion)
1 (=2018)	69,386	4,232,700	294bn
2	70,085	4,232,700	297bn
3	70,791	4,232,700	300bn
4	71,503	4,232,700	303bn
5	72,223	4,232,700	306bn
6	72,951	4,232,700	309bn
7	73,685	4,232,700	312bn
8	74,427	4,232,700	315bn
9	75,176	4,232,700	318bn
10	75,933	4,232,700	321bn
11	76,698	4,232,700	325bn

[Table 1: Baseline scenario public employment Germany, projections based on Destatis 2019a; Destatis 2019b; WSI 2020. Full figures in Appendix One]

As can be seen, wage costs are estimated to increase substantially in the decade following 2018, as real wages keep growing.¹⁰ But by how much would these costs be increased if a 30-hour work week in the public sector were to be adopted? The collectively agreed full-time work week in the public sector in Germany is slightly higher than in the rest of the economy, at 39.2 hours per week (Eurofound 2017).¹¹ Assuming a linear decrease in working time across the period of a decade, this would imply a reduction of an average of 0.92 working hours per year. Assuming an even split on job creation and productivity increases, this brings us to the following scenario:

¹⁰ By using average real wage growth over a longer period of years, we cover both years of economic crisis as well as years of economic boom, rendering our calculations more conservative.

¹¹ The data is for 2016, but between 2018 and 2016 there has been little progress in terms of collectively agreed working times in the public sector.

Year	Full-time working week (hours)	Yearly costs per FTE including social contributions, taxes and wage costs ¹²	Total FTE	Total wage costs (shorter working week, euros)	Additional wage costs (euros)	Jobs created
1 (= 2018)	39.20	69,386	4,232,700	294bn	0	0
2	38.28	69,386	4,283,563	297bn	0.6bn	50,863
3	37.36	69,386	4,336,305	301bn	1.2bn	103,605
4	36.44	69,386	4,391,044	305bn	2.0bn	158,344
5	35.52	69,386	4,447,910	309bn	2.9bn	215,210
6	34.60	69,386	4,507,044	313bn	3.9bn	274,344
7	33.68	69,386	4,568,602	317bn	5.1bn	335,902
8	32.76	69,386	4,632,752	321bn	6.4bn	400,052
9	31.84	69,386	4,699,682	326bn	7.9bn	466,982
10	30.92	69,386	4,769,600	331bn	9.5bn	536,900
11	30.00	69,386	4,842,734	336bn	11.4bn	610,034

[Table 2: Working time reductions scenario I for public employment Germany, projections based on Eurofound 2017; Destatis 2019a; Destatis 2019b; WSI 2020. For full detail, see Appendix Two]

Findings

As we can see, working time reductions in the public sector could be implemented with no cuts to wages, at a very low cost, relatively speaking. At a cost of just over **11 billion euros**, it would create an additional **610,000 jobs**, greatly improve the wellbeing of existing workers, and boost the attractiveness of the public sector as an employer. This is all the more noteworthy as working time reductions are particularly attractive to public employers since such a policy would offer strong returns on investment.

¹² Wage costs are presented in 2018 purchasing power (nominal wages would continue to grow in line with inflation in the working time reduction scenario).

The reduced costs of public sector employment

On the one hand, the cash paid out in new public sector wage packets returns, to a significant degree, to the public purse. To illustrate, let's take an example of an average full-time position in the public sector (standard, non-civil servant employment): they would earn an average monthly income of 3.630€ before taxes in 2018 (Destatis 2019a: 41). Including the Christmas bonus, this would total to a yearly pre-tax income of roughly 46.500€. Adding the incidental wage costs of around 21% (cf. Dreiling 2021),¹³ total costs add up to over 56.000€. The net income of a single full-time worker in that income group on the other hand amounted to only slightly more than 28.000€ after income taxation and social security contributions in 2018.

In other words: for every euro the German state spends on wages, roughly fifty cents are redistributed into the public sector and social spending (e.g. the federal pension system) through some form of taxation or social security contributions. But the return on public employment spending does not end there, as there are also indirect taxes, such as VAT. In 2015, these averaged around 13.7% of before-tax income (Bach et al. 2017: 34), which equates to around 6,385€ or 11.4% of the total costs (including incremental wage costs) of the FTE position in our example above. Accordingly, for every euro the state spends on public employment, more than 60 cents would typically return back to it.¹⁴

The costs are even lower, if you take into account that job creation accompanying the introduction of a shorter work week in the public sector could substantially reduce the costs of unemployment. Net state spending on unemployment amounted to 21 billion euro for 2.3 million unemployed, or on average around 9,000€ per person per year.¹⁵

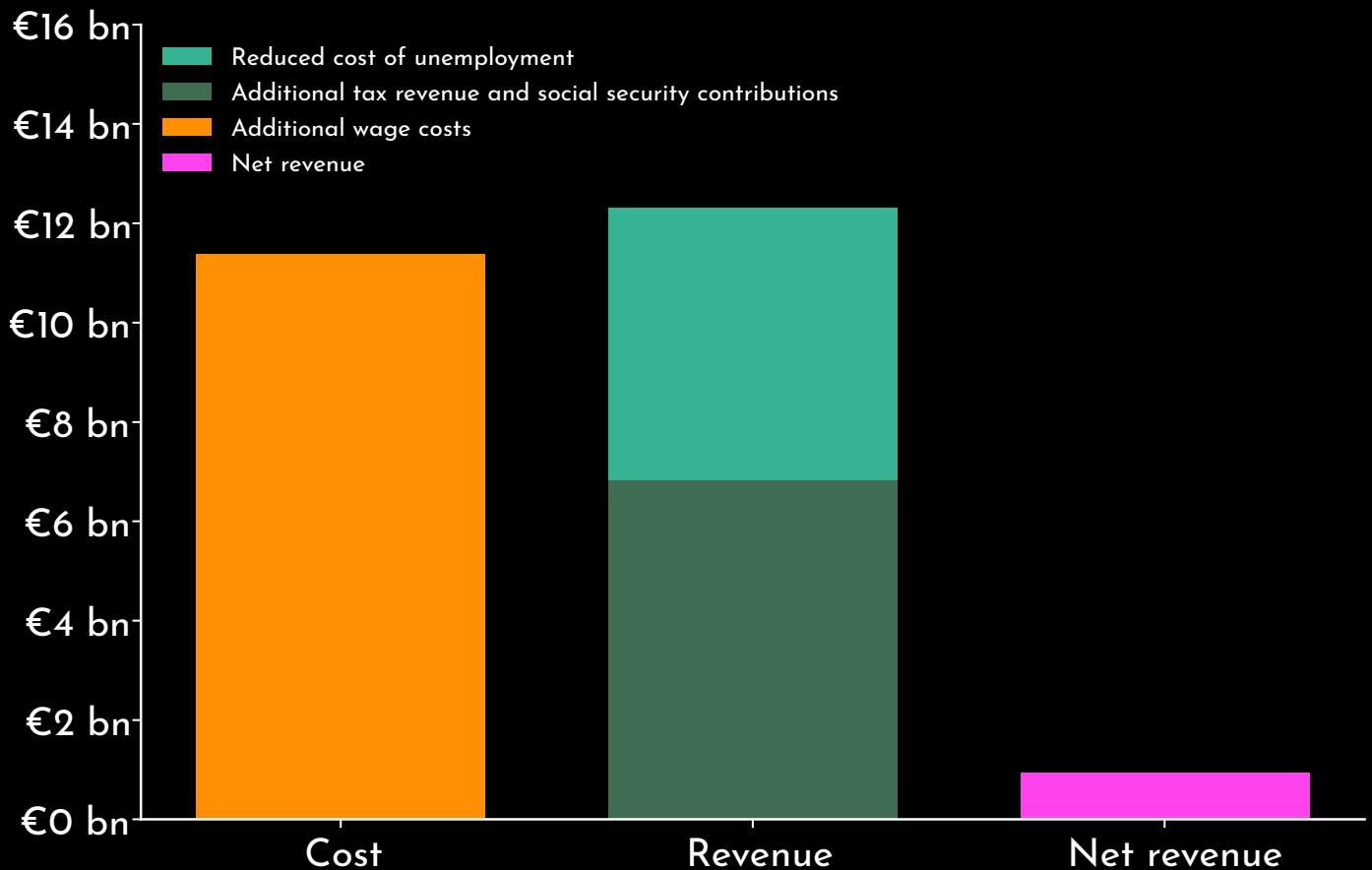
13 Due to fairly generous occupational pensions schemes in the public sector, these costs are actually slightly higher, but since parts of these contributions are funnelled into investment-based pension schemes, rather than the federal retirement scheme, we have opted to base my calculations on average social contributions.

14 Some of these revenues, for instance contributions to the pension system, imply future liabilities for the state. They are difficult to model however and should not substantially change the overall costing, particularly because the generous pensions schemes for civil servants are already included in the costing. Assuming a strong growth of employment due to working time reductions would furthermore entail a better financial position of the pension system in the future also, reducing the relative costs of these liabilities.

15 We have excluded public costs for social security contributions on behalf of the unem-

Beyond cost neutral?

As illustrated in the table below, steering the introduction of a shorter work week in the public sector in Germany with the clear aim of reducing unemployment could even mean that its implementation would not only be very cheap, but that it might even have an overall positive fiscal effect. As the 30-hour work week would be introduced over the course of a decade, this would provide ample time for training and (re-)qualification of workers.



[Fig 2: Net costs of a shorter work week in public employment Germany, projections based on Winkel 2018; Destatis 2019a; Dreiling 2021. Figures rounded to nearest hundred million. For full detail see Appendix Three]

ployed such as health insurance as these, in our approach, do not count as net costs for the state (see above). Weber et al. (2020) declare the direct costs of unemployment to be at 27,2 billion euros; we have then reduced these by the 4,3 billion euro for social security contributions for people on unemployment benefit and by 100€ a month per person for the health insurance contributions of people on welfare support (Winkel (2018).

Even without an exclusive focus on reducing unemployment, the costs of implementing shorter working hours are likely to be low. Even the costs for introducing a shorter work week in the public sector with no loss of pay, factoring in a continuation of past real-wage growth comes at a relatively modest price, as shown in the table below:

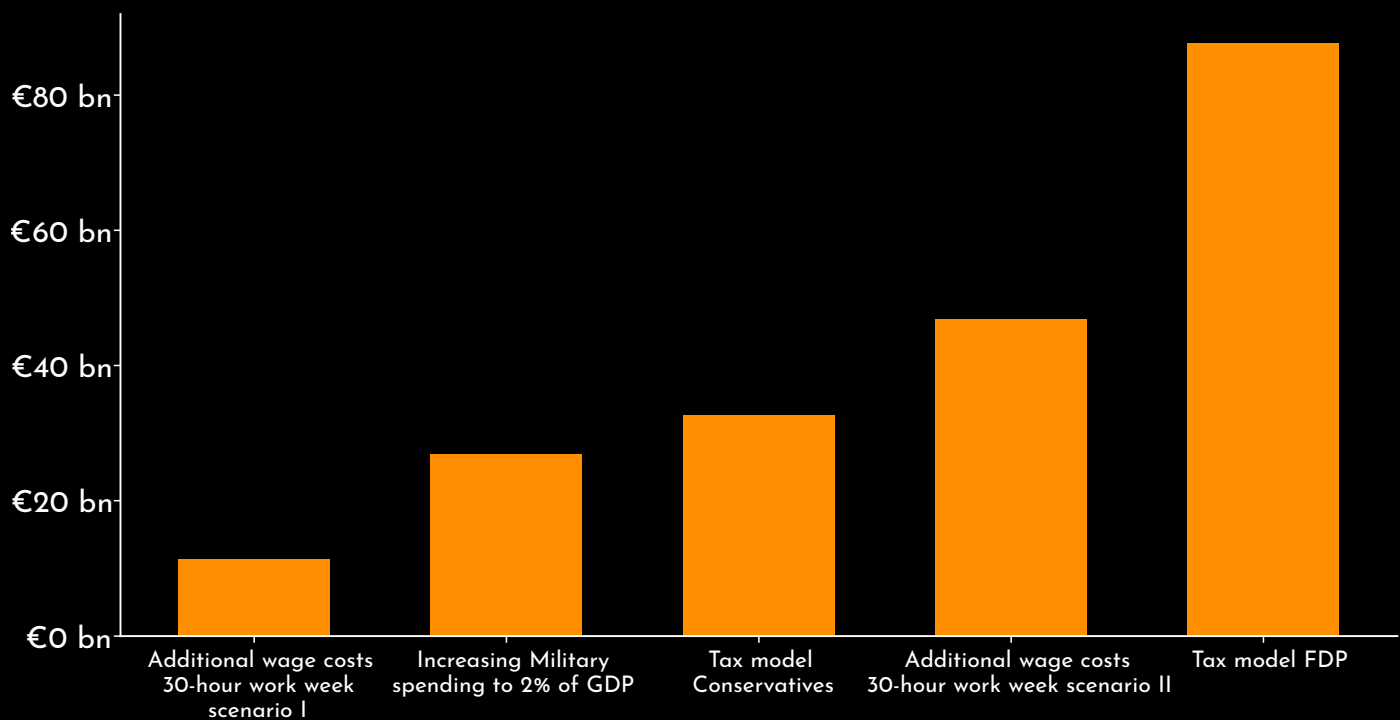
Year	Full-time working week	Yearly costs per FTE including social contributions, taxes and wage costs (euros)	Total FTE	Total wage costs (shorter working week, euros)	Additional wage costs (euros)	Jobs created
1 (= 2018)	39.20	69,386	4,232,700	294bn	0	0
2	38.28	70,085	4,283,563	300bn	3.6bn	50,863
3	37.36	70,791	4,336,305	307bn	7.3bn	103,605
4	36.44	71,503	4,391,044	314bn	11.3bn	158,344
5	35.52	72,223	4,447,910	321bn	15.5bn	215,210
6	34.60	72,951	4,507,044	329bn	20.0bn	274,344
7	33.68	73,685	4,568,602	337bn	24.8bn	335,902
8	32.76	74,427	4,632,752	345bn	29.8bn	400,052
9	31.84	75,176	4,699,682	353bn	35.1bn	466,982
10	30.92	75,933	4,769,600	362bn	40.8bn	536,900
11	30.00	76,698	4,842,734	371bn	46.8bn	610,034

[Table 3: Working time reductions scenario II for public employment in Germany, projections based on Eurofound 2017; Destatis 2019a; Destatis 2019b; WSI 2020. Full details in Appendix Four]

Accounting for the increase in direct and indirect tax revenues and reduced costs of unemployment, even in this substantially more costly scenario, the net costs might end up at only around 13 billion euros. To put these numbers into perspective, let us compare them to other recent policy proposals that have been discussed, and even adopted, in German politics.

Policy comparisons

Take for instance the commitment to raise the German military spending to 2% of GDP as demanded by its NATO partners (tagesschau 2021). By 2018 standards, this would imply that military spending grows by 0.8% of the German GDP (Destatis 2021) or roughly 27 billion euros.¹⁶ It is noteworthy that the main critique of this commitment was not an economic one, but rather focused on its normative implications: spending dozens of billions of euros a year on a single governmental undertaking seemed to be perfectly conceivable for all parties involved.



[Fig. 3: The cost of working time reductions vs. other policies, based on Destatis 2021; Buhlmann et al. 2021]

Or take the likely fiscal effect of the tax reforms suggested by Germany's Conservative Party (a loss of 32 billion euros per year) or the Free Democratic Party (a loss of 87 billion euros per year) as part of their electoral programs (cf. Buhlmann et al. 2021).¹⁷ Even making the extremely unrealistic assumptions that there would be no savings on unemployment support and no additional revenue generated from increased employment at all, these policies vastly outweigh the costs of introducing a shorter working week in Germany's public sector, offering

¹⁶ The precise figure is 26,851 million euros.

¹⁷ It might also be noteworthy to remember that according to a 2019, Germany's tax gap was at around 125 billion euro in 2015 (Murphy (2019)).

qualitatively better working conditions to millions and setting a global example for a more socially and ecologically sustainable organisation of work.

On these bases, the political parties who share the commitment to reduce working time should actively engage with such a policy to offer the population an alternative economic vision for society and our working future.

Appendix One

Year	Yearly costs per FTE including social contributions, taxes and wage costs (1% real wage growth, euros)	Total full-time equivalent jobs (FTE)	Total wage costs for the public sector (euros)
1 (=2018)	69,386	4,232,700	293,691,000,000
2	70,085	4,232,700	296,648,164,694
3	70,791	4,232,700	299,635,104,978
4	71,503	4,232,700	302,652,120,662
5	72,223	4,232,700	305,699,514,575
6	72,951	4,232,700	308,777,592,593
7	73,685	4,232,700	311,886,663,675
8	74,427	4,232,700	315,027,039,887
9	75,176	4,232,700	318,199,036,441
10	75,933	4,232,700	321,402,971,720
11	76,698	4,232,700	324,639,167,315

[Table 4: Baseline scenario public employment Germany, projections based on Destatis 2019a; Destatis 2019b; WSI 2020.]

Appendix Two

Year	Full-time working week (hours)	Yearly costs per FTE including social contributions, taxes and wage costs ¹⁸	Total FTE	Total wage costs (shorter working week)	Additional wage costs	Jobs created
1 (= 2018)	39.2	69,386	4,232,70	293,691,000,000	0	0
2	38.28	69,386	4,283,63	297,220,202,194	572,037,501	50,863
3	37.36	69,386	4,336,05	300,879,765,712	1,244,660,734	103,605
4	36.44	69,386	4,391,044	304,677,918,627	2,025,797,965	158,344
5	35.52	69,386	4,447,910	308,623,634,915	2,924,120,340	215,210
6	34.6	69,386	4,507,044	312,726,723,703	3,949,131,110	274,344
7	33.68	69,386	4,568,602	316,997,931,925	5,111,268,250	335,902
8	32,76	69,386	4,632,752	321,449,062,837	6,422,022,950	400,052
9	31,84	69,386	4,699,682	326,093,113,368	7,894,076,927	466,982
10	30,92	69,386	4,769,600	330,944,433,942	9,541,462,222	536,900
11	30	69,386	4,842,734	336,018,915,263	11,379,747,948	610,034

[Table 5: Working time reductions scenario I for public employment Germany, projections based on Eurofound 2017; Destatis 2019a; Destatis 2019b; WSI 2020]

¹⁸ Wage costs are presented in 2018 purchasing power (nominal wages would continue to grow in line with inflation in the working time reduction scenario).

Appendix Three

Year	Additional wage costs (euros)	Additional tax revenue and social security contributions (euros)	Reduced costs of unemployment (euros)	Net costs after tax revenue and reduced costs of unemployment (euros)
2018	0	0	0	0
2019	572,037,501	343,222,501	457,203,832	-228,388,831
2020	1,244,660,734	746,796,440	931,295,813	-433,431,520
2021	2,025,797,965	1,215,478,779	1,423,341,882	-613,022,696
2022	2,924,120,340	1,754,472,204	1,934,504,606	-764,856,470
2023	3,949,131,110	2,369,478,666	2,466,054,744	-886,402,300
2024	5,111,268,250	3,066,760,950	3,019,384,550	-974,877,250
2025	6,422,022,950	3,853,213,770	3,596,023,120	-1.027,213,940
2026	7,894,076,927	4,736,446,156	4,197,654,192	-1.040,023,421
2027	9,541,462,222	5,724,877,333	4,826,136,844	-1.009,551,955
2028	11,379,747,948	6,827,848,769	5,483,529,698	-931,630,519

[Table 6: Net costs of a shorter work week in public employment Germany, projections based on Winkel 2018; Destatis 2019a; Dreiling 2021. For full detail see Appendix Three]

Appendix Four

Year	Full-time working week	Yearly costs per FTE including social contributions, taxes and wage costs	Total FTE	Total wage costs (shorter working week)	Additional wage costs	Jobs created
1 (= 2018)	39.2	69,386	4,232,700	293,691,000,000	0	0
2	38.28	70,085	4,283,563	300,212,902,304	3,564,737,611	50,863
3	37.36	70,791	4,336,305	306,969,366,390	7,334,261,413	103,605
4	36.44	71,503	4,391,044	313,974,272,930	11,322,152,268	158,344
5	35.52	72,223	4,447,910	321,242,718,980	15,543,204,405	215,210
6	34.6	72,951	4,507,044	328,791,161,066	20,013,568,472	274,344
7	33.68	73,685	4,568,602	336,637,579,564	24,750,915,889	335,902
8	32.76	74,427	4,632,752	344,801,668,216	29,774,628,329	400,052
9	31.84	75,176	4,699,682	353,305,053,487	35,106,017,046	466,982
10	30.92	75,933	4,769,600	362,171,549,496	40,768,577,776	536,900
11	30	76,698	4,842,734	371,427,455,566	46,788,288,251	610,034

[Table 6: Working time reductions scenario II for public employment in Germany, projections based on Eurofound 2017; Destatis 2019a; Destatis 2019b; WSI 2020]

References

- Allmendinger, J., Eichhorst, W. & Walwei, U. (eds.) (2005) IAB-Handbuch Arbeitsmarkt: Analysen, Daten, Fakten. Campus-Verl., Frankfurt am Main.
- Bach, S., Beznoska, M. & Steiner, V. (2017) Wer trägt die Steuerlast?: Verteilungswirkungen des deutschen Steuer- und Transfersystems, Düsseldorf.
- Bosch, G. & Lehndorff, S. (2001) Working-time reduction and employment: experiences in Europe and economic policy recommendations. *Cambridge Journal of Economics* 25 (2), 209-243.
- Buhlmann, F., Hebsaker, M. & Siegloch, S. (2021) Reformvorschläge der Parteien zur Bundestagswahl 2021 - Finanzielle Auswirkungen, Mannheim.
- Dao, M. C., Das, M., Koczan, Z. & Lian, W. (2017) Why Is Labor Receiving a Smaller Share of Global Income? Theory and Empirical Evidence.
- Destatis (2019a) Finanzen und Steuern: Personal des öffentlichen Dienstes 2019: Fachserie 14 Reihe 6. https://www.destatis.de/DE/Themen/Staat/Oeffentlicher-Dienst/Publicationen/Downloads-Oeffentlicher-Dienst/personal-oeffentlicher-dienst-2140600187004.pdf?__blob=publicationFile. Accessed 3/1/2021.
- Destatis (2019b) Statistisches Jahrbuch 2019: Deutschland und Internationales. https://www.destatis.de/DE/Themen/Querschnitt/Jahrbuch/statistisches-jahrbuch-2019-dl.pdf?__blob=publicationFile. Accessed 3/1/2021.
- Destatis (2021) Anteil der Militärausgaben am Bruttoinlandsinprodukt (BIP) in Deutschland von 1995 bis 2020. <https://de.statista.com/statistik/daten/studie/183106/umfrage/anteil-der-militaerausgaben-am-bip-in-deutschland/#professional>. Accessed 6/1/2021.
- Dreiling, K. (2021) So berechnen Sie die Lohnnebenkosten für Arbeitgeber. All-in-one HR Software - FactorialHR, 2021. <https://factorialhr.de/blog/lohnnebenkosten-arbeitgeber-berechnen/#2018>.

Accessed 8/2/2021.

Eurofound (2017) Development in working time 2015-2016, Luxembourg.

Golden, L. (2012) The effects of working time on productivity and firm performance: a research synthesis paper.

Haraldsson, G. D. & Kellam, J. (2021) Going Public: Iceland's Journey to a Shorter Working Week.

Heintze, Cornelia, Ötsch, R. & Troost, A. (2020) Die Beschäftigungslücke in der sozialen Infrastruktur: Unbedeckte Bedarfe für eine gute Versorgung mit öffentlichen und gemeinwohlorientierten Dienstleistungen in Deutschland. https://www.rosalux.de/fileadmin/rls_uploads/pdfs/Studien/Studien_2-20_Beschaefigungsluecke.pdf. Accessed 7/28/2020.

IAB MAKRO (2021) IAB-Arbeitszeitrechnung: Durchschnittliche Arbeitszeit und ihre Komponenten in Deutschland.

IG Metall (2021) Durchbruch bei der Angleichung Ost. IG Metall, July 01. <https://www.igmetall.de/tarif/tarifunden/metall-und-elektro/durchbruch-bei-der-angleichung-ost>. Accessed 7/18/2021.

Jones, P., Jump, R. C. & Kikuchi, L. (2020) Public Sector as Pioneer: shorter working weeks as the new gold standard.

Jump, R. C. & Stronge, W. (2020) A Scottish Four Day Week: Initial costings for implementation in the public sector.

Murphy, R. (2019) The European tax gap: A report for the Socialists and Democrats Group in the European Parliament.

Pollert, A., Kirchner, B., Polzin, J. M. & Pollert, M. C. (2016) Wochenarbeitszeit. In: Pollert, A., Kirchner, B., Polzin, J. M. & Pollert, M. C. (eds.) Duden Wirtschaft von A bis Z: Grundlagenwissen für Schule und Studium, Beruf und Alltag. Bibliographisches Institut GmbH, Berlin.

Schulten, T. (2019) Tarifpolitischer Jahresbericht 2018: Kräftige Lohnzuwächse und mehr Selbstbestimmung bei der Arbeitszeit, Düsseldorf.

Srnicek, N. & Williams, A. (2015) Inventing the future: Postcapitalism and a world without work. Verso.

Stronge, W. & Harper, A. (2019) *The Shorter Working Week*.

Taddei, D. (1997) *La réduction du temps de travail*. Documentation Française, Paris.

tagesschau (2021) NATO-Jahresbericht: Elf Staaten erreichen Zwei-Prozent-Ziel. [tagesschau.de](https://www.tagesschau.de/ausland/europa/nato-verteidigungsausgaben-103.html), March 16. <https://www.tagesschau.de/ausland/europa/nato-verteidigungsausgaben-103.html>. Accessed 3/20/2021.

Uguccioni, J. & Sharpe, A. (2016) *Decomposing the Productivity-Wage Nexus in Selected OECD Countries, 1986-2013*. Centre for the Study of Living Standards.

Weber, E., Hausner, K. H. & Engelhard, H. (2020) Die Kosten der Arbeitslosigkeit sind 2018 erneut gesunken. <https://www.iab-forum.de/die-kosten-der-arbeitslosigkeit-sind-2018-erneut-gesunken/?pdf=14742>. Accessed 2/15/2020.

White, M. R. M. (1987) *Working hours: Assessing the potential for reduction*, 1. publ. Internat. Labour Office, Geneva.

Winkel, R. (2018) Krankenversicherungsbeiträge von ALG-II-Beziehern: Ist die Finanzierung gerecht? <https://www.ihre-vorsorge.de/magazin/lesen/krankenversicherungsbeitraege-von-alg-ii-beziehern-ist-die-finanzierung-gerecht.html>. Accessed 8/29/2020.

WSI (2020) WSI Verteilungsmonitor: Löhne und Gehälter nach Bundesländern. <https://www.wsi.de/de/wsi-verteilungsmonitor-14559.htm>. Accessed 8/2/2020.



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Mehr Zeit für Veränderung! Costing a Transformational Shorter Working Time Subsidy Scheme for the German Economy

In July 2020, Autonomy published a paper introducing a shorter working time subsidy scheme (SWTSS) as a targeted strategy to transition key economic sectors particularly hard hit by the Covid pandemic to a four-day work week to secure an economic recovery that prioritised secure and decent work (Frey et al. 2020). In designing the scheme, we drew inspiration from the German *Kurzarbeit* scheme, recognised as the ‘gold standard’ by the IMF as well as the Temporary Short Time Working Compensation Scheme (TSTWCS) overseen by the Thatcher government in the 1980s.

In this report, we build on this, developing the shorter working time subsidy scheme as a transformational policy to be employed in the transition towards a four-day work week for the whole of the economy, using Germany as an example. We situate this proposal within the German debate on the transformation of the German economy and provide a preliminary costing of such a policy.

Introduction

The German economy is faced with multiple challenges, particularly in its key industrial sector: car manufacturing. On the one hand, the global move towards a more sustainable society might lead to reduced demand for cars in the future, while the move towards electric cars has already led suppliers of car components to cut thousands of jobs as their products become obsolete. On the other hand, advances in digitalisation and automation exert additional pressure on jobs (IG Metall 2019). This situation is exacerbated by surging energy and thus production prices. Against this backdrop, the powerful IG Metall, the German Industrial Union of Metalworkers, has demanded the introduction of a *Transformationskurzarbeitergeld* – a shorter working time subsidy for the transformation (Balsler & Roßbach 2019). At its core, the IG Metall suggests that the German state should prevent additional job losses by allowing companies to take advantage of shorter working time subsidies - which usually are intended to cushion temporary lows in order intake or large-scale crises such as the Covid pandemic - on a more permanent basis. The subsidy scheme suggested by the IG Metall has a strong focus on subsidizing necessary

re-qualification times, allowing workers to keep their contracts with their companies while shifting labour costs to the state for a transitional period of unclear duration. When Covid led to a disruption of work patterns throughout Germany's economy, the IG Metall linked this demand to a transition towards shorter working times more generally, identifying a four-day work week as the answer to the structural transformation of the German car industry (IG Metall 2020b).

The IG Metall's demand generally received positive coverage, with the head of the German Trade Union Confederation Reiner Hoffmann lending his support (Saarbrücker Zeitung 2019), as well as the Federal Minister of Labour and Social Affairs (Süddeutsche Zeitung 2020) and the head of the Federal Employment Agency (Rheinische Post 2020b). The demand also proved to be popular with the rank and file of the union, two thirds of which identified a four-day work week as a key demand of the IG Metall, even willing to accept some loss in pay in exchange (IG Metall 2020a). Katja Kipping, the co-chair of Die Linke, Germany's left party, and today Senator for Integration, Labour, and Social Affairs of Berlin's regional government also lent her support and suggested expanding the idea of a SWTSS beyond the automobile sector and to develop it into a more general transitional strategy towards a 30-hour work week (Rheinische Post 2020a). This proposal is in line with a growing body of literature suggesting that the state could play a more active role in supporting the move towards a four-day work week by temporarily covering part of the costs induced by working time reductions and thus providing companies with breathing room to establish new work patterns, to invest into new technologies and to increase productivity to accommodate shorter working times (Adler et al. 2019; Stronge et al. 2019; Coote et al. 2021).

Expanding thinking about a SWTSS as a transitional strategy beyond car manufacturing is particularly pertinent given the fact that many of the challenges facing the German car industry also apply to the German economy more generally: the impacts of digitalisation and automation reach far beyond industrial manufacturing, the labour market has not quite recovered yet from the Covid pandemic as recession looms on the horizon – incentivizing policy makers to make temporary working time reductions permanent to allow for a rapid re-integration of workers (Memorandum Gruppe 2010: 87ff.) – and most importantly, working time reductions have stalled in the past three decades, leading to a backlog that should be resolved swiftly to fairly share past and future productivity increases with workers

(Frey 2021) and set the German economy on a future-proof trajectory that prioritises innovation over long working hours and (relatively) poor wages.

This report builds on our previous report *Time for Change* (Frey et al. 2020) and the method developed for modelling the costs of working time reductions in Germany’s public sector (Frey 2021), to model the costs associated with introducing a SWTSS across all of the economy.

Costing a SWTSS for Germany’s economy

As in our report on the costs of working time reductions in Germany’s public sector, our calculations will be based on the following assumptions:

- The 30-hour work week will be introduced gradually over the course of a decade.
- We assume constant labour supply and demand.¹
- Workers contribute to financing a shorter work week by accepting that wages are only increased for this decade to compensate for inflation.²
- Finally, we assume that the introduction of working time reductions will induce average productivity increases of roughly 1.22% per annum. More detail on this is provided below.

Productivity assumptions

The above assumption refers to the well-established fact that while working time reductions can lead to substantial job creation, this job creation is not necessarily proportionate to the reduction in working hours, as organisations adopt more efficient work processes, introduce new technologies and thereby make up for lost human labour (White 1987; Taddei 1997; Golden 2012). The yearly productivity increase rate is derived by applying the rule of thumb from economic literature “that the effect of a cut in working time is distributed more or less evenly between employment and productivity” (Bosch & Lehdorff 2001: 227). As working times in Germany’s public sector are longer than in the private sector and productivity is already higher in the private sector (Destatis 2021: 76), the productivity increases that could

¹ This implies that we neither account for demographic change nor major transformations of the economy that would either vastly increase or depress the demand for human labour.

² Especially those who are currently working part-time and/or are unemployed stand to profit from substantial real-wage increases due to a redistribution of working times however.

be induced by working time reductions in the private sector remain highly significant, but turn out somewhat lower than in the public sector.

Providing state support for the transition

The state could support the transition towards a 30-hour work week by temporarily subsidising large parts of the accruing additional wage costs. More specifically, we suggest a model in which state support gradually tapers off throughout the decade in which a 30-hour work week is introduced on a company level, covering 100% of additional wage costs in the first year of the transition, 90% in the second year and so on. In this way, government support would cover the majority of additional wage costs that are produced in the first half of the decade, providing companies with ample breathing room to reorganise work to be more efficient, to introduce new technologies in the workplace and to thereby increase productivity at a company level. Tapering off support in such a way both helps limit the public costs of such a policy and provides companies with a clear and enabling framework for a transition towards a four-day, 30-hour work week.

Establishing a baseline scenario

Total employment in Germany amounted to roughly 32.2 million full time equivalent (FTE) positions in 2018 (IAB MAKRO 2021), 4.2 million of which are employed in the public sector (Destatis 2019a). At an average income before taxes of 51.331€ per full-time position (Destatis 2019c) and incremental wage costs of 21% (Dreiling 2021), the total wage costs per full-time employee amount to approximately 62,111€ a year. To establish a baseline for comparison, we first project the wage costs that might be expected based on given levels of employment and real wage increases in the past (i.e. wage increases on top of inflation compensation), which averaged around 1% per annum between the reunification and 2018 (WSI 2020).³

Year	Yearly costs per FTE including social contributions, taxes and wage costs (1% real wage growth, euro)	Total full-time equivalent jobs (FTE)	Total wage costs (euro, rounded to nearest billion)
1 (=2018)	62,111	28,000,000	1,739bn
2	62,736	28,000,000	1,757bn
3	63,368	28,000,000	1,774bn

³ As in Frey (2021), we have rendered the calculations fairly conservative by using average real wage growth over a longer period of years, covering both years of economic crisis as well as years of economic boom.

4	64,006	28,000,000	1,792bn
5	64,650	28,000,000	1,810bn
6	65,301	28,000,000	1,828bn
7	65,959	28,000,000	1,847bn
8	66,623	28,000,000	1,865bn
9	67,294	28,000,000	1,884bn
10	67,971	28,000,000	1,903bn
11	68,656	28,000,000	1,922bn

[Table 1: Baseline scenario private sector Germany, projections based on IAB MAKRO 2021; Destatis 2019a; Destatis 2019b; WSI 2020.]

As we could see already in the case of the public sector (Frey 2021), the total payroll of the private sector would ordinarily increase substantially over a decade, no matter whether working time reductions with no loss in pay are introduced or not. We can now compare these figures with a scenario in which a 30-hour work week is introduced throughout the whole of the German economy (excluding the public sector for which we already presented dedicated calculations). Assuming a linear decrease in working time of roughly 0.82 hours per annum across the period of a decade to go from the average full-time work week of 38.18 hours to 30 hours per week, constant real wages and an even split on job creation and productivity increases (cf. Frey 2021), this returns us the following scenario:

Year	Full-time working week (hours)	Yearly costs per FTE including social contributions,taxes and wage costs	Total FTE	Total wage costs (shorter working week, euro)	Additional wage costs (euro)	Jobs created
1 (= 2018)	38.18	62,111	28,000,000	1,739bn	0	0
2	37.36	62,111	28,306,608	1,758bn	1.5bn	306,608
3	36.55	62,111	28,623,513	1,778bn	3.5bn	623,513
4	35.73	62,111	28,951,306	1,798bn	6.0bn	951,306
5	34.91	62,111	29,290,624	1,819bn	9.1bn	1,290,624
6	34.09	62,111	29,642,160	1,841bn	12.7bn	1,642,160
7	33.27	62,111	30,006,663	1,864bn	16.9bn	2,006,663
8	32.45	62,111	30,384,953	1,887bn	21.8bn	2,384,953
9	31.64	62,111	30,777,919	1,912bn	27.4bn	2,777,919
10	30.82	62,111	31,186,538	1,937bn	33.8bn	3,186,538
11	30.00	62,111	31,611,875	1,963bn	41.0bn	3,611,875

[Table 2: Working time reductions scenario for private employment Germany, projections based on IAB MAKRO 2017; Destatis 2019a; Destatis 2019b; WSI 2020.]

Although the costs to private companies would be significantly higher due to the larger overall scope of private employment, the additional wage costs are relatively moderate, at only slightly more than a 2% increase in the final year compared to the baseline scenario. What is more, a substantial part of the costs would be shouldered by the public purse, as illustrated in the table below.

Year	Additional wage costs (euro)	Share covered by the SWTSS	Amount covered by the SWTSS	Net costs to private employers
1 (= 2018)	-	-	-	-
2	1.5bn	100%	1.5bn	0
3	3.5bn	90%	3.2bn	0.4bn
4	6.0bn	80%	4.8bn	1.2bn
5	9.1bn	70%	6.3bn	2.7bn
6	12.7bn	60%	7.6bn	5.1bn
7	16.9bn	50%	8.5bn	8.5bn
8	21.8bn	40%	8.7bn	13.1bn
9	27.4bn	30%	8.2bn	19.2bn
10	33.8bn	20%	6.8bn	27.1bn
11	41.0bn	10%	4.1bn	37.0bn

[Table 3: Distribution of working time reductions costs.]⁴

Findings

As we can see, the costs to the public hand gradually increase over time as shorter working hours spread throughout the economy and fall in the last two years of the scheme, as the subsidy is tapered out. With a peak annual cost of 8.7bn euro compared to a total state budget of 1.4tn euro in 2018 (Destatis 2019b: 270), this policy can hardly be considered prohibitively expensive however. At the same time, the policy succeeds in keeping additional wage costs to private employers at check throughout the decade of change, with average additional wage costs staying well below 1% relative to the projected total wage costs in the baseline scenario. The costs of a 30-hour work week of 41bn euro annually in the final year of its introduction might seem steep on the other hand. From a historical perspective, wage levels have been relatively low in Germany and most developed economies in recent years however. From 1970 to 2003, the average labour share of national income was 70.51%. In the aftermath of

⁴ Due to rounding imprecision, the added costs of private employers and the SWTSS can add up to more than the total additional wage costs.

the neoliberal welfare and labour market reforms of the mid-2000s, the labour share caved in, falling from 70.91% in 2003 to just 63.6% in 2007. By 2017, the labour share had recovered somewhat, standing at 67.94% (Bundestag 2018) – but what appears to be a minor shift in national income towards capital incomes still translates into impressive numbers at a sufficiently large scale. Concretely, restoring the labour share to the 1970-2003 average would easily translate into an additional 60bn euro spent on wage costs, leaving ample room for both the introduction of a 30-hour work week without loss in pay and additional wage increases for lower wage groups.

The projected increase in wage cost would also ensure a healthy return for its investment to the state: as roughly 50% of all money spent on wages in Germany ends up in the public purse (Frey 2021), the way we designed the SWTSS allows the state to be a net beneficiary of the policy: If we assume a 100% take-up-rate of the policy (which is highly unlikely, see below), the state would pay a total of roughly 59.7bn euro in subsidies throughout the decade of the SWTSS. At the same time, total additional wage costs would be around 173.8bn euro, generating up to 86.9bn euro of tax revenue and social security contributions, resulting in a net benefit of up to 27.2bn euro.

In addition, even when assuming robust productivity increases stimulated by the introduction of a shorter working week, the transition towards a 30-hour work week might generate more than 3.5 million jobs, allowing the state to save additional billions in unemployment support. It comes as no surprise, then, that subsidy schemes that combine job creation and working time reductions have proven popular with governments in the past (OECD 1998: 153ff.).

The number of jobs that might be created however exceeds the number of unemployed people in Germany in 2018 by a small margin, which totalled slightly more than 3.4 million in 2018 (IAQ 2021). This indicates that the adoption of a 30-hour work week in Germany might lead to a structural shortage of labour, particularly if a significant number of unemployed would prove unable to be integrated into the labour market. This issue might even be exacerbated by demographic change in the upcoming decade, making it harder and harder for companies to fill vacancies. There is good reason, however, not to exaggerate this concern:

For starters, it is highly unlikely that each and every company in Germany would decide to take advantage of the SWTSS from year one of its introduction. Instead, such a policy could help companies interested in piloting better working conditions and/or whose industries face

structural challenges, such as German car manufacturers, to take the next step towards more sustainable and attractive working conditions. As a matter of fact, this would put them into a more advantageous position as the labour market tightens, allowing them to poach the best talent from competitors less dedicated to decent working conditions. Furthermore, productivity increases might easily overcompensate for a slowly declining working population (Stähler 2020), while a timeframe of a decade would provide ample opportunity for companies to train new workers – if they are willing to provide decent enough working conditions to both attract newly graduated and/or migrant workers and the unemployed (Jones & Martin 2021). Lastly, parts of the increased demand for staff could easily be met by increasing the hours of part-time workers, allowing them to substantially increase their incomes, which in turn would decrease the numbers of the working poor reliant on wage subsidies by the government to make ends meet.

One might question the framing of labour shortages as a central economic risk more generally, too: Clearly, it can be detrimental to the performance of a company if it is unable to fill its vacancies. To the contrary, it is in companies' best interest to be presented with an overabundance of applicants to any vacancy, allowing them to have their pick while keeping wages low as competition for jobs corroborated by the threat of unemployment forces workers to make painful concessions in terms of wages and overall working conditions. Low wage levels might even force workers to take up several jobs, inflating the oversupply of labour further (Bontrup 2020). What might be good for individual company profits might not be a sensible strategy on a macroeconomic level though, as companies who are able to use wage depression as a lever to generate profits are less incentivized to invest into increasing productivity (Grossmann 1929: 258; Srnicek & Williams 2015: 112). Accepting mass unemployment as a way to force down wages might temporarily increase company profits but leads to sluggish productivity growth as the relative costs of automation are increased, an underutilisation of the work force and thus an underperformance of the economy at large – and it causes substantial costs to the public purse that foots the bill of unemployment and loses out on income taxes and social security contributions. Not to mention the terrible costs forced upon workers that have to surrender to a punitive and degrading welfare regime.

Shorter working times promise to invert this situation, forcing companies to compete for staff by offering better wages and overall working conditions and by increasing investment into

vocational training. A slight undersupply of labour might help keep companies on their toes and trigger a virtuous cycle of increasing wages and increasing productivity, strengthening overall economic performance (Beveridge 1944; Stirling 2019).⁵ From this perspective, working time reductions are aimed not just at immediately improving working conditions – they are also a central tool to fight unemployment, to accelerate technological development, to increase overall economic performance and to empower workers (Erixon 2011; Srnicek & Williams 2015; Bontrup 2020; Krull & Steinrücke 2020). Accordingly, any social actor interested in promoting an economic model which nurtures innovation, prioritises decent work that is equitably spread throughout the population and fosters workers’ autonomy should welcome working time reduction as a policy to steer economic actors away from an economic model based on low pay, a withering welfare state and the ever-looming threat of unemployment. As this paper illustrates, governments can play an essential role in facilitating such a reorientation of economic priorities and might be able to do so at relatively low costs.

⁵ This line of reasoning also seems to inform the turn towards a policy of full-employment by US President Joe Biden, who argued: “We want to get something that economists call full employment. Instead of workers competing with each other for jobs that are scarce, we want employers to compete with each other to attract work. We want the companies to compete to attract workers. That kind of competition in the market doesn’t just give workers more ability to earn a higher wage. It gives them the power to demand to be treated with dignity and respect in the workplace.” (cf. Levitz 2021)

References

- Adler, D., Wargan, P. & Prakash, S. (2019) *The Green New Deal for Europe: Blueprint For Europe's Just Transition*, 2nd edn.
- Balser, M. & Roßbach, H. (2019) Gewerkschaften fordern neue Form des Kurzarbeitergelds. *Süddeutsche Zeitung*, May 16.
<https://www.sueddeutsche.de/wirtschaft/kurzarbeitergeld-ig-metall-umbruch-automobilindustrie-1.4447544?source=rss>. Accessed 10/29/2021.
- Beveridge, W. H. (1944) *Full Employment in a Free Society*. Bradford and Dickens, London, UK.
- Bontrup, H.-J. (2020) Kollektive Arbeitszeitverkürzung ist lange überfällig. *Sozialismus* **47** (9), 51–55.
- Bosch, G. & Lehdorff, S. (2001) Working-time reduction and employment: experiences in Europe and economic policy recommendations. *Cambridge Journal of Economics* **25** (2), 209–243.
- Bundestag (2018) Antwort der Bundesregierung auf die Kleine Anfrage der Abgeordneten Pascal Meiser, Fabio De Masi, Jörg Cezanne, weiterer Abgeordneter und der Fraktion DIE LINKE: Entwicklung der Lohnquote in Deutschland. *Drucksache* (19/5019).
- Coote, A., Harper, A. & Stirling, A. (2021) *The case for a four-day week*. Polity, Cambridge, UK, Medford, MA, USA.
- Destatis (2019a) Finanzen und Steuern: Personal des öffentlichen Dienstes 2019: Fachserie 14 Reihe 6.
https://www.destatis.de/DE/Themen/Staat/Oeffentlicher-Dienst/Publicationen/Downloads-Oeffentlicher-Dienst/personal-oeffentlicher-dienst-2140600187004.pdf?__blob=publicationFile. Accessed 3/1/2021.
- Destatis (2019b) Statistisches Jahrbuch 2019: Deutschland und Internationales.
https://www.destatis.de/DE/Themen/Querschnitt/Jahrbuch/statistisches-jahrbuch-2019-dl.pdf?__blob=publicationFile. Accessed 3/1/2021.
- Destatis (2019c) Vierteljährliche Verdiensterhebung: Durchschnittliche Bruttojahresverdienste (mit Sonderzahlungen) der vollzeitbeschäftigten Arbeitnehmer/-innen im Produzierenden Gewerbe und Dienstleistungsbereich nach Bundesländern im Jahr 2018 [VVE].
<https://www.statistik-bw.de/Arbeit/Verdienste/VVE-WZ-DE-Yym.jsp?y=2018&v=y&form=csv>. Accessed 6/1/2021.
- Destatis (2021) Volkswirtschaftliche Gesamtrechnungen: Inlandsproduktberechnung. Detaillierte Jahresergebnisse.
https://www.destatis.de/DE/Themen/Wirtschaft/Volkswirtschaftliche-Gesamtrechnungen-Inlandsprodukt/Publicationen/Downloads-Inlandsprodukt/inlandsprodukt-endgueltig-pdf-2180140.pdf?__blob=publicationFile. Accessed 8/1/2021.
- Dreiling, K. (2021) So berechnen Sie die Lohnnebenkosten für Arbeitgeber. *All-in-one HR Software - FactorialHR*, 2021. <https://factorialhr.de/blog/lohnnebenkosten-arbeitgeber-berechnen/#2018>. Accessed 8/2/2021.
- Erixon, L. (2011) A social innovation or a product of its time? The Rehn–Meidner model's relation to contemporary economics and the Stockholm school. *The European Journal of the History of Economic Thought* **18** (1), 85–123.
- Frey, P. (2021) *Zeit für Veränderung! Costing a shorter working week in Germany's public sector*.
- Frey, P., Jones, P., Khurana, I., Kikuchi, L. & Stronge, W. (2020) *Time For Change: the four-day week as a strategy for unemployment*.
- Golden, L. (2012) *The effects of working time on productivity and firm performance: a research synthesis paper*.
- Grossmann, H. (1929) *Das Akkumulations- und Zusammenbruchsgesetz des kapitalistischen Systems: (zugleich eine Krisentheorie)*. Hirschfeld, Leipzig.

- IAB MAKRO (2021) *IAB-Arbeitszeitrechnung: Durchschnittliche Arbeitszeit und ihre Komponenten in Deutschland*.
- IAQ (2021) Registrierte Arbeitslose und Stille Reserve 2000 - 2020.
https://www.sozialpolitik-aktuell.de/files/sozialpolitik-aktuell/_Politikfelder/Arbeitsmarkt/Datensammlung/PDF-Dateien/abbIV34.pdf. Accessed 8/10/2021.
- IG Metall (2019) Das Transformationskurzarbeitergeld: Ein Vorschlag der IG Metall zur Beschäftigungssicherung und Stärkung von Qualifizierung im Betrieb.
https://www.igmetall.de/download/20190605_Faktenblatt_Transformationskurzarbeitergeld__ad5c79ba937cc7628d88a0ddeb62b5fe65bb89f.pdf.
- IG Metall (2020a) Beschäftigtenbefragung 2020 - Ergebnisse: Beschäftigung sichern, Entgelte erhöhen.
https://www.igmetall.de/download/Datenblatt-Tarifpolitische-Forderungen_2f7c927cc108c1ad7009eb2dbfc10717e2b59ce8.pdf.
- IG Metall (2020b) IG Metall schlägt 4-Tage-Woche vor, August 19.
<https://www.igmetall.de/tarif/tarifrunden/metall-und-elektro/4-tage-woche-als-wahlmoeglichkeit>. Accessed 10/29/2021.
- Jones, P. & Martin, A. (2021) *A Shortage of Vision: solving the labour market crisis by raising standards*.
- Krull, S. & Steinrücke, M. (2020) Arbeitszeitverkürzung - die soziale Seite einer ökologischen Transformation. *Z - Zeitschrift Marxistische Erneuerung* (124), 101–106.
- Levitz, E. (2021) Letting the Economy Create Jobs for Everyone Is (Sadly) Radical.
<https://nymag.com/intelligencer/2021/06/biden-full-employment-policy-labor-shortage-inflation.html>. Accessed 11/21/2021.
- Memorandum Gruppe (2010) *Memorandum 2010: Sozial-ökologische Regulierung statt Sparpolitik und Steuergeschenken*. PapyRossa-Verl., Köln.
- OECD (1998) *OECD Employment Outlook 1998 June*. OECD Publishing, Paris.
- Rheinische Post (2020a) Kipping fordert generelle Vier-Tage-Woche mit neuem Kurzarbeitergeld als Anschlagfinanzierung. *Presseportal.de*, July 21. <https://www.presseportal.de/pm/30621/4657519>. Accessed 10/29/2021.
- Rheinische Post (2020b) Bundesagentur-Chef befürwortet Vier-Tage-Woche mit teilweisem Lohnausgleich, August 22. <https://www.presseportal.de/pm/30621/4686199>. Accessed 10/29/2021.
- Saarbrücker Zeitung (2019) DGB-Chef Hoffmann warnt vor sozialen Verwerfungen beim ökologischen Wandel. *Presseportal.de*, July 22. <https://www.presseportal.de/pm/57706/4328683>. Accessed 10/29/2021.
- Srnicek, N. & Williams, A. (2015) *Inventing the future: Postcapitalism and a world without work*. Verso.
- Stähler, N. (2020) *The impact of aging and automation on the macroeconomy and inequality*, Frankfurt am Main.
- Stirling, A. (2019) *Time for Demand: Boosting productivity with public investment, minimum wages and paid holiday*.
- Stronge, W., Lewis, K., Lawrence, M., Siravo, J. & Oikonomidis, S. (2019) *The Future of Work and Employment Policies in the Comunitat Valenciana: Research and Proposals for a Transitional Strategy*.
- Süddeutsche Zeitung (2020) Corona - Arbeitsminister Heil offen für Vier-Tage-Woche, August 19.
<https://www.sueddeutsche.de/politik/hubertus-heil-4-tage-woche-1.5003356>. Accessed 10/29/2021.
- Taddei, D. (1997) *La réduction du temps de travail*. Documentation Française, Paris.
- White, M. R. M. (1987) *Working hours: Assessing the potential for reduction*, 1. publ. Internat. Labour Office, Geneva.

WSI (2020) WSI Verteilungsmonitor: Löhne und Gehälter nach Bundesländern.
<https://www.wsi.de/de/wsi-verteilungsmonitor-14559.htm>. Accessed 8/2/2020.

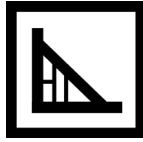
The Ecological Limits of Work:

*on carbon emissions, carbon budgets
and working time*

By Philipp Frey



Autonomy



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The Ecological Limits of Work

Faced with accelerating technological progress and a deepening ecological crisis, a growing discussion sees a reduction in working hours as a multiple dividend policy, increasing, among other things, individual wellbeing, productivity and gender equality whilst simultaneously potentially contributing to a reduction in unemployment and greenhouse gas (GHG) emissions. One cannot help but feel reminded of some earlier sociotechnical visions of a society in which productivity gains would be shared broadly to allow for radically shorter working hours and thus a qualitatively better life.

① History of an Idea

As early as the 1880s, Paul Lafargue, a son-in-law of Karl Marx, put forth the demand for a three-hour work day, enthusiastically highlighting the emancipatory potentials of technological progress (Lafargue 1883). Roughly half a century later, John Maynard Keynes dedicated himself to discussing the “economic possibilities for our grandchildren”, likewise putting forth the prospect of three-hour shifts or a fifteen-hour work week (Keynes 1930). Societal development, however, took a different route: working hours largely decreased, but nowhere near to the extent discussed by Lafargue and Keynes, whilst increases in productivity lead to qualitatively and quantitatively vastly expanded production that provided the base for modern-day mass-consumer culture.

② The Urgency of the Situation

The ecological crisis contributes to bringing the question of how productivity gains ought to be used to the fore once more. With little time left to prevent long-lasting and irreversible changes to our global ecosystem, “rapid, far-reaching and unprecedented changes in all aspects of society” (IPCC 2018) are required. Rather than discussing how to maximize economic performance (all too often a code for forcing the vast majority of the population to work long hours to the benefit of capital owners), the climate crisis forces us to change the conversation and raise the question: provided current levels of carbon intensity of our economies and current levels of productivity, how much work can we afford? To approach this question, I will build on existing research on the connection between working hours and GHG emissions and present a framework to assess sustainable levels of working hours based on OECD data.¹

③ Using Available Research

While there is a general agreement that GHG emissions and working hours have a strong, positive relationship, the exact magnitude of this relationship is still being discussed. Research by Nässén and Larsson suggest that a 1 percent decrease in working hours could lead to a 0.8 percent decrease in GHG emissions (Nässén and Larsson, 2015; see also Autonomy’s report: Stronge and Harper, 2019, 50).

¹ Anthropogenic climate change is of course just one of the ecological challenges facing humanity today (others include soil degradation, for example). The focus on GHG emissions as an indicator for ecological sustainability could accordingly be challenged. However, due to climate change being considered the key issue of ecological sustainability by policy makers, GHG emissions are more reliably tracked than other indices of ecological sustainability and at the same time one can hope that if a radical reduction of hours would contribute to a decrease in carbon emissions, it would also contribute to reducing other forms of stress on the ecological system.

In their paper “Reducing Growth to Achieve Environmental Sustainability: The Role of Work Hours” Knight et al. (2012) predicted that a 1 percent decrease in working hours could lead to a 1.46 percent decrease in carbon footprint and 0.42 percent decrease for CO₂ emissions. This significant difference is explained, in their research, by the fact that changes in consumption patterns are reflected in the carbon footprint as it is a consumption-based indicator, including the consumption of imported goods and excluding those exported, while the CO₂ emissions indicator is production-based and therefore does not account for changes in consumption of imported goods.

④ Constructing Another Calculation

I will be using the data compiled by the OECD on carbon productivity per industry sector (Data Set 1). This data is in part drawn from the 2018 National Inventory Submissions to the United Nations Framework Convention on Climate Change. As this data links GHG emissions to units of GDP, and because GDP maps closely onto waged working time in one form or another, I will assume a proportional relationship between labour time and GHG emissions.²

We must also understand how much GHG is sustainable per capita, including what the remaining Carbon Budget per capita (CB) is. In their paper “A good life for all within planetary boundaries”, O’Neill et al. (2018) assume that 1610 kg CO₂ eq emissions per year per capita would allow the world to stay within the planetary boundary of 2°C warming compared to pre-industrial levels.

² The data puts a nation’s total GHG emissions in relation with its GDP. However, it does exclude emissions from land use, land-use change and forestry (LULUCF). These have been largely negative for the United Kingdom, Sweden and Germany however, with Germany and the UK roughly being on the same level and Sweden registering three times as much negative emissions from LULUCF. The intensity per unit of GDP (expressed in USD at 2010 prices and PPPs) is calculated on gross direct emissions (excluding LULUCF). Due to the limitation of the data provided by the OECD, the effects of unpaid work had to be excluded in this paper for pragmatic reasons.

The OECD data details the total GHG emissions per unit of GDP (kg CO₂ eq per dollar GDP), or Carbon Intensity of an economy (CI).³ Combining this data, we can learn how much GDP per capita would be sustainable, provided a per Carbon Budget of 1610 kg eq CO₂ per year derived from research literature and the levels of Carbon Intensity provided by the OECD.

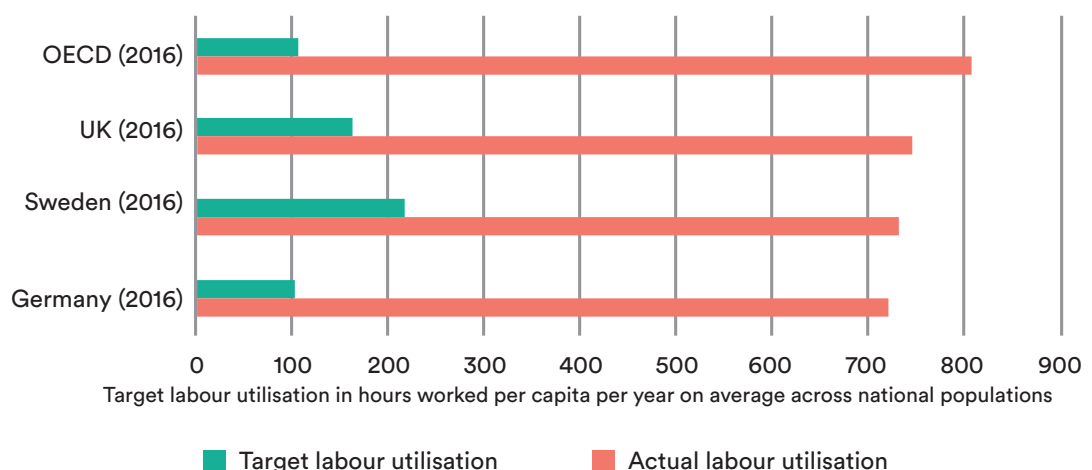
In another step we can divide this sustainable GDP by the productivity, measured in GDP per hour worked (P in dollar per hour worked) to see how many hours⁴ worked within a given economy (target Labour Utilisation tLU_i in hours per year) might be sustainable.

Accordingly, we can solve:

$$tLU_i = \frac{CB / CI_i}{P_i}$$

(whereby index i denotes the country and year the data refers to) for various countries.

Chart 1: Actual vs. Target Labour Utilisation



³ I would like to thank Nela Šalamon for her help in formalizing my initial 'back-of-the-envelope' approach.

⁴ Hours worked per capita per year on average across the whole national population.

Actual working hours levels vastly exceed the levels that might be considered sustainable

As we can see, actual working hours levels vastly exceed the levels that might be considered sustainable, with Sweden, whose Carbon Intensity is around half of that of Germany reaching unsustainable levels of work at a much later point,⁵ whereas the slightly lower-than-average Carbon Intensity of the German economy compared to the OECD-average hardly registers due to the higher per hour productivity in Germany.

Since almost no one deals with statistics on labour utilisation on a regular basis, the question arises: what does a labour utilisation of 100 or 240 hours per capita per year actually mean? The relation between the length of full-time employment and labour utilisation varies from economy to economy, as a number of factors such as vacation times or the number of bank holidays differ. Additionally, the composition of national labour markets might differ both in regards of who participates (e.g. number of students or the share of population occupied by the retired population) and how (e.g. whether part-time jobs are widespread or not). This explains why the overall labour utilisation is significantly lower than the average per capita hours worked by the employed population in these countries (which usually lies between 1.3 and 1.5 thousand hours per year).

It is possible, however, to calculate the relation between actual labour utilisation (LU_i) on the one hand and the actual length of an average full-time employment week (WT_i) though.

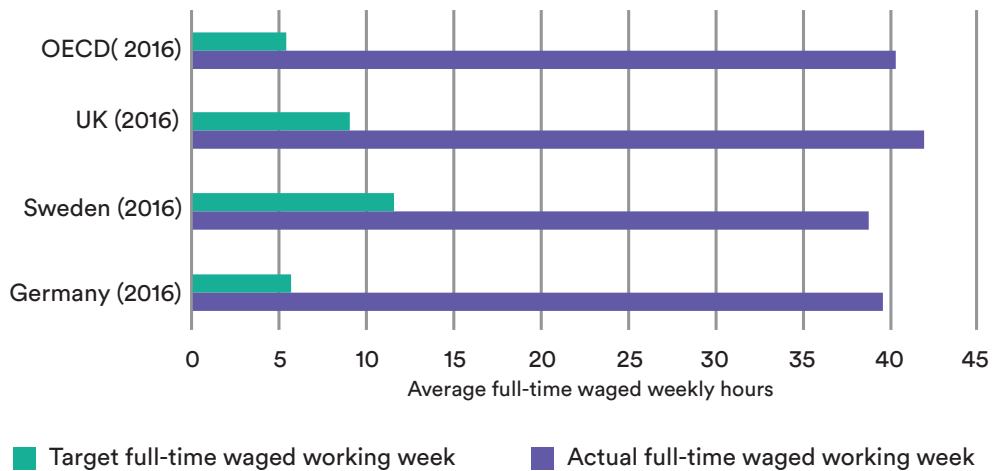
Drawing on our initial formula, the length of a sustainable full-time week, assuming a linear decrease in working times, would be:

$$tWT_i = \frac{tLU_i}{LU_i / WT_i}$$

⁵ The lower Carbon Intensity of the Swedish economy can partly be explained by its composition which is not as centred on manufacturing as the German economy, but more importantly it points to an early adoption of progressive sustainability policies such as carbon taxation and a relatively high share of renewable energies, supported by government investment.

This looks as follows:

Chart 2: Actual vs. Target Full-time Working Weeks



Although the results differ greatly between countries, with Sweden reaching its limit for sustainable working time twice as late as the OECD average, these findings imply that unless enormous progress in carbon efficiency would be achieved, cutting the work-week by, for example, just one day would fail to decrease carbon emissions to a sustainable level by itself.

One could provocatively say that the length of the working week, as envisioned by Lafargue and Keynes, actually matches sustainable levels of work

With Sweden reaching its limit of sustainable work hours at close to 12 hours, one could on the contrary say that the length of the working week envisioned by Lafargue and Keynes match sustainable levels of work more closely and thus provide a more sound normative orientation than any approach that propagates full-employment with working weeks of around the current 40 hours per week.

I would thus argue that the climate crisis calls for an unprecedented decrease in the economic activity that causes GHG emissions, and this confronts us with, to adapt Paul Lafargue's phrase, the 'necessity to be lazy'. If ecological sustainability requires an overall decrease in material consumption, a vast expansion in terms of leisure time and thus an increase in "time prosperity" would be less of a luxury and more of an urgency.

⑤ Other Considerations

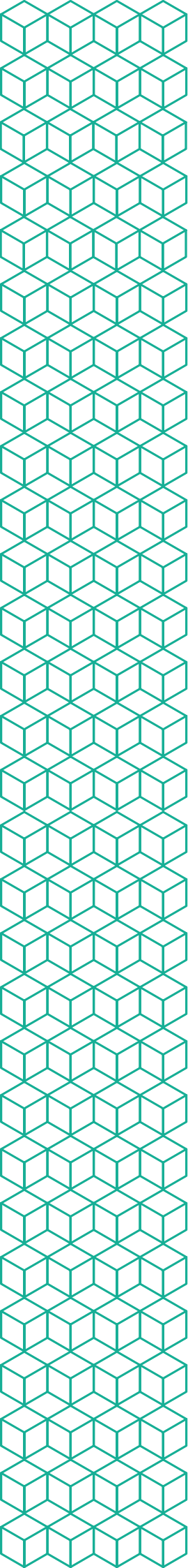
Working time reduction as an isolated policy by itself will likely be insufficient to combat climate change

At the same time, these findings reinforce that working time reduction as an isolated policy by itself will likely be insufficient to combat climate change. Rather, it needs to be supplemented by other policies facilitating radical economic transformation, for instance to shift jobs from sectors such as manufacturing and fossil fuel extraction towards employment in service professions and green jobs (e.g. reforestation operations).

This is particularly true as the carbon budget of 1610 kg CO₂ eq per year emissions per capita already seems quite generous today: Not only does it assume a population of only 7 billion people, it is also based on the 2°C goal rather than the more ambitious goal of limiting climate change to a 1.5°C increase.

Additionally, as discussed in previous sections, reductions in working hours might lead to less than proportionate decreases in GHG emissions due to an increase in per hour productivity caused by organisational improvements, a more motivated and efficient work force and/or technological improvements.

Lastly, the working week reductions above assume a linear and absolute decrease in working time, which would therefore not allow the use of working time reductions to offer jobs to the unemployed or to increase the working hours of the underemployed (which would require a more equal sharing out of current working hours). If we wished to achieve these social goods, an even more radical conclusion emerges: the actual sustainable work week, based on today's levels of productivity and carbon intensity, would likely need to be well below 10 hours per week per person, even in relatively carbon-efficient economies such as Sweden.



In addition to shortening the working week quantitatively and pushing for a substantial reconfiguration of the economy, a more qualitative approach to a politics of time might also be needed (Stronge and Harper, 2019). The existing high levels of productivity could also in part be used to reverse the intensification of work that is having significant negative impact on individual wellbeing and mental health.

Clearly, such a transformation of work cannot be brought about overnight. It is becoming equally clear, however, that driving the current mode of production forward is even more unrealistic if we are to avoid disaster. In the past, progress towards ecological sustainability, if it was made at all, oftentimes amounted to too little, too slow. Today, it might be high time to use the momentum that is behind the demand for a shorter work week to discuss even more ambitious goals in terms of ecological sustainability and time prosperity. I hope this paper might provide some stimulation to such a debate.

⑥ Bibliography

Lafargue, P. (1883/1907). *The Right To Be Lazy*. Chicago, IL: Charles H. Kerr and Co.

Keynes, J.M. (1963). *Essays in Persuasion*, New York: W.W. Norton & Co., pp. 358-373.

Knight, K.; Rosa, E.A.; Schor, J.B. (2012). 'Reducing Growth to Achieve Environmental Sustainability: The Role of Work Hours'; *Political Economy Research Institute Working Paper Series*, Number 304, University of Massachusetts: Amherst, MA, USA.

Nässén, J.; Larsson, J.; (2015). 'Would shorter working time reduce greenhouse gas emissions? An analysis of time use and consumption in Swedish households', *Environment and Planning C: Government and Policy*, vol. 33, pp. 726–745.

O'Neill, D.W.; Fanning, A.L.; Lamb, W.F.; Steinberger, J.K. (2018) 'A good life for all within planetary boundaries', *Nature Sustainability*, 1, pp. 88–95.

Stronge, W.; Harper, A. (2019). 'The Shorter Working Week: a radical and pragmatic proposal'. Hampshire: Autonomy. (online at: <http://autonomy.work/wp-content/uploads/2019/03/Shorter-working-week-docV6.pdf>)

IPCC (2018). Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C approved by governments (online: https://www.ipcc.ch/site/assets/uploads/2018/11/pr_181008_P48_spm_en.pdf)

7 Data Sets

Data Set 1:

National Inventory Submissions 2018 to the United Nations Framework Convention on Climate Change (UNFCCC, CRF tables), and replies to the OECD State of the Environment Questionnaire. Available at:

https://stats.oecd.org/Index.aspx?DataSetCode=AIR_GHG

Other data found at: <https://stats.oecd.org/>

Dataset: Greenhouse gas emissions / Total GHG excl. LULUCF per unit of GDP

Dataset: Level of GDP per capita and productivity / GDP per hour worked

Dataset: Productivity / Level of GDP per capita and productivity / Labour utilisation (hours worked per head of population)

Dataset: Average usual weekly hours worked on the main job / All persons, dependent full-time employment

[All data extracted on 23 Apr 2019]

TOLL GATES AND MONEY PUMPS:

**Why carbon taxation
could be a simple,
fair and transformative
policy instrument**

March 2022



Autonomy

Authors

Philipp Frey
Luiz Garcia



Autonomy

Autonomy is an independent research organisation which creates data-driven tools and research for sustainable economic planning. Our research focuses on issues such as the future of work, sustainable jobs and just green transitions. Our team of policy experts, economists, physicists and machine learning specialists means that we can produce data-driven, analytically sharp research that can influence policy, intervene in public debate and augment movements for sustainable change.

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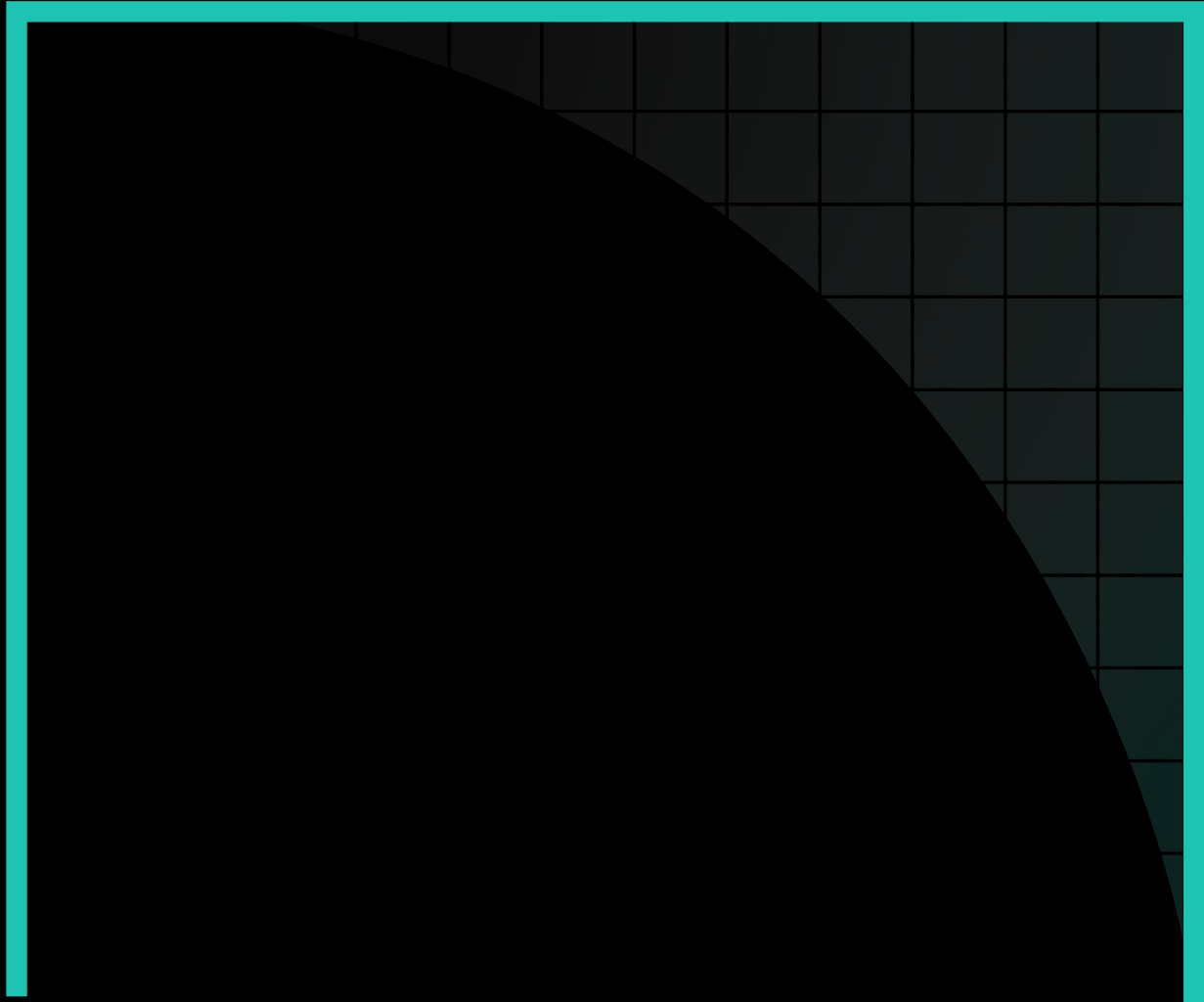
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References



EXECUTIVE SUMMARY

- This study looks at the possible impacts of a carbon tax and dividend scheme upon incomes across society. In its simplest formulation, such a scheme taxes individuals according to their carbon consumption and pays out the revenue to all individuals within a defined geography. It is comparable to a form of Universal Basic Income, funded by carbon taxes.
- This study models such a scheme at three different scales: Global, European and the nation state.

EXECUTIVE SUMMARY

GLOBAL

A global carbon tax dividend would disproportionately benefit countries in Latin America, South Asia, Sub-Saharan Africa and many other countries in the Global South.

Such a global scheme, if tuned properly, would **effectively end extreme poverty** globally and would also serve to lift more than a billion people above more ambitious poverty lines of **\$3.2** and **\$5.5** a day.

3.8bn people would see their income increase by at least **10%** with a global carbon dividend scheme.

The global scheme would see individuals in the group of heavily indebted poor countries (HIPCs) receive a total of **\$438bn** in dividends annually, outperforming today's schemes for development assistance and debt relief combined.

Emerging economies such as Brazil and India would also profit substantially from such a global carbon dividend, receiving a net gain of more than **\$37bn** (1.9% of GDP) and **\$696bn** (24% of GDP) respectively for Brazil and India.

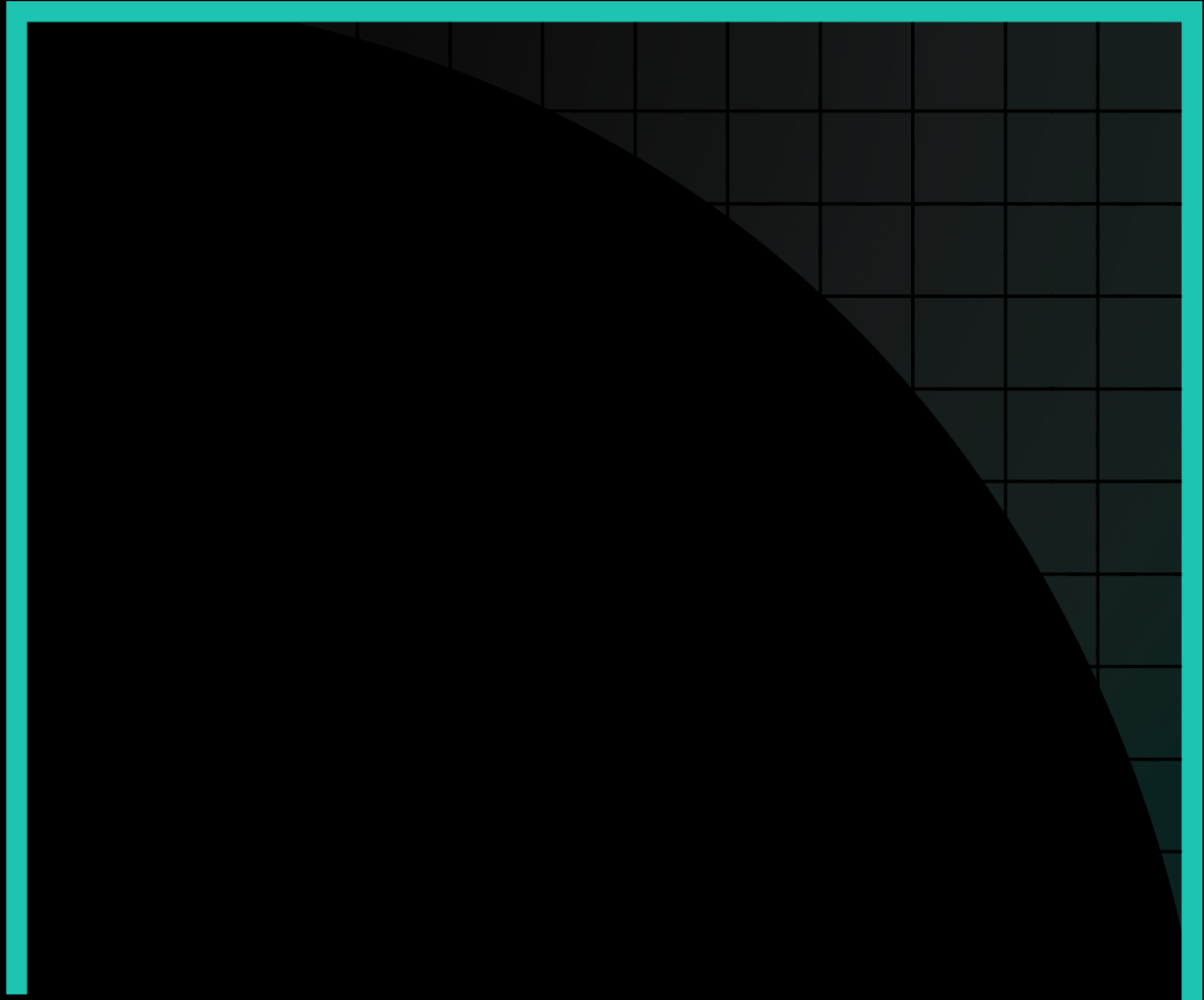
EUROPE

A carbon tax dividend scheme limited to Europe would most benefit Bulgaria, Croatia and Romania, but would also significantly benefit the poor (lower income deciles) in most European countries.

NATIONAL

At the national scale, a national carbon tax-dividend scheme in Brazil would have huge economic effects, increasing the income of the bottom **10%** by more than **72%**, while the top **1%** would lose around **10%** of their income.

In the UK and Germany, national carbon dividend schemes would benefit **70%** of the respective populations, who would receive net contributions from the top **30%** of the population - with the majority of contributions coming from the top **1%**.



CONTEXT AND BACKGROUND

Humanity is facing a rapidly exacerbating climate crisis, driven by anthropogenic greenhouse gas (GHG)

CONTEXT AND BACKGROUND

emissions. To reduce emission levels, economists have long called for the introduction of carbon pricing, either through direct taxation or through emission trading schemes, in order to discourage carbon use. The basic argument is that such a taxation is required to remedy one of the central market failures of our time: that without state intervention, no immediate costs are attached to emitting GHG emissions despite the immense environmental, economic (and potentially existential) costs associated with them. This leads economic actors to, for instance, prefer marginally cheaper energy sources to sustainable alternatives - the costs of GHG emissions are thus externalised. There are fears however that pricing them in through taxation might adversely affect social stability, with the French so-called Yellow Vests serving as a warning of the political and social price that might be attached to trying to fix the climate crisis in ways that entail increased consumption costs (Chancel 2021).

Our governments seem to be stuck between a rock and a hard place: either let climate change run its course, and postpone action for another few years, or risk upsetting huge parts of the electorate. The result is the standstill that still characterises much of policy making around ecological sustainability. Thus, we need to search for ways to combine ecological and economic sustainability: we need incentives to consume less carbon and rewards for those that already do.



WHAT IS A CARBON TAX?

The basic idea of a carbon tax is to introduce a tax charged for every ton of carbon emissions 'consumed' by the production of a good or service.

Ideally the introduction of such a tax would act as a 'stick', leading to lower carbon emissions by deterring consumption of a particular kind via higher costs. It also would bring in significant revenue, which can be redeployed in a number of ways.

It should also be noted that using taxation to reduce carbon emissions - whether they be levied upon companies or on individuals - will ultimately affect consumers themselves at the end of the day. 'Upstream' emitters such as car companies or oil firms will push the new costs accrued from targeted taxes downstream to their customers.

WHAT IS A CARBON TAX?



MONEY PUMPS:

**The importance of the
dividend component**

MONEY PUMPS:

The importance of the dividend component

"The principle behind carbon dividends is straightforward. The amount that each person pays is based on his or her use of a limited resource: the atmospheric space for carbon emissions. The amount that each receives is based on common ownership of the resource. From each according to use, to each according to equal ownership." (Boyce 2019: 82)

As is well established, normal consumption tax schemes can often be regressive (Mathur/Morris 2014; Wang et al. 2016). By taxing a certain form of consumption (e.g. sugar, alcohol, carbon, etc.), such schemes inevitably deduct a larger proportion of the incomes of lower earners, simply because there is a smaller pot from which this consumption draws (Boyce 2019). An extra £1,000 in tax per year means something very different to someone on the minimum wage than it does to someone earning six figures. This underlines the importance of the dividend component of any carbon taxation scheme: we need money pumps to protect lower earners and emitters from being financially worse off (Barnes 2021).

A carbon tax affects some cohorts of the population more than others. A solid body of research has evidenced a correlation between higher income, higher consumption and higher emissions on national and global levels (Chancel/Piketty 2015; Oxfam 2015; Hardadi et al. 2020; Oswald et al. 2020; Oxfam 2020). As emissions are polarised roughly in line with socio-economic polarisation, schemes that would tax everyone's GHG emissions and then distribute the income via a dividend amongst the population, could potentially be hugely transformative (Bach et al. 2019; Kalkuhl et al. 2021; Gechert/Dullien 2021).¹ Support for a system of carbon dividends is particularly strong within the field of economics, inspiring the largest public statement of US economists in history, rallying 4 Former Chairs of the Federal Reserve, 28 Nobel Laureate Economists and thousands of rank-and-file colleagues behind the demand for carbon dividends (Akerlof et al. 2019). At the same time, evidence is mounting that an inclusive redistribution generated from carbon taxation is key to gaining political support for ambitious policy making (Klenert et al. 2018).

Beyond academia, an increasing number of prominent actors are calling for proposals along these lines too. From David Miliband's proposal of tradeable personal carbon allowances in 2006, or the Green New Deal for Europe campaign demanding a tax-and-dividend system, to the contemporary German Greens' *Energiegeld*, redistributive carbon pricing has increasingly gained traction in politics. Crucially, the idea has also gained popularity with parts of the labour movement, who have been long wary of additional indiscriminate consumption taxes, with the Macroeconomic Policy Institute of the German Hans-Böckler-Foundation, the premiere trade union think tank in Germany, demanding the introduction of a tax-and-dividend system to ensure a retributive implementation of CO₂-taxation (Gechert/Dullien 2021).

¹ This is the another reason why an individualised carbon taxation scheme would likely be progressive.

In the following, we will model such a tax-and-dividend system based on Lucas Chancel's updated database (2021) on global emission distributions. We will do so by investigating how the introduction of a tax-and-dividend system might lead to redistribution on the global, regional and national levels. Our modelling is based on the assumption that carbon taxation is levelled indiscriminately on all consumption based on its emission intensity, with all revenue generated through that taxation being equally redistributed amongst the population in full. Ideally, this would take place on a monthly basis through direct money transfers from the taxing authorities to the population at large.

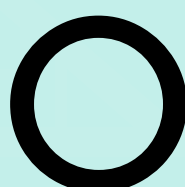
To allow for a direct feedback loop to consumers, the GHG-share of commodities would need to be labelled explicitly on purchased products, providing individuals as well as companies transparency over the environmental impact of their consumption.² This transparency in combination with the increased relative costs of carbon-intensive consumptions would provide a powerful incentive for both private as well as institutional consumers to "green" their consumption.

² The carbon indexing of products should follow established methodologies for environmental impacts assessment within sustainability studies such as life cycle assessment (LCA), as defined in ISO standards ISO 14040 and ISO 14044. To avoid double-taxation, environmental costs that are produced throughout the use phase of the product, e.g. through energy use of electronic equipment, should be excluded.

NOTE Needless to say, carbon taxation is just one of the instruments at our collective disposal to tackle the climate crisis: it is no magic bullet. As is suggested by many Green New Deal proposals, governments should actively intervene to help transform industries, invest into new technologies and phase out old, unsustainable ones (such as combustion engines or coal plants), take decisive action to protect biodiversity, create hundreds of thousands of decent jobs in climate protection and (re-)shape markets (DiEM25 2017; Mazzucato 2021). Yet, in an economy in which prices are central to economic coordination and individual behaviour, not using price signals as a lever - as long as they can be implemented in a socially advantageous way - to shape the market is at best negligent and at worst dangerous. In turn, state intervention might be needed to help individuals adapt to their changing behaviour however, for instance by providing subsidies for home isolation and updates to heating systems or by providing public transport as a universal basic service (Portes et al. 2017).



METHOD AND KEY QUESTIONS



ur database focuses on consumption-based CO₂-

equivalent emissions

and income per capita decomposed into eleven groups: the bottom nine deciles, the top ten percent excluding the top 1%, and the top 1% itself. We cover 169 countries totalling 7.6bn people. The consumption based emissions were obtained from Chancel (2021) for the year of 2019. The income shares were obtained from UNU-WIDER, World Income Inequality Database (WIID)³, released in May 2021.⁴ We derived the gross per capita income by applying the income shares provided by UNU-WIDER to the nominal GDP per capita for the year of 2019 provided by the World Bank.⁵ We assume that the relationship between income and emissions is monotonic, consequently the individuals inside each emissions group per country are the same ones inside the income group per country.

METHOD AND KEY QUESTIONS

3 We gathered the most timely data available for income shares by the most recent version of the World Income Inequality latest Database (WIID).

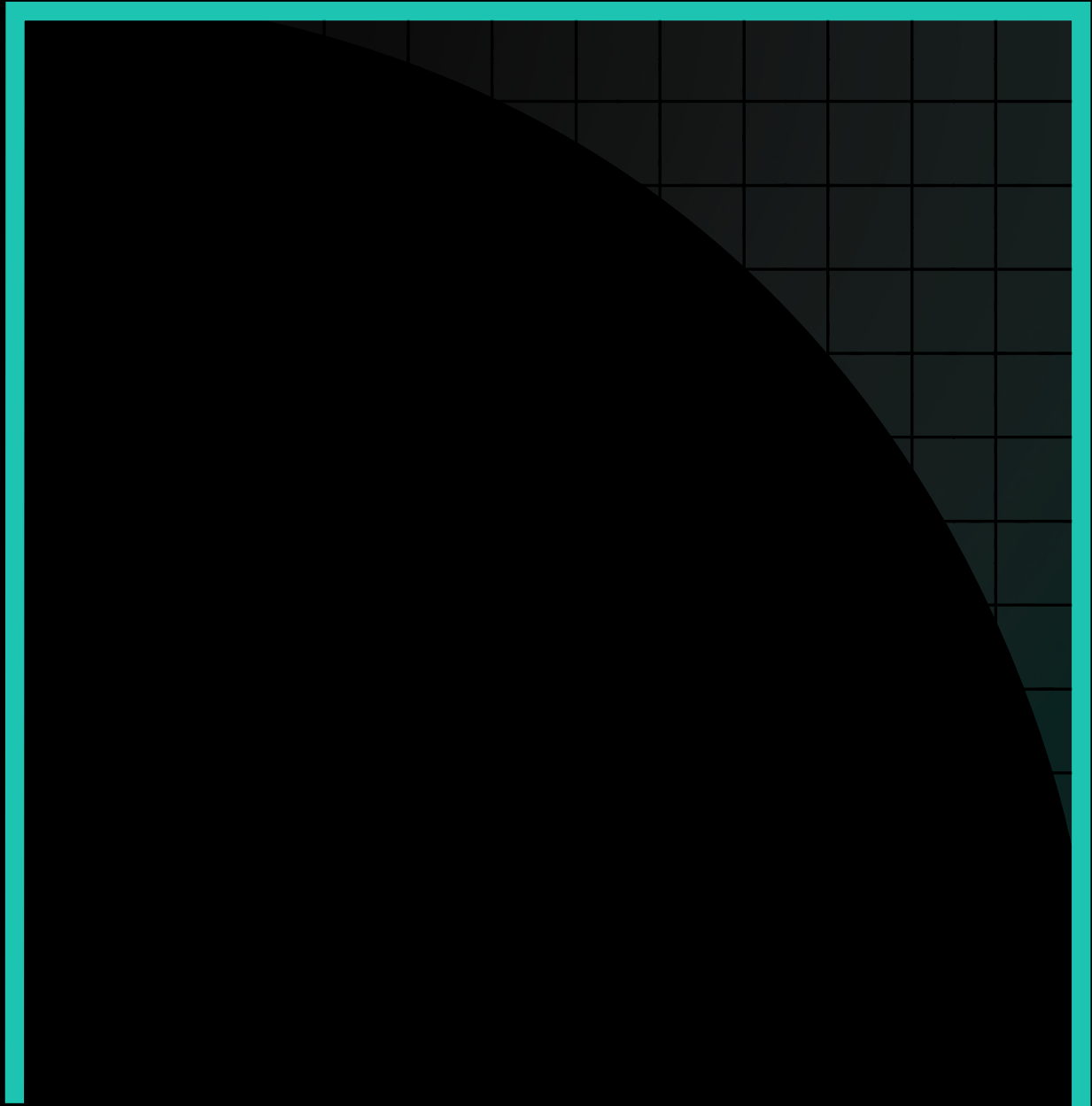
4 It can be found here: <https://doi.org/10.35188/UNU-WIDER/WIID-310521>

5 This conversion was necessary to derive a dataset for income distribution in nominal values, rather than purchasing power parity adjusted ones. We opted for nominal values since we assume a nominally constant CO₂-price across economies in order to avoid so-called carbon leakage.

CARBON PRICING In our modelling, we investigate what the economic effects of generalising the Swedish carbon price, currently the highest in the world at \$137 per metric ton of CO₂-equivalent (Destatis 2021), would be on a global level.⁶ In a second step, we investigate the impacts of a slightly higher carbon price of €195 (roughly \$225), which is the discounted rate suggested by the Federal Environment Agency of Germany to be used in the context of advanced economies (UBA 2020: 8). What effect would this have on a European level and in the context of national tax-and-dividend schemes in Germany and the United Kingdom? Further, we provide another deep-dive on the distributional effect of a \$137 (Swedish carbon price) carbon tax-and-dividend scheme for Brazil, to illustrate the effects of such a national tax-and-dividend scheme in an emerging economy.⁷

6 We are choosing this carbon price because it is already being applied in reality today and because it fairly precisely fits into the lower end of the carbon price bandwidth indicated by IPCC to be needed by 2030 to stay below 1.5°C-warming (IPCC 2018: 152).

7 Not only does our more detailed analysis cover both developed and emerging economies - the countries differ in respect to their specific accumulation regimes (industrial manufacturing-led in Germany, service based economy in the UK, extractivist economy in Brazil) and the levels of national inequality.



FINDINGS 1: GLOBAL

The introduction of a global carbon tax and dividend at \$137, the price already established

FINDINGS I: GLOBAL

in Sweden today, would be transformative. In total, \$2.69tn would be raised annually through such a tax and redistributed evenly. While countries in South America, Sub-Saharan Africa, South-Asia and many other parts of the Global South would profit immensely, most developed economies would only see proportionally relatively small losses. The preliminary result is illustrated below:

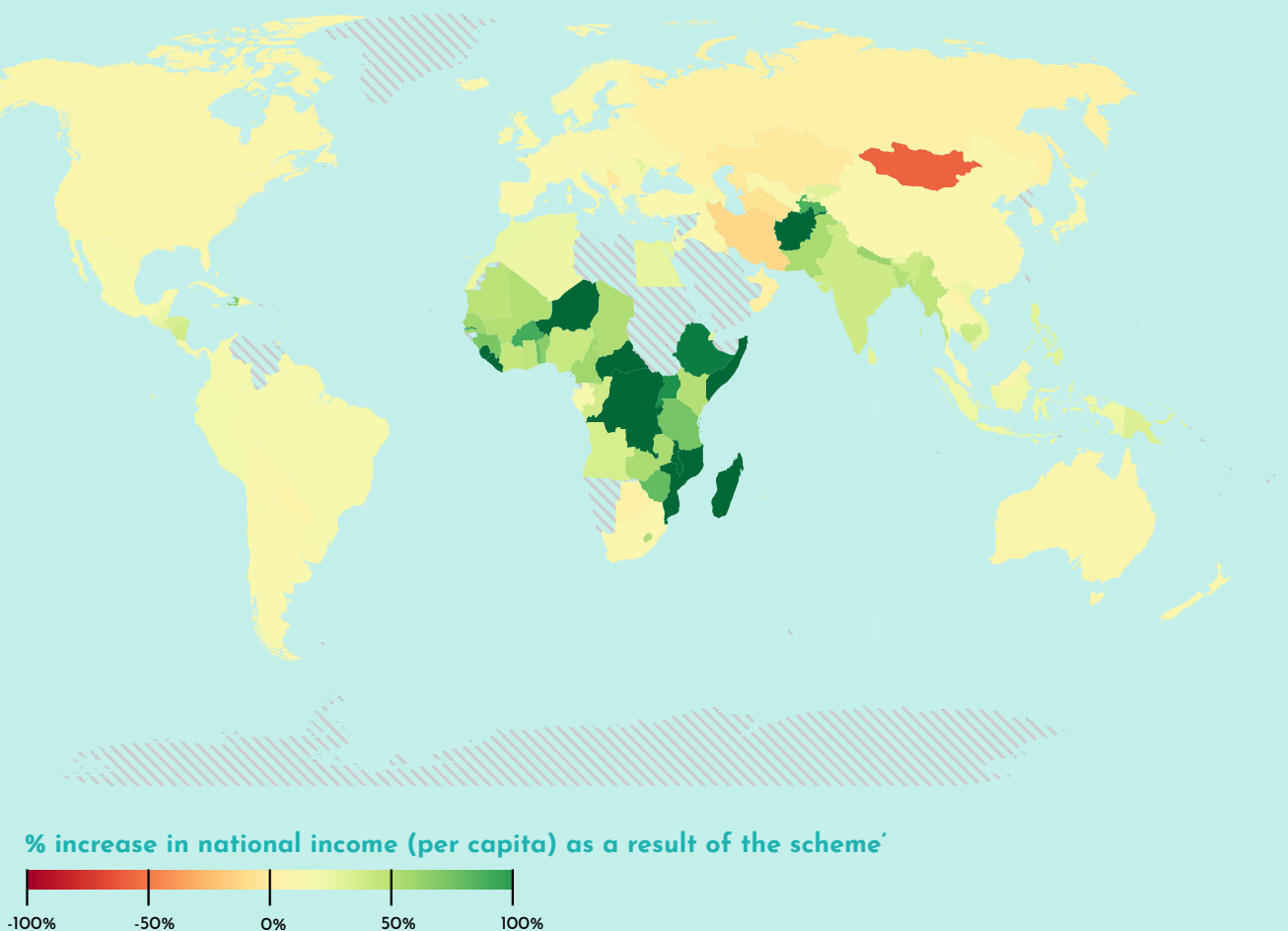


Fig 1. A map of 169 countries, where % loss/gain of GDP per country, as a result of a global carbon tax and dividend scheme is displayed according to colour. We have here used the amount of US\$ 137 as a carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021).

Countries such as Burundi, Somalia and Sierra Leone would see a net carbon dividend⁸ equal to 274%, 181% and 129% of their respective GDP, while many upper middle-income countries, such as Sri Lanka (13%), Guatemala (10%) and Algeria (9%), would still profit from the substantial redistributive effects of such a policy. The picture gets even clearer however if the country-based data is disaggregated. Those that stand to gain the most through such a global scheme are the poorest of the global poor, living in countries such as the Central African Republic, Benin and Zimbabwe, as illustrated in the table below.

Top 10 winning deciles by relative income increase under Swedish carbon pricing rate of \$137 per metric ton

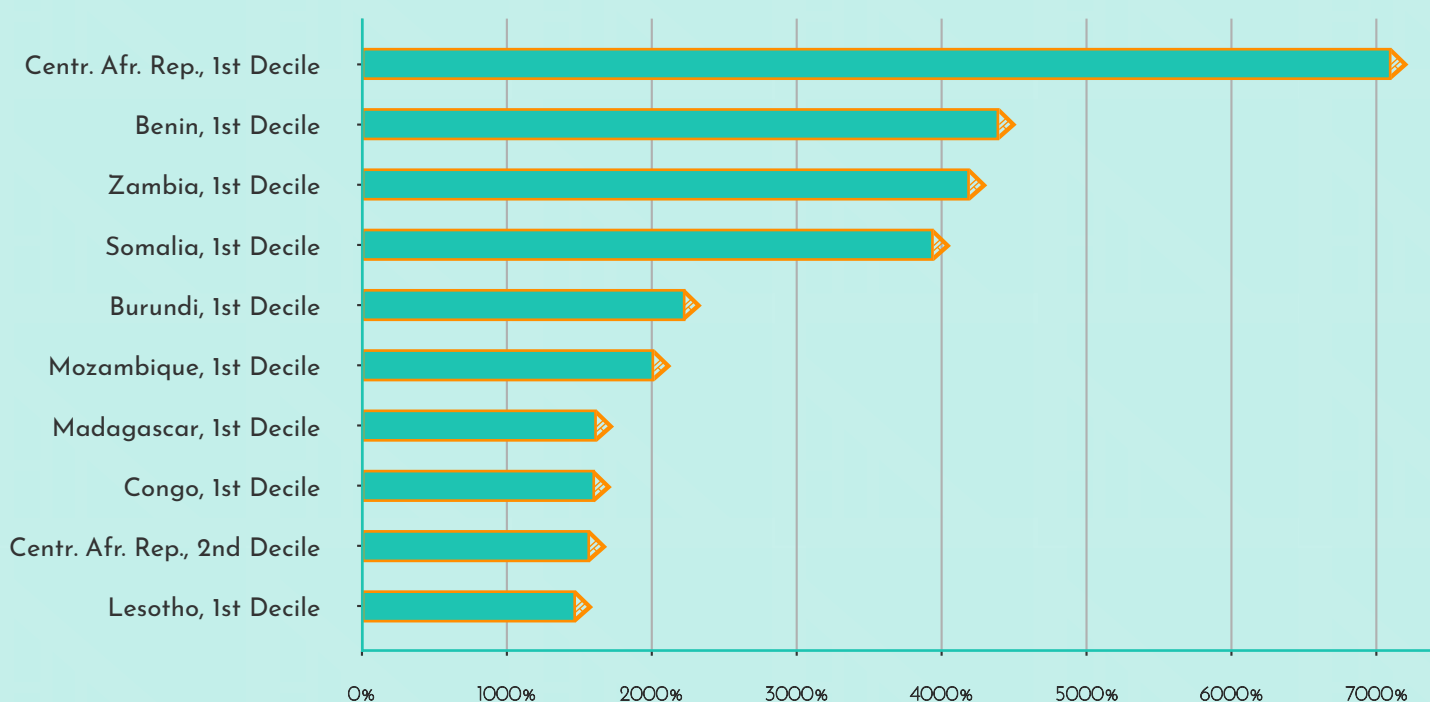


Fig. 2a Top ten winners (income groups in various countries) by relative gain (% increase in income) from a global carbon tax and dividend scheme. We have here used the amount of US\$ 137 as carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021)

⁸ In the following, the term dividend refers to the net amount of money transferred to countries or specific income deciles within countries, i.e. after the reductions in income through CO₂e-based taxation have been subtracted from the absolute dividend.

Absolute change in mean, annual per capita income of top 10 winning deciles under Swedish carbon pricing rate of \$137 per metric ton

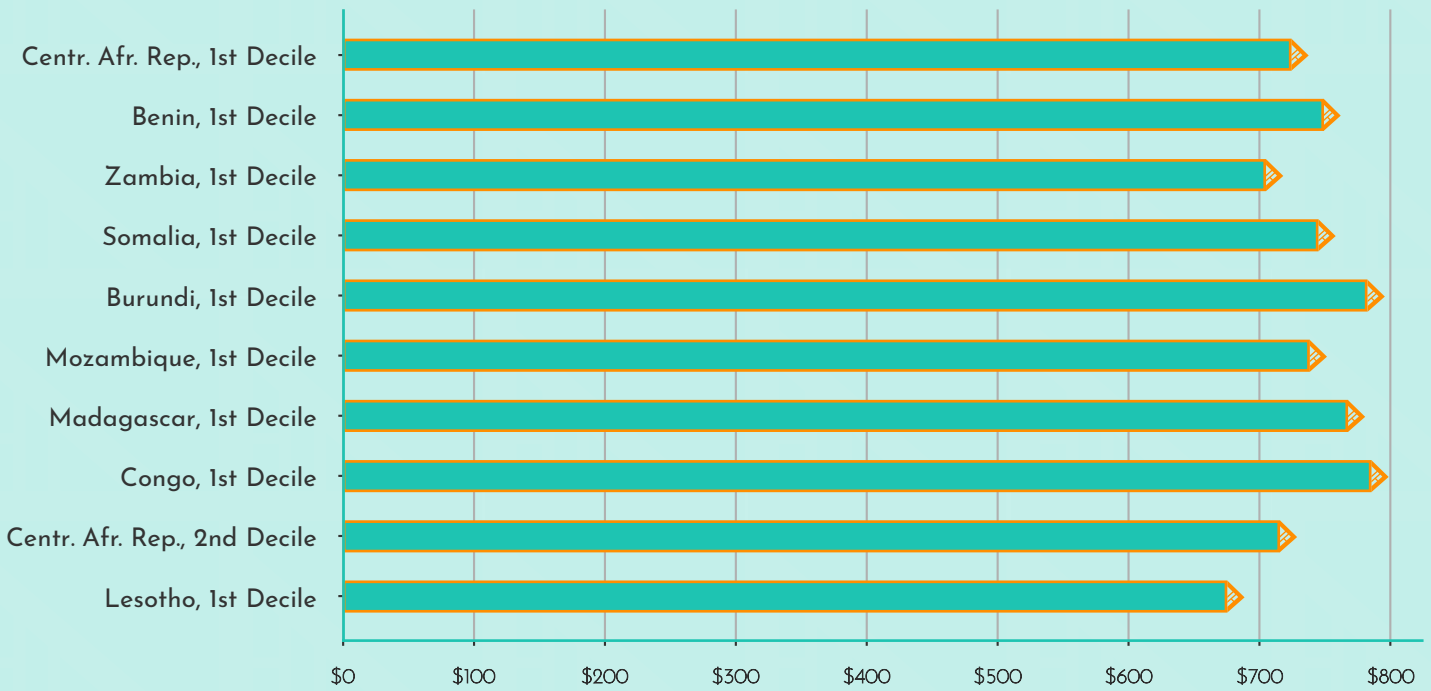


Fig. 2b The absolute increases in income for the same groups as in Fig. 2a, after a global tax and dividend scheme. The X axis is in US dollars. We have here used the amount of US\$ 137 as carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021).

The top winners of such a global scheme would see their per capita income skyrocket, increasing dozens of times over, while every second person in the world (3.8bn people) would experience a substantial increase of their income of 10% or more.⁹ In absolute terms, the dividend could come close to \$800 a year for those parts of the global population that are responsible for almost no emissions.

Such a global scheme would effectively end extreme poverty, defined as \$1.9 per person per day, as, according to our calculations, combined pre-existing per-capita incomes and carbon dividends would by far exceed the extreme poverty threshold across the board. But the effects of such a global scheme in fighting global poverty would not end there. Another 371m people would be lifted above the national poverty line typically found in lower middle-income countries of \$3.2 a day and 820m would be lifted above the poverty line typically found in upper middle-income countries of \$5.5 a day. A total of 636m people would be protected from falling below the international extreme poverty line by their carbon dividend alone, establishing elements of a global safety net.

⁹ According to our data, the bottom 10% in income in the Central African Republic would receive a dividend equivalent to 70 times their annual income in such a global scheme. The bottom 10% of Benin, Somalia and Zambia would receive more than 40 times their current income through such a scheme. This is based on extremely low levels of per capita incomes of only \$10.2 a year per person at the bottom of the Central African Republic and of \$17 for the bottom 10% in Benin. Average nominal GDP per capita for the Central African Republic was \$467.9 in 2019 according to the World Bank - the extremely low per capita income in the lowest income decile might be explained through extreme levels of inequality within the country, the fact that large households might rely on only a small number of family members lucky enough to receive an income, purchasing power disparities (meaning that \$10.2 in nominal terms transfer to a higher consumption potential within the country) and a higher importance of self-sufficiency (e.g. through subsistence farming) that might distort the dataset. All this cannot belie the extreme levels of material deprivation suffered in this part of the global population and the transformative effect of such a global scheme however.

While \$800 per person annually might not look particularly impressive compared to incomes in the Global North, even relatively low amounts of money can have a transformative effect on lives in the Global South: in 2008, a Basic Income Grant trial was run in the neighbouring Namibian villages of Otjivero and Omitara. A basic income of \$15 was paid per person per month for a year (Osterkamp 2013). Even though the trial was quite limited in terms of duration and the amount of money distributed, the effects were decisive. The share of people below the poverty line dropped from 76% to 37%, labour market participation increased from 44% to 55%, child malnutrition fell from 42% to 10%, school drop-out rates fell from almost 40% to 5% and household debt fell (Haarmann et al. 2009)

The funds mobilised through such a scheme are also particularly impressive when compared to existing measures of global redistribution. Take, for instance, the group of heavily indebted poor countries (HIPC) with a total population of 715m, eligible for debt relief by the International Monetary Fund and the World Bank due to their particularly high levels of poverty. The global scheme would see the population of this group of states receive a total of \$438bn in dividends annually, outperforming today's schemes for development assistance and debt relief combined.

According to the OECD, official development assistance (ODA) mobilised by the Development Assistance Committee (DAC) amounted to \$152.8bn in 2019 (OECD 2020) while the IMF's debt relief programme mobilised a grand total of \$76bn debt-service relief since its inception in 1996 (IMF 2021), bringing the annual total of debt-relief and development aid paid under these schemes to just over \$155bn annually - or just over one third of the dividend that the HIPC would receive under the carbon dividend scheme we have modelled here. Our scheme also greatly exceeds the \$100bn that was promised by the countries of the Global North to help countries in the Global South adapt to climate change and mitigate its effects (Timperley 2021). In light of massive global carbon inequalities and the externalisation of the costs of climate change onto the global poor, such a global scheme would provide a vehicle through which to transform global financial flows - helping to highlight the debt that the Global North owes to the Global South. What form these flows could take is obviously an open question, and our modelling here merely demonstrates the strong redistributive effects of taxation upon carbon consumption.

It is becoming increasingly clear that those that will be hit by the worst effects of global climate change are largely not its creators. There are two overlapping cohorts of the global population that are particularly at risk: the poor in the Global South and children (Xu et al. 2020; Unicef 2021a). Such a global scheme would not only implement a form of global climate justice but would also provide people in the Global South with much needed funds to finance climate adaptations and allow them to meet their most basic needs - in effect materially implementing a "right to stay" (Paul/Gebrial 2021).

At the same time, those that would be the greatest net-contributors to the global scheme can largely afford to take the hit.

The ten groups shouldering the greatest reductions in annual income per-capita under Swedish carbon pricing rate of \$137 per metric ton

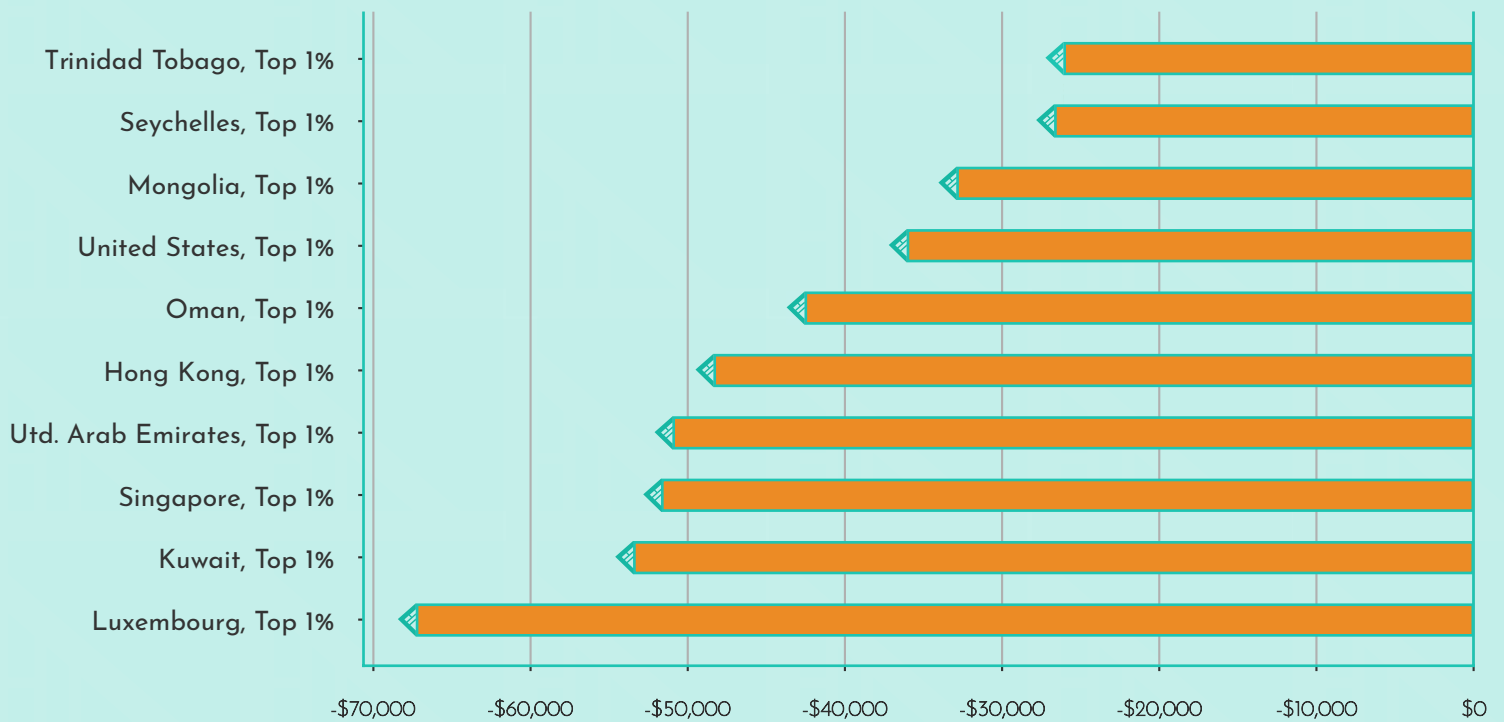


Fig. 3 Top ten losers (income groups in various countries) by absolute decline in income as a result of a carbon tax and dividend scheme. We have here used US\$ 137 as carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021).

As we can see in Figure 3, the greatest burden in absolute numbers would fall upon the rich in Luxembourg, Kuwait and Singapore. The relative losses in income for the top 1% of these countries would however be relatively limited and dwarf in relation to the gains of the global poor.¹⁰

¹⁰ The top 1% of Mongolia represent a clear outlier in our data, standing to lose disproportionate losses of more than 100% of their income - which is, of course, technically impossible. This can be explained through the fact that even the richest Mongolians only make relatively modest incomes by global standards and that the Mongolian lifestyles are extremely emissions intensive. See our discussion of Mongolia below.

This is largely true across most of the economies in the Global North, as the majority of costs have to be covered by the rich while the poor even stand to profit from such a global scheme as they already emit less than the global average.

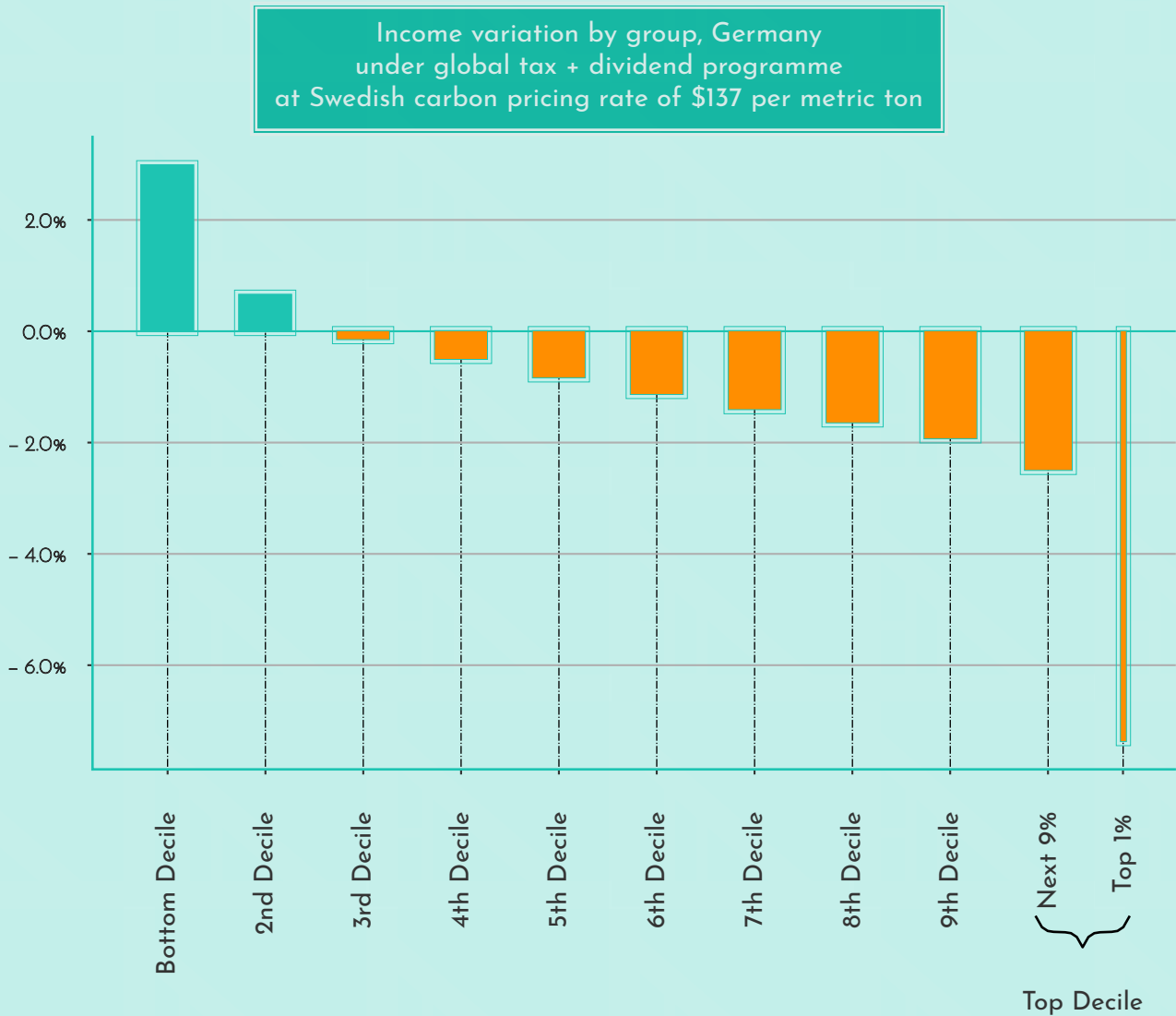


Fig. 4 Relative income variation in Germany under global scheme by income group. We have here used the amount of US\$ 137 as carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021).

In Germany, for instance, the bottom 10% would see their income increase by more than 2%, with the bottom 20% still receiving a marginal dividend from the scheme. Losses to medium income groups are limited, with only the top 20% of society seeing losses of more than 2% of their gross per capita income. What is more, even within these 20%, the losses are very unequally distributed, as the highest losses fall upon the top 1% of society (more than 6%). In other words: the very rich, who can afford to lose some income, and who cause vastly disproportionate emissions, even on a national level, would pay. Things look even better for the UK: lower average emissions translate into higher income gains for the bottom 10% (3%), whereas losses for the top 1% would be limited to 4.8%.

On an everyday basis, consumer prices would increase moderately under such a global scheme.

To give two examples: the costs of driving 1000 km with an average petrol-powered car would increase by \$24.78 - or 2.5 cents per km - and the costs of a High-End Smartphone would increase by around \$11.37.¹¹



At the same time, these increased consumer costs would partly be counteracted by the carbon dividend paid out globally and indiscriminately.

¹¹ The assessment for cars is based on the UK Government GHG Conversion Factors for Company Reporting provided by the Department for Business, Energy & Industrial Strategy (2021). The one for the smartphone is based on the LCA provided by Apple (2021) for an iPhone 13 with 512GB storage. This is a slight overestimate however, since Apple's assessment also covers the use phase of the product, whose emissions would, under our scheme, be taxed independently through taxation on energy consumption.

EMERGING ECONOMIES

Emerging economies such as India and Brazil would profit - between moderately and substantially - from such a global carbon dividend, receiving a net gain of more than \$37bn (1.9% of GDP) and \$696bn (24% of GDP) for Brazil and India respectively. As these two examples illustrate, the effects of such a global scheme would differ quite significantly, depending on existing emission levels. But these numbers obfuscate the fact that such a global scheme would be hugely redistributive even where the absolute numbers seem fairly insignificant.

Income variation by group, Brazil under global tax + dividend programme at Swedish carbon pricing rate of \$137 per metric ton

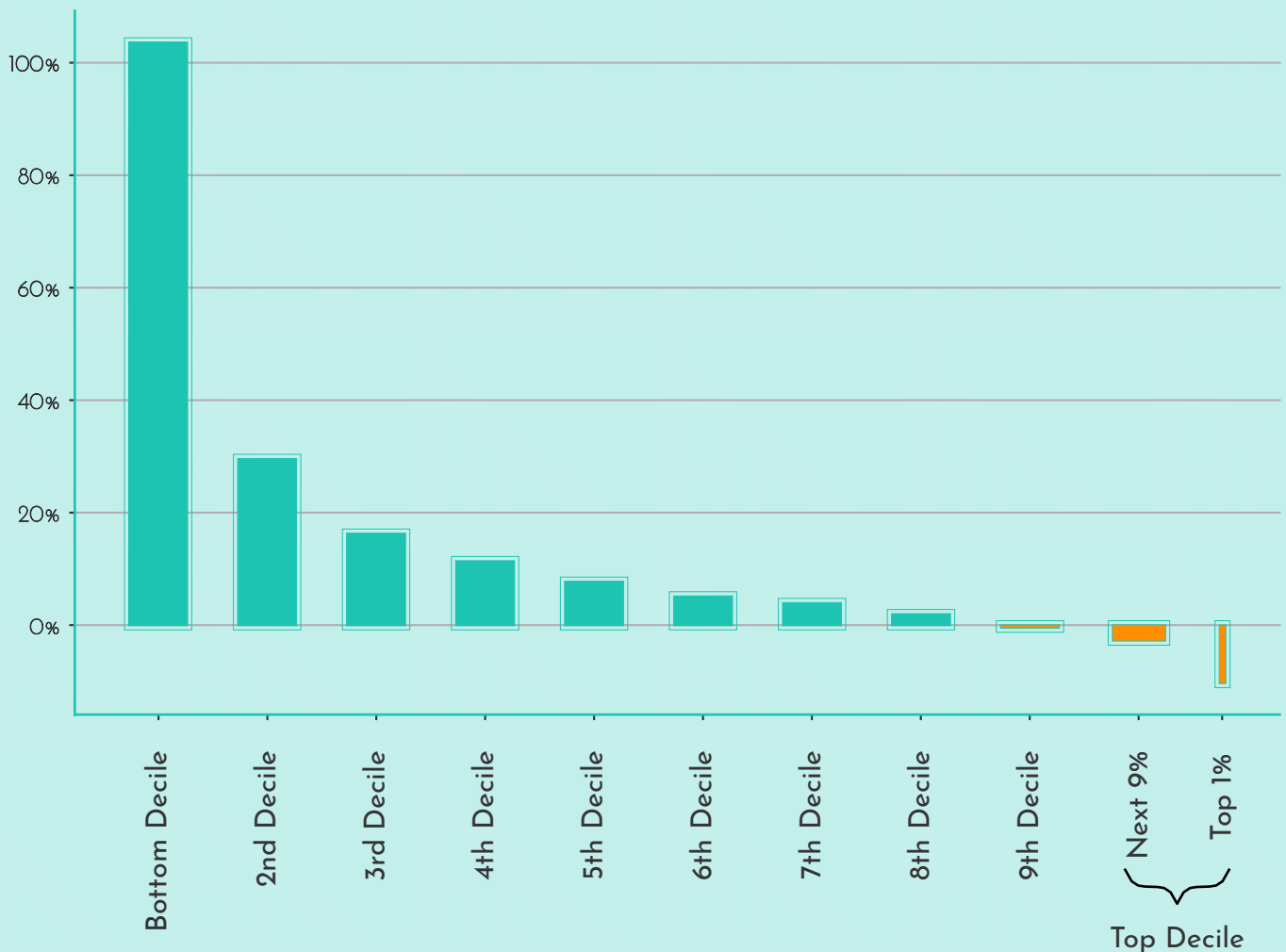


Fig. 6 Relative income variation in Brazil under global scheme by income group. We have here used the amount of US\$ 137 as carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021).

Even though Brazil would only see a relatively modest carbon dividend on a national level, the income of the bottom 10% would double, whereas the bottom half of society would see their incomes increase by over 30% on average. Only the top 10% would end up as net-contributors to such a global scheme, with the top 1% facing the most significant, although relatively limited, income losses.

Income variation by group, India
under global tax + dividend programme
at Swedish carbon pricing rate of \$137 per metric ton

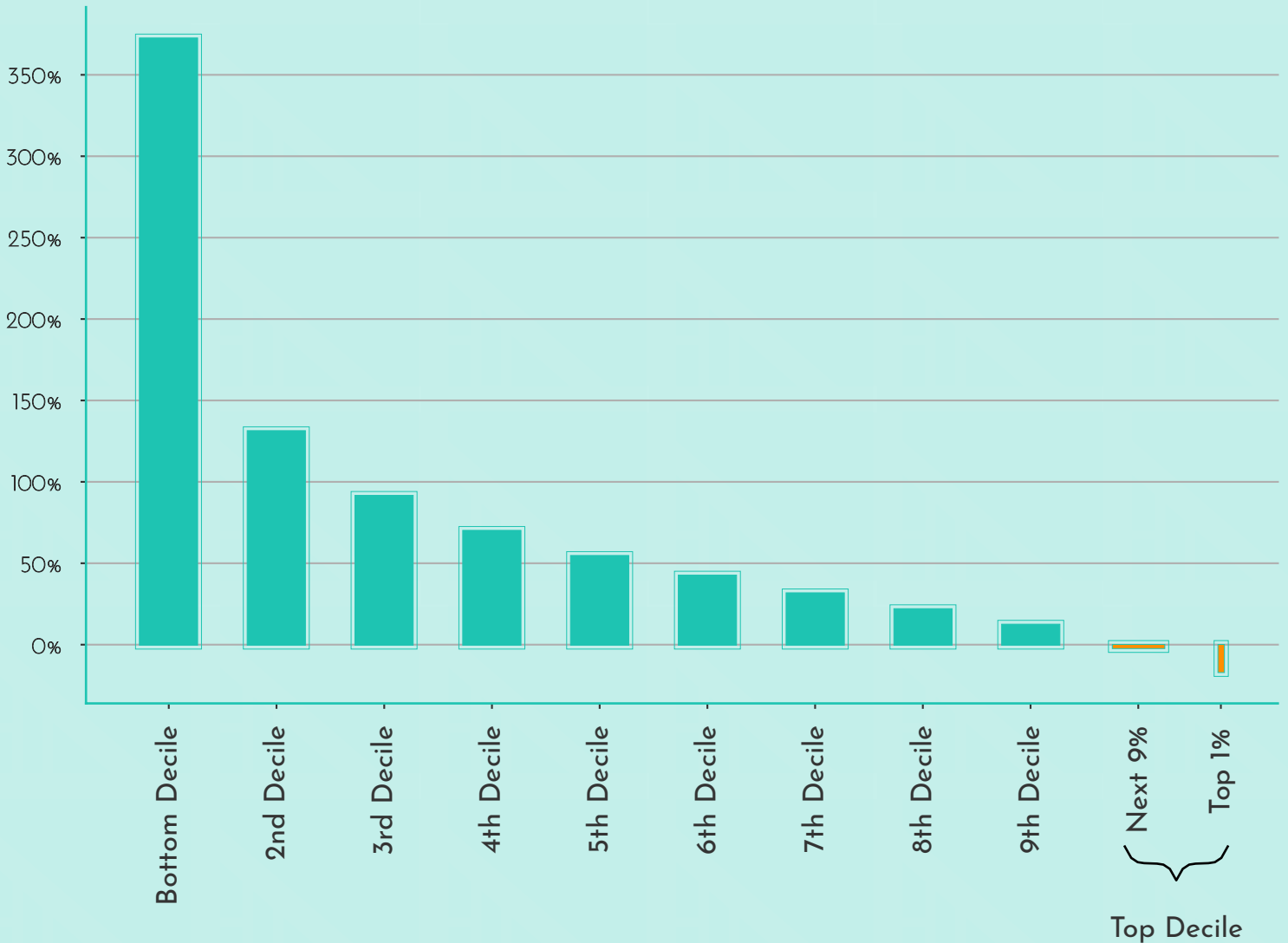


Fig. 7 Relative income variation in India under global scheme by income group. We have here used the amount of US\$ 137 as carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021).

In the Indian case (Fig. 7), the global carbon dividend would be an extremely effective policy to tackle poverty. The bottom 3 deciles would profit particularly strongly, with the dividend corresponding to 3.7x the income for the first decile (the bottom 10%), 1.3x for the second decile and would double the income of the third decile. In our income class aggregation, only the top 10% of India would pay carbon taxes, while the income interval from the 90% to 99% would lose almost none of their income (0.005%) and the top 1% would lose 16% of their income. The bottom 50% of India would see an increase of 1.4 times their income on average.

Not only could such a global scheme take hundreds of millions of people out of (relative) poverty in emerging economies, it could also help to turn the tide on the enormous economic dependencies burdening them, helping to bring them on a more equal footing with their counterparts in the Global North. Take for instance the Indian case: the total external debt (private and state) of India amounted to \$560.9bn in 2019 (World Bank 2021). This amounts to roughly 80% of the dividend Indians would receive on an annual basis according to our modelling. In other words: the dividend of a single year would be enough to pay off all foreign debt (and then some). Although our scheme stipulates that the carbon dividend would go to individuals, and although it might be politically challenging to tax an income that is effectively already a tax-refund itself, even moderate levels of VAT alongside substantial economic growth driven by the expansion of private consumption might give the governments of emerging countries leeway to pay off foreign debt, to expand their welfare systems and to invest in green infrastructures.

Aside from such a scheme organising massive redistribution towards emerging and developing economies, it would also curb the massive income inequalities within national economies too: even the lower income deciles in contributing economies largely either profit from such a scheme or are hardly affected negatively. What is more, in the Global North as well as the Global South, such a scheme would constitute a massive economic incentive towards greening the economy, driving out fossil fuel from much of energy production and ensuring that as living standards rise in the Global South, it is accompanied by a prioritisation of sustainable energies over new coal plants, and green infrastructures over a development model that mimics the historic development that took place in the Global North.

Still, such a global scheme would be no silver bullet. There are some economies - usually characterised by a combination of low GDP and a fossil-fuel intensive, extractivist accumulation regime, who would suffer significantly under such a scheme. For example, Mongolia (-63% of GDP), Iran (-22% of GDP) and Turkmenistan (-16% of GDP), would be big losers, seeing economic stress applied across the income spectrum. The international community should provide assistance to these countries to help them adapt to the necessities of fighting climate change. Correspondingly, nation states with strong income inequalities, relatively low income levels and relatively high emission levels, might need to provide additional support to lower income deciles, working-poor, pensioners and unemployed, to prevent any hardships from such a taxation scheme and to ensure public support.



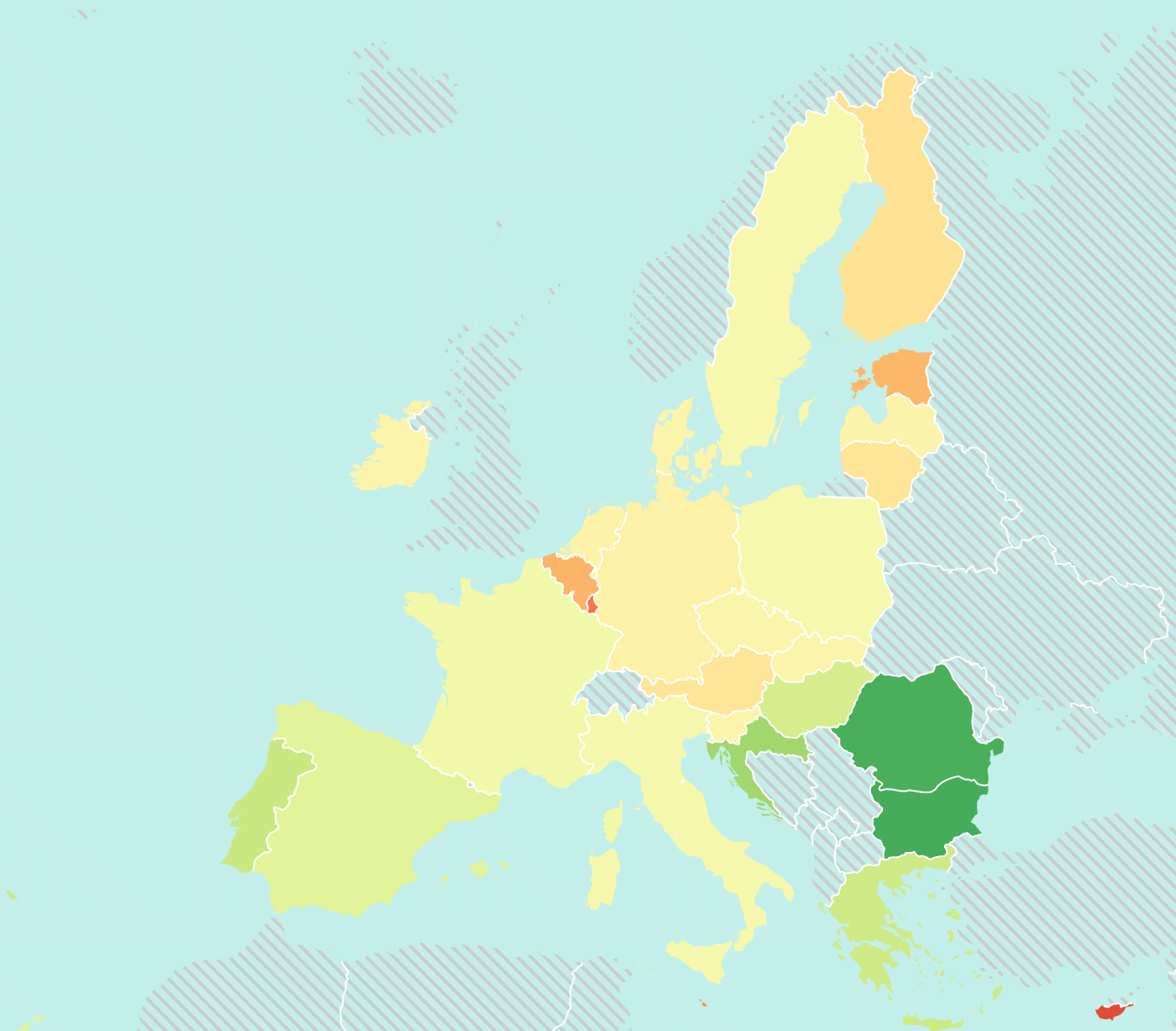
FINDINGS 2: EUROPEAN UNION

In a second step, we investigate the effects of a tax-and-dividend scheme on a European scale.

FINDINGS 2: EUROPEAN UNION

Since economic and political integration is much more advanced within the EU than on a global level, a European scheme is significantly more practically feasible.¹² The EU 27 countries have a total population of around 447m people, emitting roughly 9.6 tons CO₂e per capita in 2019. In this tax-and-dividend scheme for a region of advanced economies, such as the EU, we follow the carbon price suggested by the Federal Environment Agency of Germany (UBA 2020: 8) of roughly \$225.

¹² The European Union Emissions Trading System as well as the collective approach to climate diplomacy of EU countries form part of this integration, providing reasonable grounds for a shared approach to carbon taxation. Such a European-wide tax-and-dividend scheme would however not take into account global inequalities in emissions that would have to be accounted for differently, for instance through contributions to climate adaptation funds. Furthermore, such a regional scheme would require robust policies to prevent carbon leakage and regional deindustrialisation, for instance through CO₂ border adjustments (see Felbermayr 2019, Bellora/Fontagné 2020, Sund 2020).



% increase in national income (per capita) as a result of the scheme'

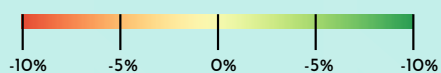


Fig 8. Relative income increases and decreases for individuals within various EU countries, as a result of a carbon tax and dividend scheme. We have here used the amount of US\$ 225 as carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021).

Absolute change in annual per capita income of top 10 winning EU deciles under German UBA recommendation of \$225 per metric ton

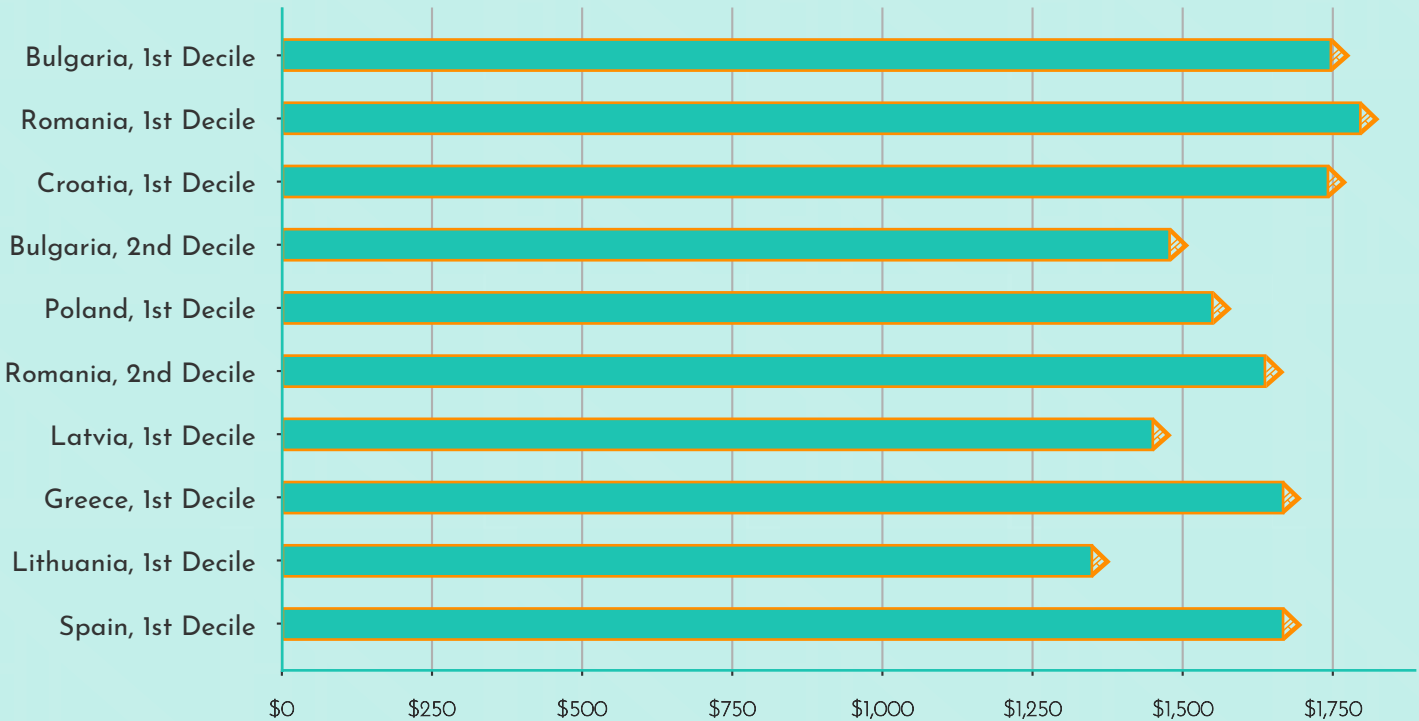


Fig. 9a Top ten winners and amounts received from a carbon tax scheme, in absolute numbers by income group by EU country. We have here used the amount of US\$ 225 as carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021).

On a national level, the top contributors to an European implementation of a tax-and-dividend scheme, per capita, would be Luxembourg, Belgium and Estonia, whereas Bulgaria, Romania and Croatia stand to gain the most. But the positive effects of such a European scheme would not be limited to these countries, but would also extend (to a lesser degree) to the poor of many countries, even in Luxembourg, who would gain an increase of roughly 1.5% of their income. On a national level, even individuals within countries with quite a high living standard such as France and Sweden would profit from such a scheme.

Top 10 winning deciles by income relative variation, EU Tax + Dividend Scheme under German UBA recommendation of \$225 per metric ton

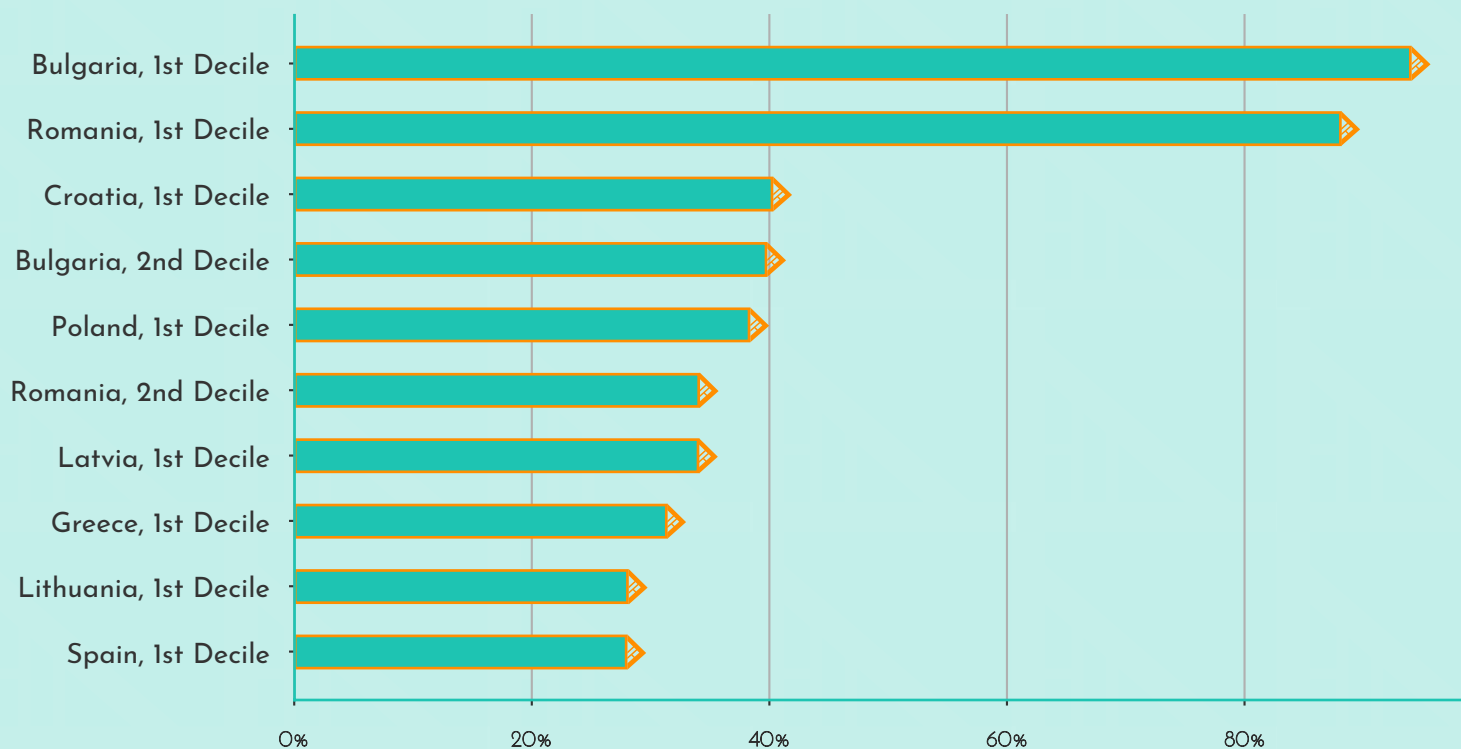


Fig. 9b Top ten winners (income groups in various EU countries) by relative gain (% increase in income) from an EU carbon tax and dividend scheme. We have here used the amount of US\$ 225 as carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021).

The ten groups shouldering the greatest reductions in annual income per-capita, EU Tax + Dividend Scheme under German UBA recommendation of \$225 per metric ton

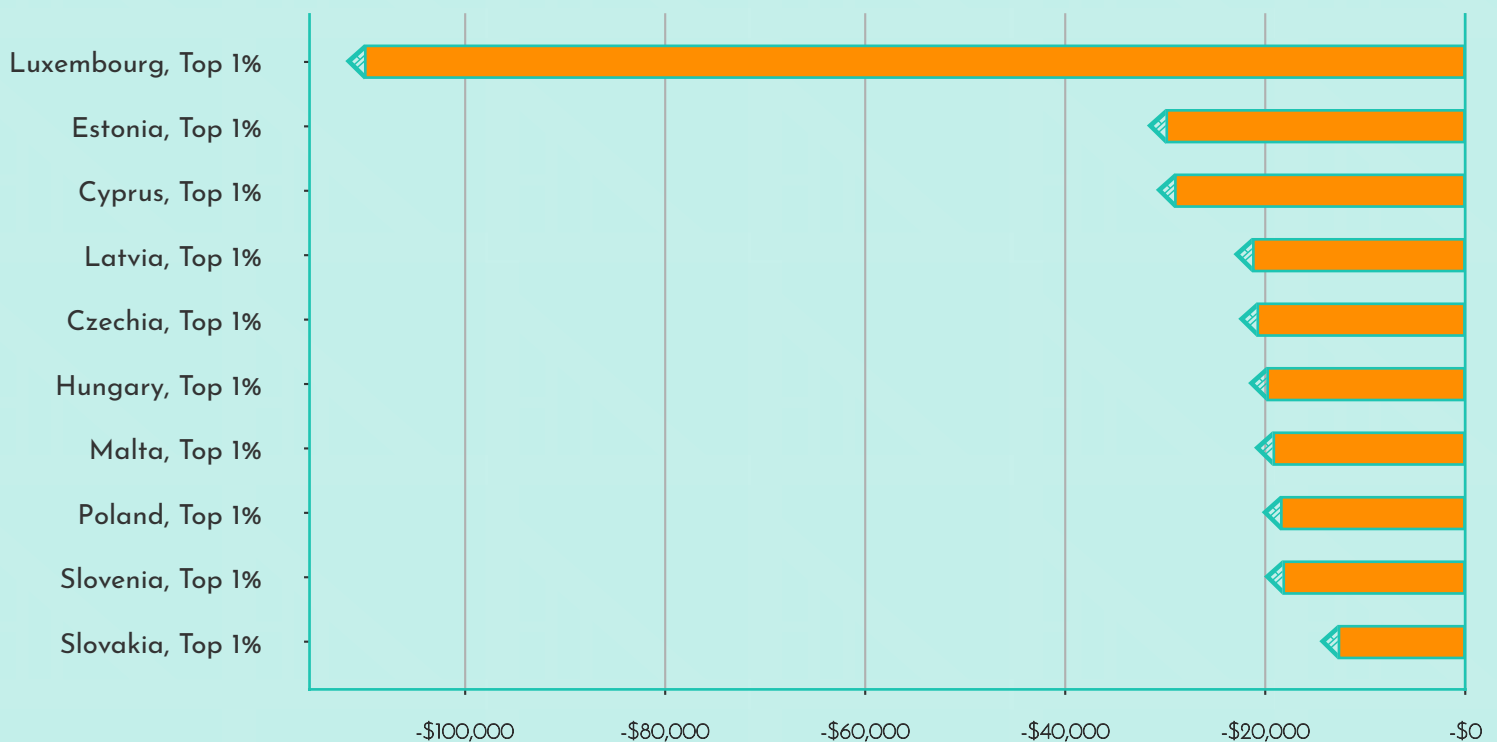


Fig. 10a Top ten losers (income groups in various countries) by absolute decline in income as a result of an EU carbon tax and dividend scheme. We have here used the amount of US\$ 225 as carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021).

Relative loss in income of 10 biggest losing groups
under German UBA recommendation of \$225 per metric ton

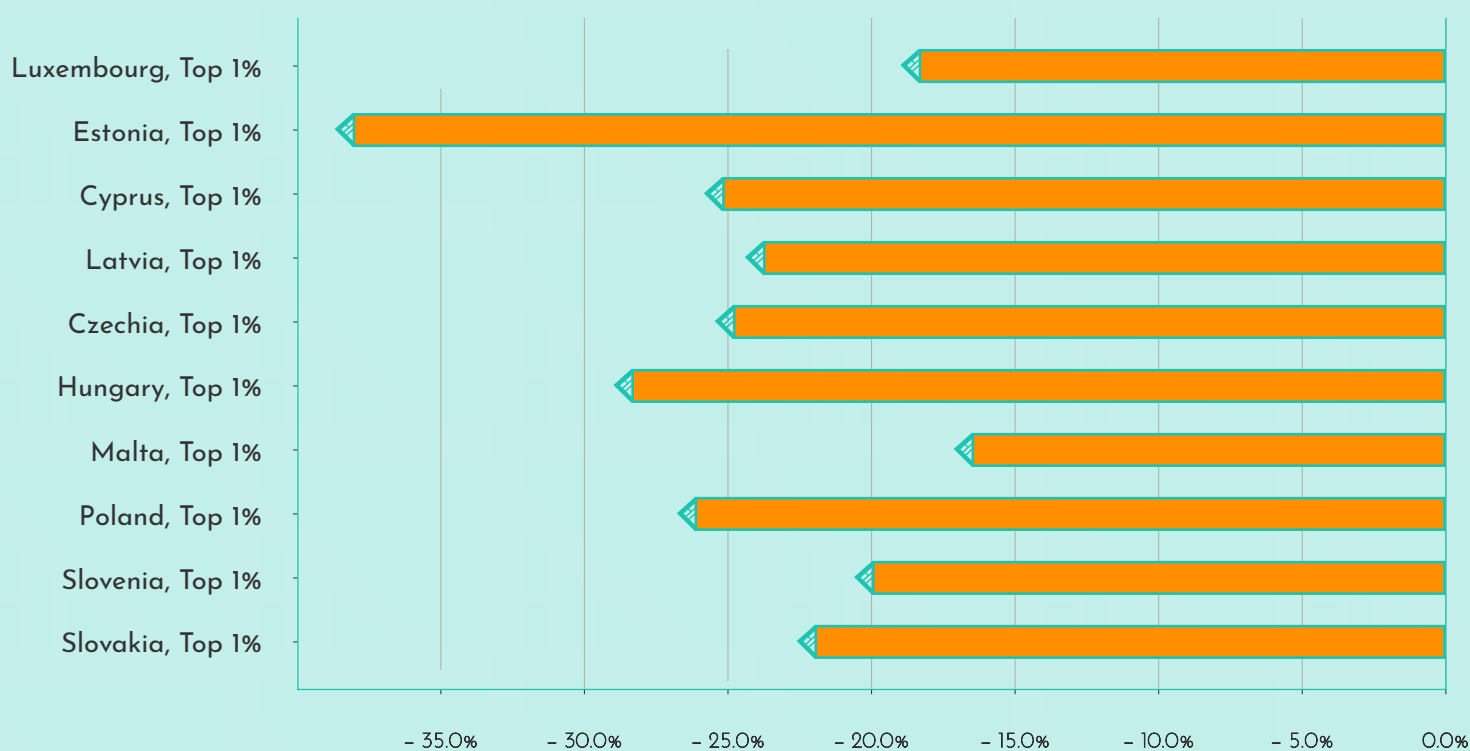


Fig. 10b Top ten contributors by relative numbers, by income group and EU country, as a result of an EU carbon tax and dividend scheme. We have here used the amount of US\$ 225 as carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021).

As with the global scheme, the impact of an European scheme is also much more pronounced when disaggregating the data. The poorest parts of the population in Bulgaria and Romania would see their incomes almost double, but the poor parts of countries such as Greece or Spain would also see increases of more than 20% of their income. The monthly dividend would stand at around \$180 per month per person in absolute terms, with annual net dividends of up to \$1,750 for the lowest emitting Europeans. The top 1% of the EU countries would be hit the worst, losing more than 35% of their population's income in Estonia, and more than 25% in Poland and Hungary. The clear, top contributors to the scheme in absolute terms would be the top 1% in Luxembourg however, contributing more than \$100,000 annually to the scheme. As such, a European scheme could advance convergence within the EU and within member states at the same time. And here, too, the relative burden for the continent's rich would be bearable, given their high incomes. Additionally, funding from the EU's Green New Deal Initiative could and should be mobilised to help countries who would be burdened the most from such a scheme such as Belgium and Estonia (approx -4% of GDP) and Luxembourg (approx -6% of GDP) adapt.



FINDINGS 3: NATIONAL

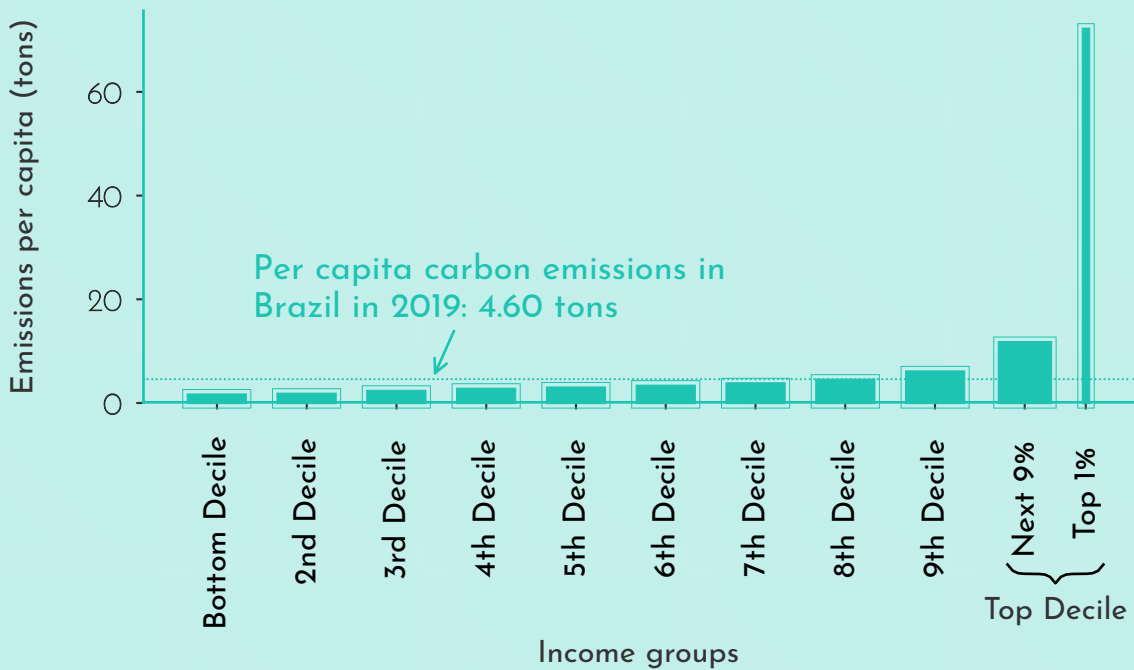
(BRAZIL, GERMANY, UK)

Finally, we will evaluate national tax and dividend schemes for Brazil, Germany and the UK. We will do so by using the Swedish carbon price of \$137 for Brazil and the higher rate suggested by the Federal Environment Agency of Germany to be used in the context of developed economies (UBA 2020: 8) of roughly \$225 for Germany and the UK.

FINDINGS 3: NATIONAL (BR,DE,UK)

BRAZIL For Brazil the average emissions for consumption in 2019 were 5 tons per capita, hiding the fact that the top 1% emit an amount not far from their counterparts in high income countries such as the UK. Since in Brazil income is highly concentrated within the top deciles, 80% of the population would benefit from the carbon dividend scheme. The income of the bottom 10% would for instance be increased by more than 72% and there would be at least 10% increases in income for the bottom 40% of the population. At the same time, the top 1% would lose less than 10% of their gross income. Thus, such a national scheme would contribute to improving the shape of the highly asymmetric Brazilian income redistribution, while at the same time not unreasonably impacting the richest 1% of society, who would contribute only 10% of their income to this scheme.

Per capita carbon emissions for each income group, Brazil, 2019



Projected change in income for each group as a result of a carbon tax + dividend scheme, Brazil

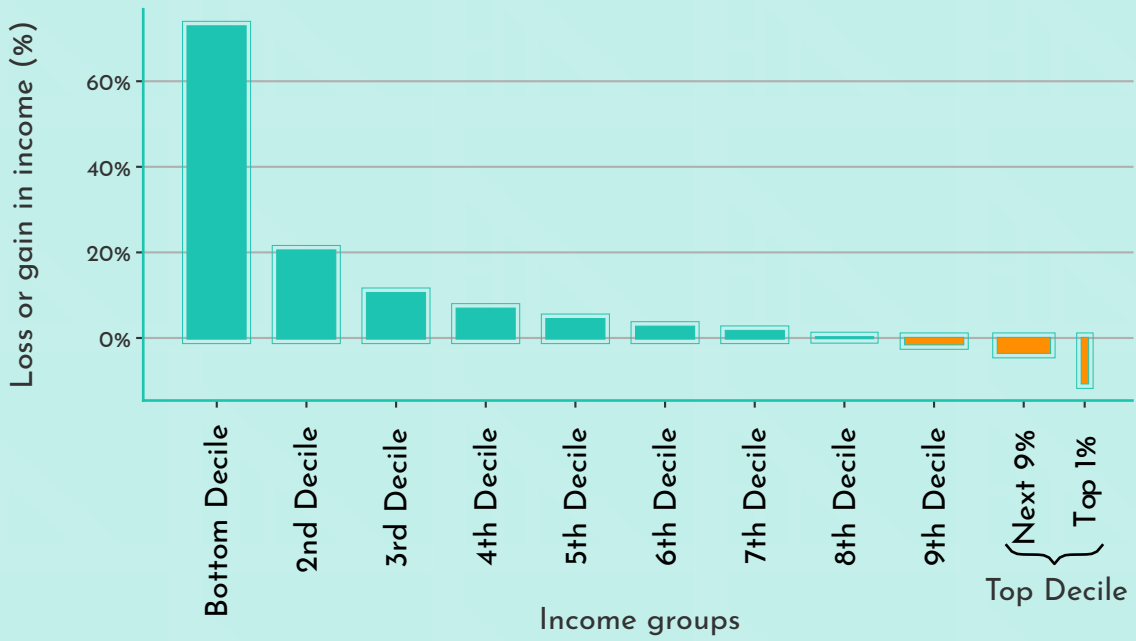


Fig. 11a Emission per capita for each class in Brazil. Fig. 11b income variation per capita for each member of each group in Brazil. We have here used the amount of US\$ 137 as carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021).

UK The UK average emissions for consumption in 2019 was 9.9 tons per capita. Despite inequality in the UK being lower than a country like Brazil, almost 70% of the UK population would benefit from the carbon tax dividend scheme, while the top 20% would be the effective contributors towards carbon dividends. The impact for those in the bottom 10% would be an increase in income of almost 14%, while the tax impact on incomes for the top 1% would be around 7%.

Per capita carbon emissions for each income group, UK, 2019

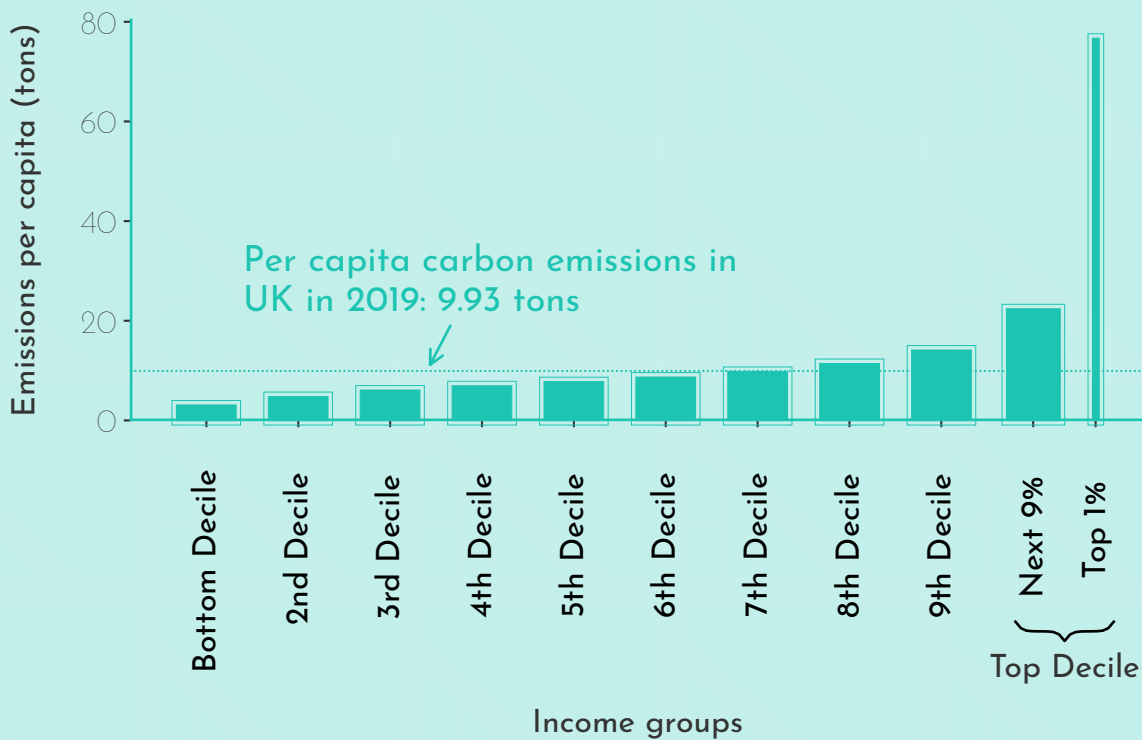


Fig. 12a Emission per capita for each class in the UK.

Projected change in income for each group as a result of a carbon tax + dividend scheme, UK

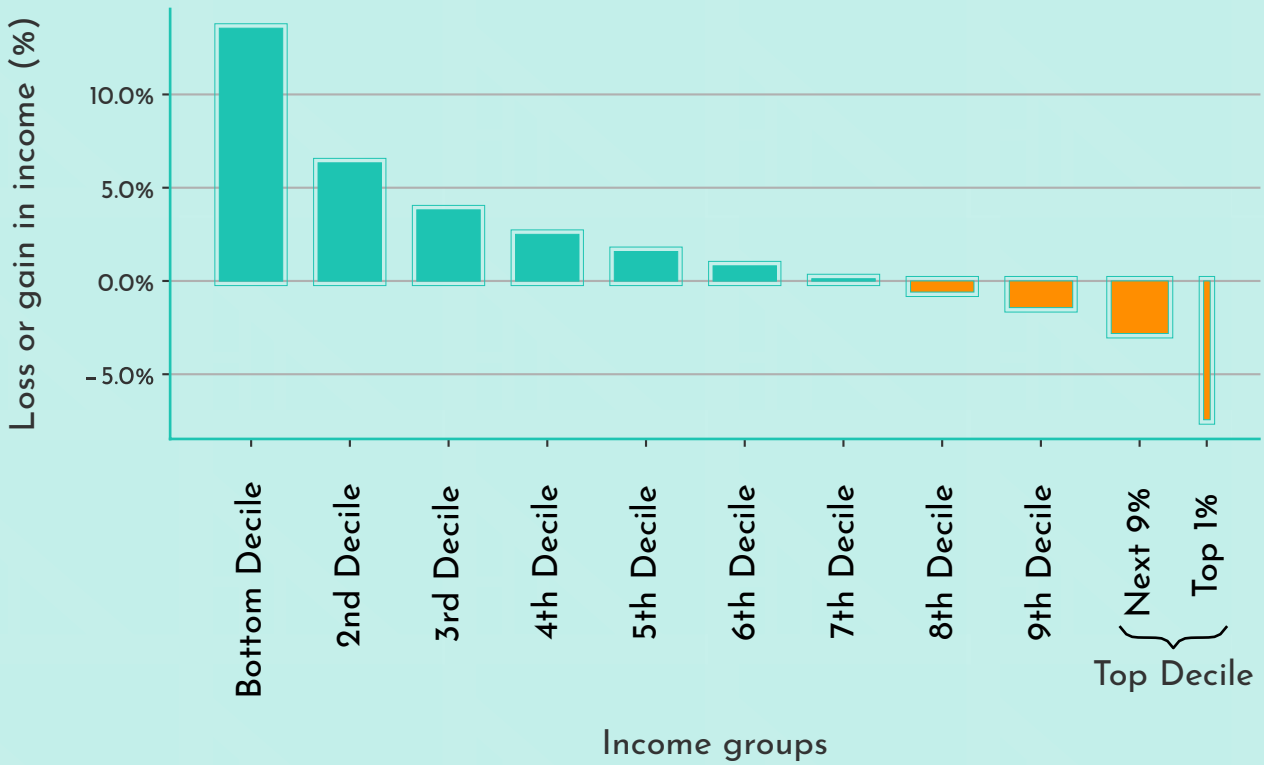


Fig. 12b income variation per capita for each member of each group in the UK. We have here used the amount of US\$ 225 as carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021).

GERMANY

Finally, for Germany average emissions measured through consumption are around 11 carbon ton per capita for 2019. This is higher than the UK and the EU27 average. While a national carbon tax-and-dividend scheme would reduce the income of the top 1% by 12%, it would increase the bottom 10%'s income by almost 15%. Like in the UK, the dividend fund would receive net contributions from the top 30%, while 70% of the German population would receive at least some dividend.

Per capita carbon emissions for each income group, Germany, 2019

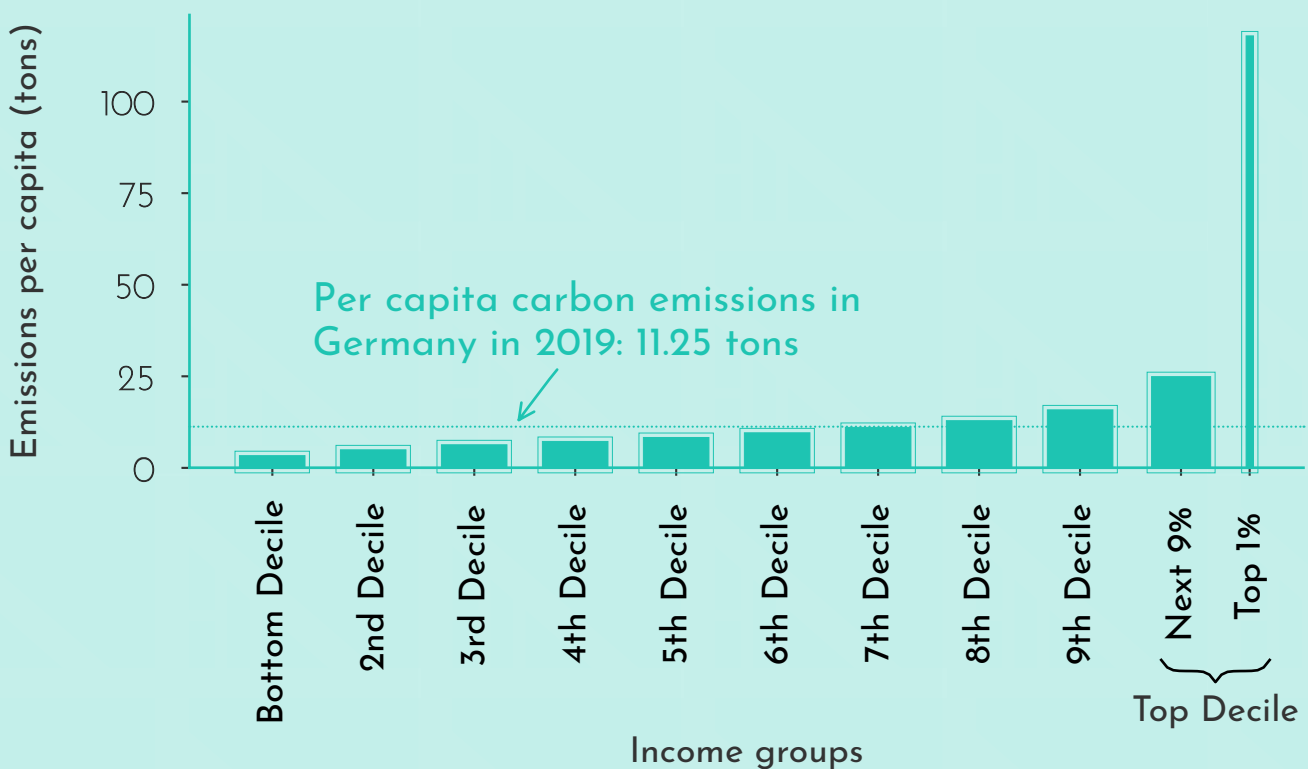


Fig. 13a Emission per capita for each class in Germany.

Projected change in income for each group as a result of a carbon tax + dividend scheme, Germany

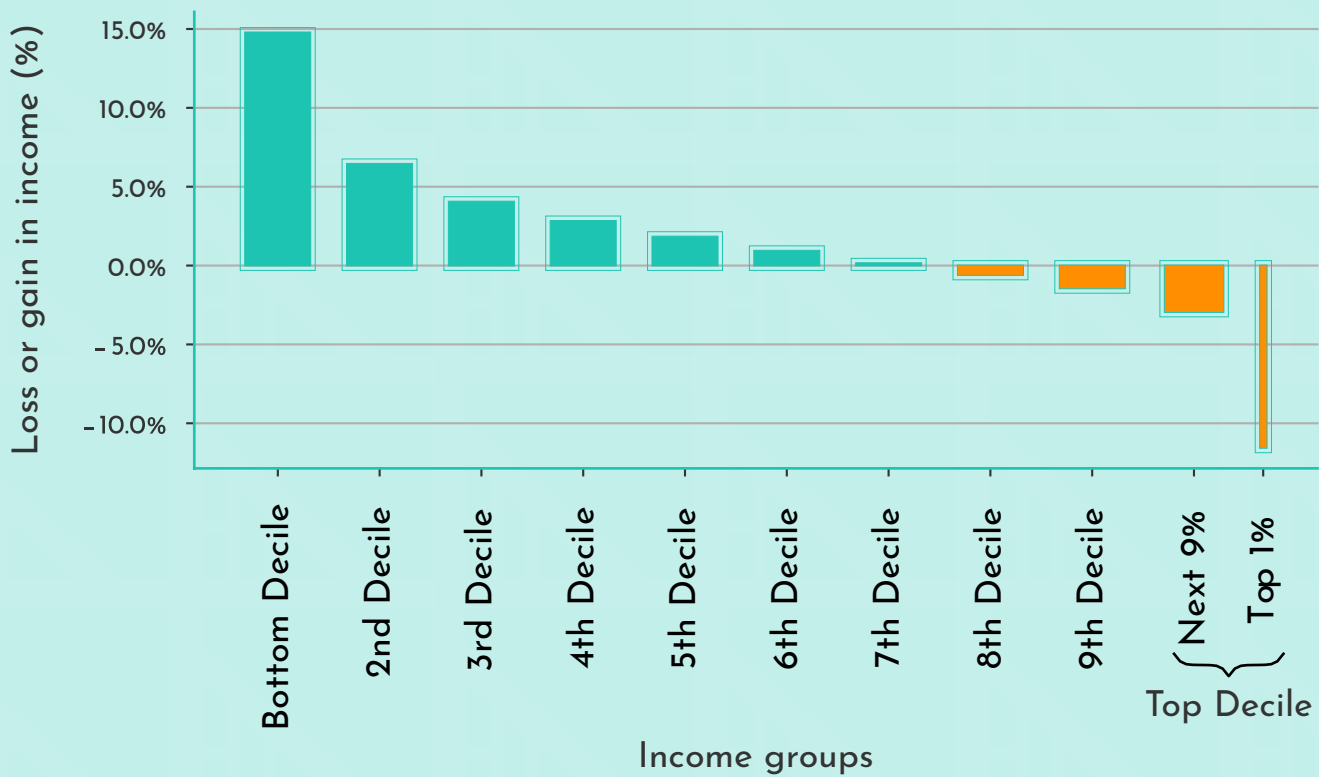
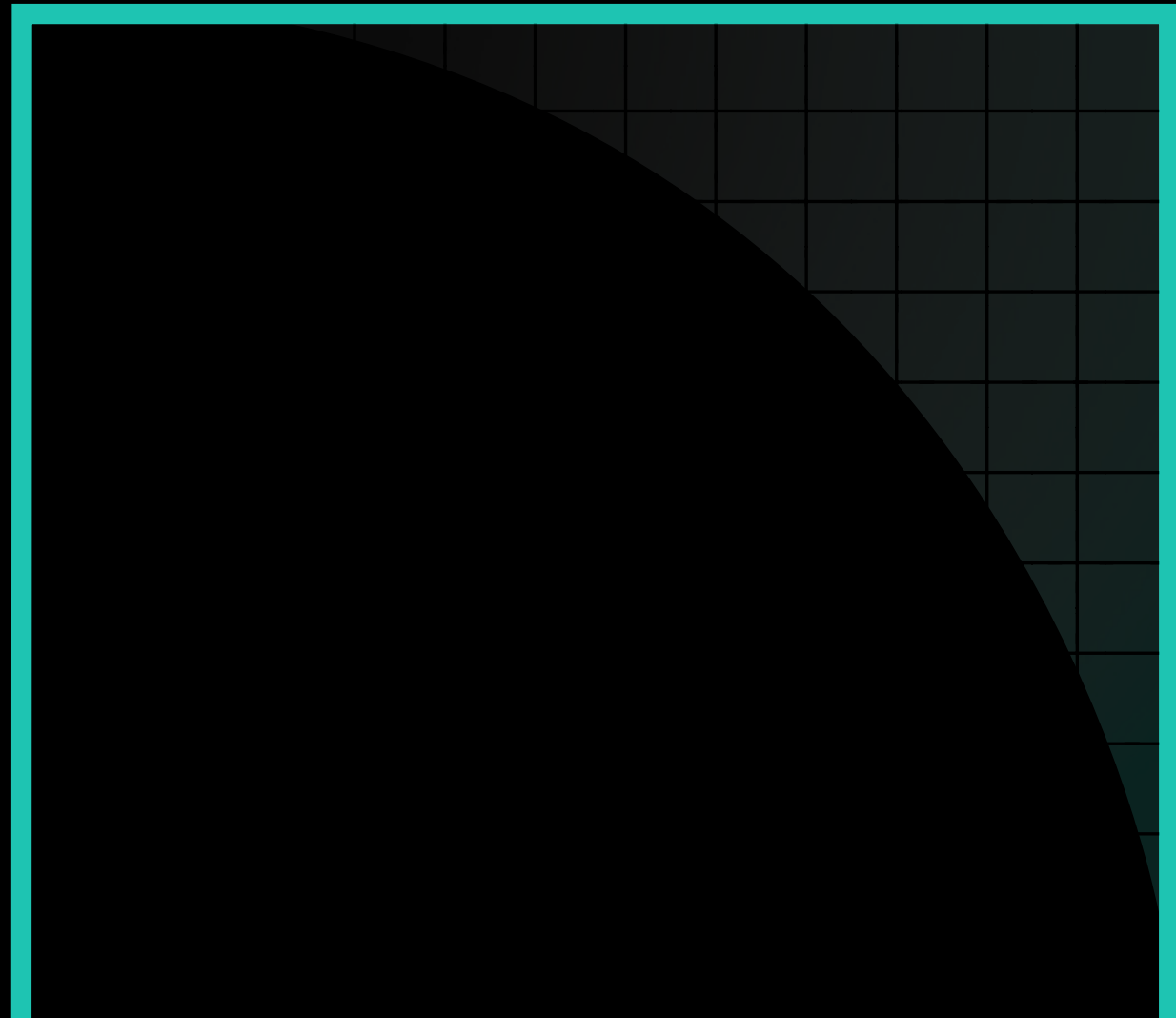


Fig. 13b income variation per capita for each member of each group in Germany. We have here used the amount of US\$ 225 as carbon price to model the projected results. Source: Autonomy calculations based on Chancel (2021), WIID (2021) and World Bank (2021).



FINAL NOTE

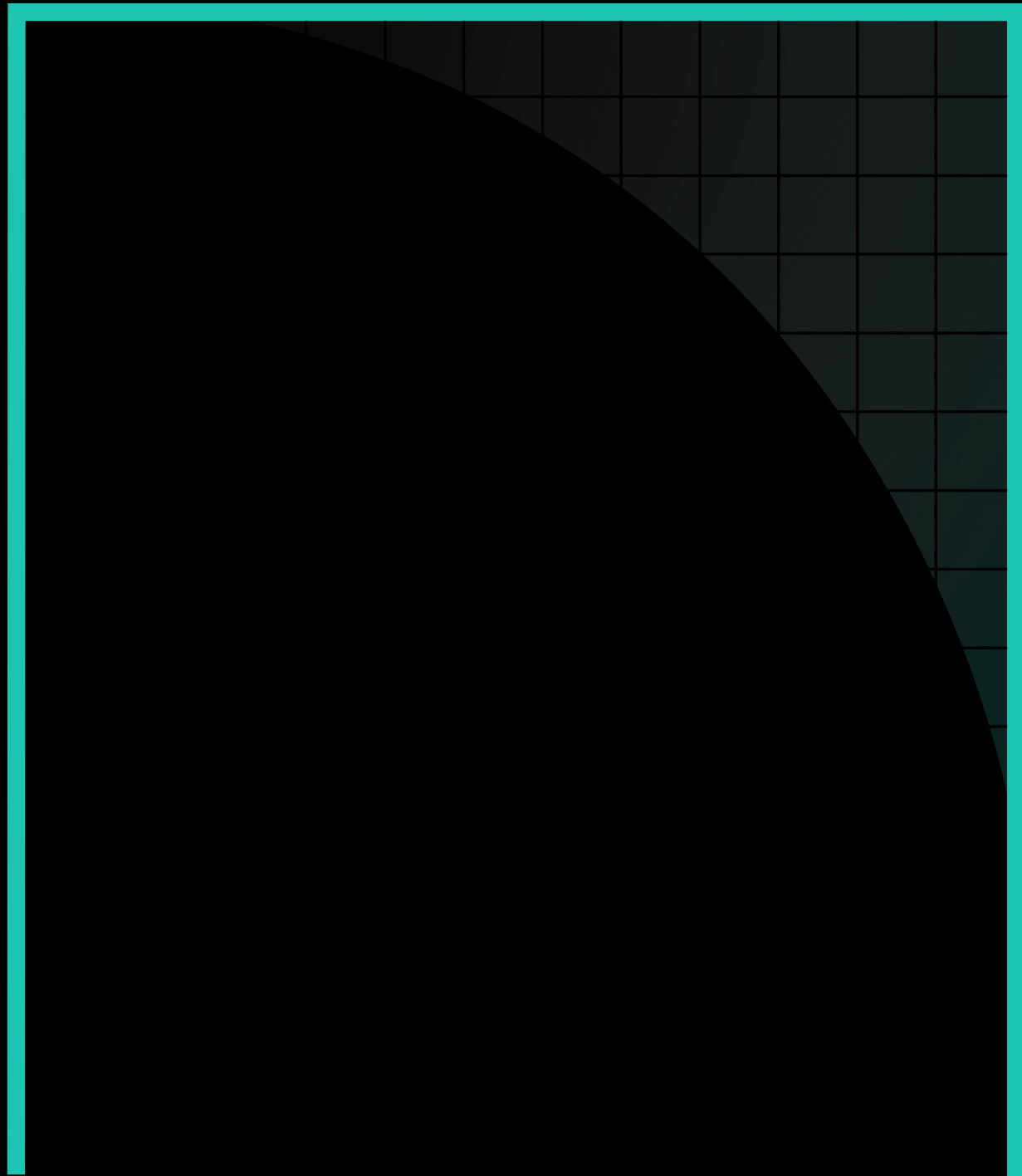
**Why carbon dividends can help
deliver ecological and economic
justice**

As illustrated above, a universal tax-and-dividend system for CO₂e-emissions would be transformative - on an economic and social level as well as in terms of the consequent ecological effects. In fact, the redistribution facilitated by such schemes increases as carbon prices increase; social and ecological justice mutually reinforce one another. As a global policy, it could wipe out extreme poverty and easily dwarf the scope of any existing development aid and debt relief schemes, illustrating that, in this sense, it is the Global North that owes an immense debt to the populations in the Global South, not the other way round. It would also go a long way to alleviate the disastrous impacts the Covid pandemic has had on the world's poorest and most vulnerable, with for instance an additional 100m children falling into poverty, and prevent global disparities from deepening as richer countries recover while poorer countries fall even further behind (UNICEF 2021b). Such a global carbon dividend scheme could end the bitter reality of mass hunger and destitution and be a key building stone of a fairer, more sustainable and more inclusive post-pandemic economy.

FINAL NOTE

Implemented within a fairly economically homogeneous framework such as the EU, it could help slow down and possibly reverse economic disintegration and facilitate a transfer of economic resources from the continent's rich to its ecological trailblazers and the less affluent. Implemented nationally, it could significantly reduce social inequality while at the same time providing an unprecedented impulse to green the economy, as producers are forced to disclose the hidden ecological costs of their products. As such, a tax-and-dividend system might provide a way to reconcile ecological and social sustainability and rally popular support behind a demand for social and ecological transformation.

A Global Carbon Dividend scheme could also constitute a stepping stone towards the introduction of a more comprehensive, far-reaching UBI - implementing a global infrastructure for roll-out and, more importantly, materially recognize and implement the right to equal use of our planet.



REFERENCES

REFERENCES

- Akerlof, G., Aumann, R., Baily, M., ... & Yellen, J. (2019) Economists' Statement on Carbon Dividends: As published in the Wall Street Journal on January 17, 2019. <https://clcouncil.org/media/EconomistsStatement.pdf>. Accessed 7/8/2021.
- Apple (2021) Product Environmental Report: iPhone 13. https://www.apple.com/euro/environment/pdf/a/generic/products/iphone/iPhone_13_PER_Sept2021.pdf. Accessed 10/15/2021.
- Bach, S., Isaak, N. & Kemfert, C. et al. (2019) Für eine sozialverträgliche CO₂-Bepreisung: Forschungsvorhaben "CO₂-Bepreisung im Wärme- und Verkehrssektor: Diskussion von Wirkungen und alternativen Entlastungsoptionen" im Auftrag des Bundesministeriums für Umwelt, Naturschutz und nukleare Sicherheit (BMU). DIW Berlin Deutsches Institut für Wirtschaftsforschung, Berlin.
- Barnes, P. (2021) Ours: The case for universal property. Polity, Cambridge, UK.
- Bellora, C. & Fontagné, L. (2020) Possible carbon adjustment policies: An Overview: Research Report on behalf of the European Parliament Directorate-General For External Policies.
- Boyce, J. K. (2019) The case for carbon dividends. Polity Press, Cambridge, UK.

- Chancel, L. (2021) *Climate Change & the Global Inequality of Carbon Emissions, 1990-2020*.
- Chancel, L. & Piketty, T. (2015) *Carbon and inequality: from Kyoto to Paris: Trends in the global inequality of carbon emissions (1998-2013) & prospects for an equitable adaptation fund*.
- Department for Business, Energy & Industrial Strategy (2020) *Greenhouse gas reporting: conversion factors 2019*. <https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2019>. Accessed 8/15/2021.
- Destatis (2021) *Carbon taxes worldwide as of April 2021, by select country*. <https://www.statista.com/statistics/483590/prices-of-implemented-carbon-pricing-instruments-worldwide-by-select-country/>. Accessed 9/17/2021.
- DiEM25 (2017) *European New Deal: A comprehensive economic & social policy framework for Europe's stabilisation, sustainable recovery & democratisation*.
- Felbermayr, G. (2019) *Grenzausgleich: Für Klima und Wirtschaft*. <https://www.ifw-kiel.de/index.php?id=13370&L=1>. Accessed 11/8/2021.
- Gechert, S. & Dullien, S. *Steigender CO2-Preis: Warum der Klimabonus ideal für den sozialen Ausgleich ist*.
- Haarmann, C., Haarmann, D. & Jauch, H. et al. (2009) *Making the difference!: The BIG in Namibia*. NANGOF, Windhoek, Namibia.

- Hardadi, G., Buchholz, A. & Pauliuk, S. (2021) Implications of the distribution of German household environmental footprints across income groups for integrating environmental and social policy design. *Journal of Industrial Ecology* 25 (1), 95-113.
- IMF (2021) Factsheet - Debt Relief Under the Heavily Indebted Poor Countries (HIPC) Initiative. <https://www.imf.org/en/About/Factsheets/Sheets/2016/08/01/16/11/Debt-Relief-Under-the-Heavily-Indebted-Poor-Countries-Initiative>. Accessed 8/25/2021.
- Kalkuhl, M., Knopf, B. & Edenhofer, O. CO₂-Bepreisung: Mehr Klimaschutz mit mehr Gerechtigkeit.
- Klenert, D., Mattauch, L. & Combet, E. et al. (2018) Making carbon pricing work for citizens. *Nature Climate Change* 8 (8), 669-677.
- Mathur, A. & Morris, A. C. (2014) Distributional effects of a carbon tax in broader U.S. fiscal reform. *Energy Policy* 66, 326-334.
- Mazzucato, M. (2021) *Mission economy: A moonshot guide to changing capitalism*. Allen Lane an imprint of Penguin Books, London.
- OECD (2020) Aid by DAC members increases in 2019 with more aid to the poorest countries.
- Osterkamp, R. (2013) The Basic Income Grant Pilot Project in Namibia: A Critical Assessment. *Basic Income Studies* 8 (1).

- Oswald, Y., Owen, A. & Steinberger, J. K. (2020) Large inequality in international and intranational energy footprints between income groups and across consumption categories. *Nature Energy* 5 (3), 231-239.
- Oxfam (2015) *Extreme Carbon Inequality: Why the Paris climate deal must put the poorest, lowest emitting and most vulnerable people first.*
- Oxfam (2020) *Confronting Carbon Inequality: Putting climate justice at the heart of the COVID-19 recovery.*
- Paul, H. K. & Gebrial, D. (eds.) (2021) *Perspectives on a Global Green New Deal.*
- Portes, J., Reed, H. & Percy, A. (2017) *Social prosperity for the future: A proposal for Universal Basic Services.*
- Sund, L. (2020) Was kann ein CO₂-Grenzausgleich leisten? <https://makronom.de/der-mythos-vom-aufstieg-durch-bildung-36961>. Accessed 9/20/2020.
- Timperley, J. (2021) The broken \$100-billion promise of climate finance - and how to fix it: At Glasgow's COP26 summit, countries will argue for more money to mitigate and adapt to the effects of climate change. <https://www.nature.com/articles/d41586-021-02846-3>. Accessed 10/23/2021.
- UBA (2020) *Methodenkonvention 3.1 zur Ermittlung von Umweltkosten: Kostensätze Stand 12/2020.* https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2020-12-21_methodenkonvention_3_1_kostensaetze.pdf. Accessed 1/19/2021.

- UNICEF (2021a) The Climate Crisis is a Child Rights Crisis: Introducing the Children's Climate Risk Index.
- UNICEF (2021b) Preventing a lost decade: Urgent action to reverse the devastating impact of COVID-19 on children and young people.
- Wang, Q., Hubacek, K., Feng, K., Wei, Y.-M. & Liang, Q.-M. (2016) Distributional effects of carbon taxation. *Applied Energy* 184, 1123-1131.
- World Bank (2021) International Debt Statistics. <https://datatopics.worldbank.org/debt/ids/countryanalytical/ind/counterpartarea/wld>. Accessed 11/3/2021.
- Xu, C., Kohler, T. A., Lenton, T. M., Svenning, J.-C. & Scheffer, M. (2020) Future of the human climate niche. *Proceedings of the National Academy of Sciences of the United States of America* 117 (21), 11350-11355.

APPENDIX: KEY DATA SOURCES

UNU-WIDER, World Income Inequality Database (WIID), released on May 2021 (<https://doi.org/10.35188/UNU-WIDER/WIID-310521>)

Chancel, L. "Climate change & the global inequality of carbon emissions, 1990-2020", World Inequality Lab Study

World Bank Time Series indicators: EN.ATM.CO2E.PC (Carbon per capita), SP.POP.TOTL (National Population), NY.GDP.MKTP.CD (National GDP in USD current Prices).



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Drawing the line

A strategy to leverage higher wages and eco-taxation to spur innovation

Taking stock of the German economy

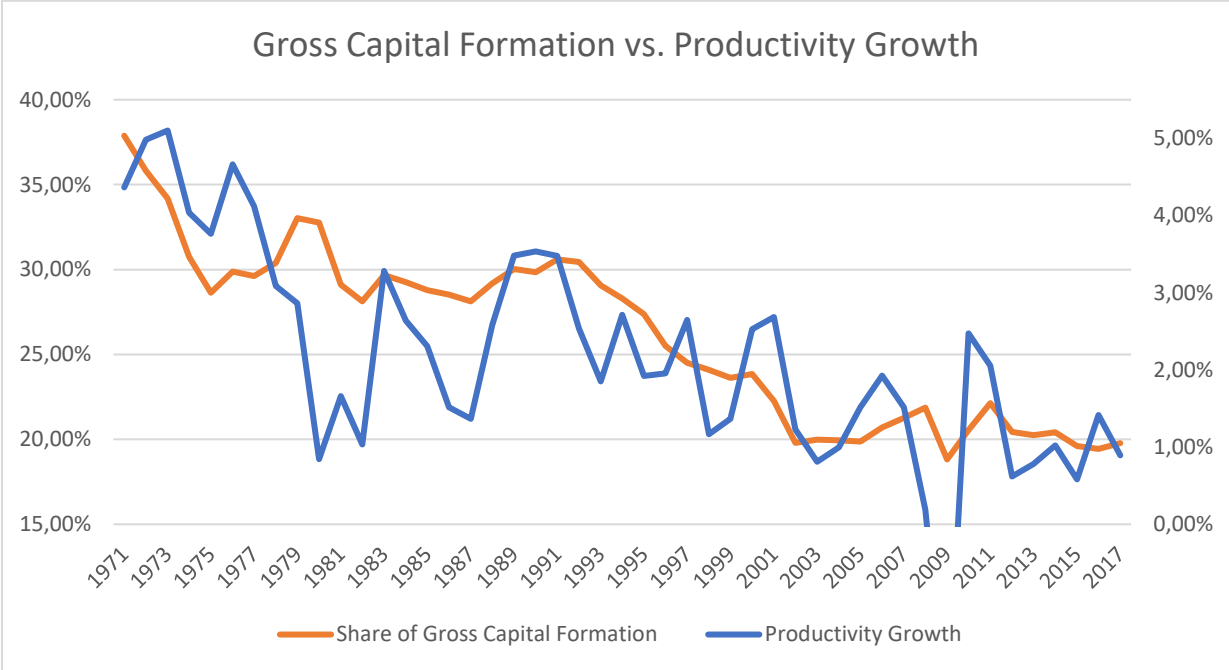
For the better part of two decades, German elites have prided themselves on the success story of the German economy. And indeed, the ascent of the German economy has been impressive, at least when it is measured in terms of trade surplus, surging from just €59.1bn in the year 2000 to €248.9bn in 2016 (Destatis 2021a). The export-focus of the German economy, subsidized by an underperforming currency kept low by economic disparities in the Euro area ensured healthy tax revenues as well low unemployment rates.

Depressed wages, ecological degradation and lacklustre investment

But this success story comes at a terrible cost: after the neoliberal labour market and welfare reforms of the mid 2000s, Germany saw a rapid rise in low-wage employment. Wages were depressed to such an extent that data shows that purchasing power adjusted, real hourly wages for the bottom 40 percent of income earners had not recovered to 1995 levels by 2018 (Fedorets et al. 2020). This means that more than two decades of economic development led to sinking hourly wages for millions of workers while many millions more saw an overall stagnation of their incomes. The wage depression is also reflected in a dramatic slump of the labour share of national income, which fell from 70.91 percent to just 63.6 percent in in the course of half a decade (Bundestag 2018). The share of low-wage employment grew from around 17 percent in 1995 to 23.7 percent in 2015 (Fedorets et al. 2020) while German GDP and exports reached ever new heights.

This wage suppression allowed German companies to stay profitable and internationally competitive despite a long-term trend of decreasing investment and sluggish productivity growth. At the same time, the possibility to realize profits despite low levels of innovation and investment thanks to depressed wage-levels has led to immense disparities in terms of productivity between companies “specialised” on such business models based on low investment and low wages (called “Laggards” in part of the research literature) and a select group of very productive and well-paying companies (dubbed “Frontiers”). The productivity of these Frontiers is estimated to be two and a half times as high as that of their competitors in manufacturing and five to seven times as high in the service sector (Schiersch 2019: 18). The key factor distinguishing the Frontiers, be they large or small, from their competitors is their capital-intensity (Schiersch 2019: 19f.), illustrating the key role investment plays in increasing

productivity.¹ Overall, investment (measured as the share of GDP committed to gross capital formation) has been weak in recent decades:



Graph 1: Gross Capital Formation vs. Productivity Growth Germany, 1971 to 2017; based on Feenstra et al. 2015 and OECD 2019.²

The German export success of recent decades coincided with a stabilisation – but no marked increase – in investment into capital formation, oscillating at around 20 percent of GDP, after a marked decline from almost 38 percent of GDP in the early 1970. At the same time, annual productivity growth fell from around 5 percent to today just 1 percent, a historically low level enabled by unusually weak wage pressure.

Most of the costs of depressed wages are borne by individual workers and their families who suffer material deprivation and/or overwork as they struggle to make ends meet at poor hourly wages. At the same time, social and economic precarity and the anxiety about social relegation has been one of the drivers of political polarisation in recent years (Hilmer et al. 2017; Nachtwey 2018). Apart from threatening to undermine democracy, the state is also damaged by low-wages more immediately in an economic sense: between 2007 and 2018, the state paid €117bn in social security support to families in which at least one family member was in

¹ This diagnosis corroborates similar analyses that have been put forward for the UK by the Chief Economist of the Bank of England (Haldane (2017)) and by the OECD on an international level (Andrews et al. (2016)).

² In 2009, the German economy saw an isolated case of a drop in hourly productivity (-2.56%). This seemed to be a one-off effect of the financial crisis and is not displayed in the graph in order not to skew the representation of the rest of the data.

employment, effectively subsidizing poverty wages. In 2018 alone these payments amounted to nearly €10bn (RND 2019). And the public costs of the low-wage sector do not end there, as low-wages also contribute to low pension entitlements, condemning workers to spend their final years in poverty and the state to prop up their pensions. In addition, the state itself loses out on a significant amount of social security contributions and income taxes. According to estimates by the German Trade Union Confederation (DGB), the German state missed out on €47.9bn in 2021 due to depressed wage levels (DGB 2021).³

But it is not just workers and the state who have borne the costs of the internal devaluation that enabled the pre-Covid success story of the German economy. The German economic model is also ecologically unsustainable. In accordance with its heavy export focus, the German economy features a strong manufacturing sector, contributing over 20 percent of GDP in value added, compared to 11.2 percent in the US and 9 percent in the UK (World Bank 2021c). High resource and energy use is characteristic for manufacturing – and in addition, Germany has been relatively slow in phasing out energy production from coal, which contributed 44.26 percent of all electricity production in 2015 in Germany, compared to 34.23 percent in the US and 22.81 percent in the UK (World Bank 2021b). Despite decreases in per capita emissions in the last decades, emission levels in Germany are still unsustainably high, with 8.56 tons of CO₂ emitted per capita in 2018 (World Bank 2021a), many times more than would be sustainable, with the economy greening at nowhere near the speed needed to enable future generations to live a sustainable and decent life.

Accordingly, recent economic success has taken place not only on the back of millions of low-paid workers and the state, but also at the cost of a rapidly worsening climate crisis, systematically undermining the natural fundament of social reproduction. Substantial state intervention is needed to ensure dignified wage levels for all workers in the German economy and to massively and rapidly curtail emission levels. In the following report, we will sketch out social and ecological baselines the German economy should meet in order to avert social and ecological crisis as well as policy instruments to enforce these baselines.

³ This likely represents a rather conservative estimate as possible increases in consumption based taxes such as VAT on the €41.6bn potential additional purchasing power of employees are not included.

Drawing the (base-)lines

The rationale behind our focus on baseline costs of labour (wages) and pollution (i.e. CO₂-emissions) is both normative as well as economic: ensuring decent wage floors reflects the basic notion that human lifetime is a precious resource that ought not be squandered. Exercising pressure on business models built on low wages through ambitious minimum wage policy and the strengthening of collective bargaining agreements (CBA) implements this notion. Increasing the costs of emissions similarly serves a normative goal – averting the threat of the climate crisis which puts humanity’s future at risk and is already driving mass extinction. At the same time, a hike in wage levels at the bottom of the income distribution would incentivise companies to innovate to stay competitive, increasing productivity across the economy and closing the productivity gap between today’s Laggards and Frontiers. By increasing the pressure on companies to innovate would furthermore boost state finances and economic growth as higher wages lead to increased domestic demand and social security contributions. In a similar manner, more ambitious sustainability policy would force companies to search for new production technologies or business models less harmful to the environment – which would not only increase their own future economic sustainability but would also avert the immense economic costs caused by climate catastrophe (today externalised to the general public).

In the following, we will briefly discuss three policy options to establish higher baseline levels for wages (minimum wage, strengthening CBA) and pollution (a CO₂-price).

A higher minimum wage

The year 2015 saw the introduction of a minimum wage in Germany, after years of dramatic wage erosion and campaigning around the issue had rendered the minimum wage a flagship policy too topical to ignore. A supermajority of 535 members of the Bundestag voted in favour and only 5 against the introduction of a minimum wage of €8.50 an hour.⁴

The minimum wage has largely been evaluated favourably: it induced wage increases at the lower end of the income distribution that were substantially above average (between 2014 and 2018, employees covered by the minimum wage saw their wages increase by 21.8 percent versus an average of 11.4 percent), benefitting female workers, workers in smaller enterprises, unskilled workers and those on fixed-term contracts and/or uncovered by CBA in particular

⁴ Only the oppositional Left party, who had been one of the most active supporters of the policy, abstained collectively, citing the exclusion of underaged and so-called long-term unemployed workers and the fact that the trade union demand to set the minimum hourly wage to €10 an hour was not met as reasons, cf Bundestag (2014).

(Baumann & Bruttel 2020). Not only did individual workers benefit from their higher wages,⁵ but so did the German economy overall, which benefited from a boost in domestic demand (Böckler 2020). At the same time, the doomsday scenarios invoked by entrepreneurs and the overwhelming majority of German economists did not come to pass: neither did the minimum wage have a significant effect on the unemployment rate, nor did it lead to a massive rise in bogus self-employment. Instead, marginal employment and self-employment decreased and employment covered by social security increased (Bruttel et al. 2019; Lubczyk et al. 2020). One effect of the introduction of the minimum wage was, however, that workers reallocated to more productive firms while overall “firm quality (measured as firm size and fixed firm wage effect) increased” (Dustmann et al. 2020).

The widespread failure to accurately predict the effects of the minimum wage has been subject to controversy amongst economists. On the one hand, it appears as if many economists underestimated the adaptability of companies and the labour market. On the other hand, it appears as if the modelling of the impact a minimum wage would have on employment was overly normatively informed. Furthermore, the highly abstract and simplifying character of neoclassical economic models and their epistemic limitations were largely ignored in contributions to the public debate (Bruttel et al. 2019), leading to an uncritical reception of a specific form of economic reasoning in public and policy discourse.

To sum up, the introduction of a minimum wage in Germany has yielded substantial benefits whereas the arguments brought forward against its introduction have turned out to be by and large incorrect. This has vindicated proponents of the minimum wage to make the case for further increases of the minimum wage which is projected to further boost productivity and government revenue without jeopardizing employment levels (Krebs & Drechsel-Grau 2021).⁶

As a matter of fact, the most consistent critique of the German minimum wage has come from its supporters in academia, the trade unions and the progressive opposition: that – its positive effects notwithstanding – it is too low to achieve the goals the legislature set out for the minimum wage. In its reasoning in favour of a minimum wage two key criteria were introduced by the legislature: the minimum wage should ensure that workers would be able to make ends meet without having to rely on state-support – and that they should not have to rely on state-

⁵ These benefits are not limited to immediate economic effects: Research suggests that there also exists a strong connection between minimum wages levels and mental health. For the US case, Kaufman et al. (2020) for instance have shown that “[t]he effect of a US\$1 increase in the minimum wage ranged from a 3.4% decrease (95% CI 0.4 to 6.4) to a 5.9% decrease (95% CI 1.4 to 10.2) in the suicide rate among adults aged 18–64 years with a high school education or less”.

⁶ The study discusses the effects of a minimum wage increase from €9.6 to €12 an hour.

support in old age either. Since living costs vary strongly throughout Germany depending on family status (a single parent of two will need to generate a substantially higher income than a member of a double-income earner household) and location (with rents, one of the key expenses of private households, more than twice as high in places such as Munich and Stuttgart compared to large areas of North Rhine-Westphalia and Eastern Germany), the retirement provision has been generally accepted as a robust target value as the level of basic support is nationally more or less uniform (Herzog-Stein et al. 2020).

Model calculations have shown that in order for workers' pensions to exceed basic support when assuming a work life of 45 years à 40 per week, a minimum wage of €11.51 per hour would have been required in 2019. In reality, the minimum wage stood at €9.19 per hour (Herzog-Stein et al. 2020). At the same time, it needs to be emphasized that these assumptions are highly unrealistic: not only is the average work life substantially shorter – on average, workers accumulate insurance contributions for around 39 years before entering retirement (DRV 2021: 125) – but the average working week is also much shorter, standing at 30.24 hours per week (IAB MAKRO 2021). Assuming that the minimum wage is supposed to provide a dignified existence to the *average* worker and not just to those workers with an extraordinarily long work life and job security⁷, an hourly minimum wage of €17.57 would have been required in 2019. This certainly seems steep, given that it would nearly double the actual minimum wage in 2019 and still be substantially higher than the €12 introduced in 2022.

But would such an ambitious minimum wage level really spell disaster for Germany's labour market? A possible plausibility check might be to compare this minimum wage to existing wages in Germany's public sector which spans a vast variety of occupations and qualification levels. For the purpose of this plausibility check, we can derive a full-time yearly income by multiplying the increased minimum wage level of €17.57 by 52 work weeks à 39 hours: An hourly wage of €17.57 is then represented by a yearly income of €35,632.

⁷ Such a high level of job security on the contrary would make them an unlikely target demographic for minimum wage policies.

Pay grade ↓	Years of work experience					
	0	1	3	6	10	15
E 15Ü	73 951.54	82 073.63	89 767.94	94 897.78	96 094.66	
E 15	60 333.21	64 779.50	69 065.39	75 660.98	82 121.89	86 372.37
E 14	54 633.35	58 658.29	63 326.21	68 694.44	74 981.09	79 301.00
E 13	50 358.67	54 626.29	59 035.03	64 172.18	70 390.03	73 620.67
E 12	45 852.54	50 642.56	56 420.99	62 603.01	69 953.02	73 407.36
E 11	44 250.88	48 690.05	52 728.70	57 313.66	63 648.64	67 103.10
E 10	42 648.70	46 258.30	50 112.13	54 250.50	59 244.03	60 798.59
E 9c	37 787.65	43 729.92	47 227.26	51 487.36	55 879.68	57 582.72
E 9b	37 787.65	40 919.04	44 178.56	48 180.61	52 335.36	55 789.44
E 9a	37 787.65	40 547.84	41 252.35	43 502.21	48 017.02	49 637.12
E 8	35 722.04	38 329.38	40 019.93	41 683.77	43 476.87	44 374.97
E 7	33 519.10	36 411.41	38 160.52	39 850.81	41 398.81	42 301.29
E 6	32 889.58	35 345.23	36 977.33	38 583.00	40 092.43	40 937.76
E 5	31 553.27	33 927.77	35 456.55	37 062.09	38 510.11	39 291.72
E 4	30 056.87	32 433.05	34 356.18	35 542.21	36 727.98	37 422.51
E 3	29 584.73	32 100.49	32 730.40	34 088.25	35 107.22	36 040.67
E 2Ü	27 719.91	30 558.55	31 578.30	32 937.96	33 872.43	34 569.68
E 2	27 381.54	29 888.91	30 523.21	31 377.32	33 254.39	35 218.03
E 1		24 549.86	24 966.53	25 487.56	25 973.25	27 223.26

Table 1: Yearly incomes in Germany's public sector (federal level) in Euro (2019).⁸

It is immediately apparent that the majority of pay grades do not stand to profit from even an ambitious increase in minimum wages as for instance any positions requiring any sort of academic qualification (pay grades E9+) already exceed this wage level. The same is true even for the better paid entry positions for skilled workers that went through vocational training (E8 and the lower end of the E9 spectrum). The only public sector workers who would stand to immediately benefit from such an increase in the minimum wage would be freshly hired, lower-paid skilled workers (with freshly hired E6 staff, a fairly common pay grade for entry-level administrative staff, seeing its wage progression fast-forwarded by roughly three years) and unskilled workers (E1-E4). The latter however make up a relatively insignificant share of public sector employment, with the pay groups E1-E4 constituting less than 5 percent of public sector employment (Destatis 2019) – and even here, the most populous groups (E4 and E3) reach adequate wage levels after some professional experience. Where this does not apply, the wage gap that would have to be bridged is relatively miniscule.

⁸ This table actually provides a slight underestimate of wage levels in the public sector as it does not account for shift or holiday surcharges, special subsidies, higher levels of paid vacations and additional occupational pensions.

What can we learn from this plausibility check? For one, it illustrates that within more or less regulated income structures, a minimum wage of €17.57 appears unlikely to cause much disruption. It would, however, incentivize employers to prioritize the hiring of more skilled, productive workers and to invest into an upskilling of the workforce which in Germany is largely reliant on vocational training on the shop floor (supplemented by studies at vocational schools). It is not the case that wages in Germany's public sector are extraordinarily lavish either: as a matter of fact, they are rather mediocre with an average hourly wage of €33.11 per hour vs. an average of €33.92 in the whole of the economy in 2019 (Destatis 2021b: 80).⁹

As such, it would be a misrepresentation to frame such a robust minimum wage increase as “anti-business”. Instead it is a policy that very directly targets a specific kind of employer: badly performing businesses who are relatively unproductive and built on poor wages. On the contrary, such a bold state intervention might plausibly be understood as bolstering up any business offering more or less decent wage levels as they would benefit from a more level playing field.

By levelling the playing field, a substantially higher minimum wage would disrupt the business model of companies who pay low wages and have fallen behind in terms of productivity. However, such a disruption might be acceptable or even welcome if it leads to a more productive and future-fit economy that prioritizes efficient use of well-compensated labour time over long working hours and low wages. As a matter of fact, long before technology giants as well as start-ups started branding themselves as disruptors, progressive economists advocated for disruption of business as usual in the interest of levelling up the economy: As early as 1893, German liberal economist Lujo Brentano argued for increased pressure on employers to raise productivity in the interest of overall economic performance. He noted, too, that not every employer might be able to keep pace with accelerated economic development. Singling out “narrow-minded” and “unenergetic” employers using outdated technology in particular, he advocated to welcome their demise (Brentano 1893: 50). Research predominantly agrees that higher minimum wages would force companies to adapt by raising productivity if they are to

⁹ A minimum wage of €17.57 also does not seem outlandish in relation to minimum wage demands adopted in other countries such as the United Kingdom, where the centre-left Labour party adopted the demand for a £15 (~17.92€) minimum wage that was introduced by its affiliated trade unions in 2021 (Breese (2021)). A subsequent survey commissioned by Autonomy showed that the demand is supported by a majority of voters of all parties, including a majority of Tory and “red wall” voters (Stone (2021)). Putting the demand into a historic perspective makes it appear fairly modest even. As the Center for Economic and Policy Research (2020) has shown, the US minimum wage rose roughly in step with productivity between 1938 and 1968, but has decoupled ever since. Had it kept pace with productivity increases, it would have stood at over \$24 (€21.25) an hour in 2020, illustrating the level of ambition once tied to minimum wage policies.

stay profitable (Riley & Rosazza Bondibene 2017; Lordan & Neumark 2018; Bruttel et al. 2019; Dustmann et al. 2020; Krebs & Drechsel-Grau 2021) and that the potential for automation is particularly high in low-paid occupations (C. Frey & Osborne 2017; C. Frey 2019). This can be relatively easily explained economically: many of those jobs probably could have been automated for decades using tried and tested automation technologies – but low wage levels might have raised the relative costs of automation to a level unattractive to capital investment. Raising those wages in turn would lower the relative costs of automation, strengthening the economic argument for investment into new technologies.

Aside from incentivising investment into labour-saving technologies, higher minimum wages might also contribute to productivity increases through reallocation effects as less-productive companies are weeded out, allowing other, more productive competitors to expand market shares and hire new staff (Dustmann et al. 2020). To support this reallocation of labour, the state should commit to active labour market policies, supporting (re-)qualification of employees, expanding its support to match employers and employees and subsidizing relocation costs. And as discussed in we will argue in an upcoming paper on TRANSFORM Germany, a public investment agency aimed at boosting productivity and greening the economy, it should also provide access to funds and expertise to help companies become more innovative. But even then, there is no guarantee that increased minimum wages might not lead to a temporary increase in unemployment, highlighting the importance of a future-fit welfare state. On the other hand, higher wages would lead to increased aggregate demand which in turn should stabilize the economy (Bruttel et al. 2019). For example, higher demand would allow companies to expand their operations to match this demand and in the process make investment into new technologies feasible which then again allows for higher wages, thereby creating what has been dubbed an economic “virtuous circle” (Stirling 2019; UNCTAD 2020).

At the same time, higher minimum wages would promote a renegotiation of societal priorities: many occupations that have demonstrated their vital importance during the Covid pandemic such as care workers, cleaners and cashiers stand to profit from higher minimum wages (Koebe et al. 2020). The pandemic has revealed that a massive gap exists between the societal importance of many occupations and their remuneration – a gap that has not been fundamentally reduced throughout the pandemic, despite all symbolic recognition showered upon its “heroes”. Instead, there is the risk that existing wage disparities will be perpetuated and even deepened, as inflation erodes medium and low incomes (Tober 2022). A minimum wage hike on the other hand would mark a clear renunciation of the depreciation of so-called “low-skilled” workers

(who, when push came to shove, suddenly turned out to be “key workers” or “essential workers”) and would contribute to a fairer recognition of the societal value of work (Lawlor et al. 2009; Urban 2019; Nachtwey 2020; Bergfeld & Farris 2020).

Even if wage hikes for those workers charged with ensuring the reproduction of our society could not be fully compensated by more efficient work organisation and new technology, the ensuing increased costs for certain goods and services might then be welcomed to some degree, as they would reflect an increased appreciation for these occupations. This would be socially acceptable, too, as many low-wage households would see their income rise significantly at the same time.¹⁰ At the same time, a substantial potential for income redistribution exists: surely, a global economy that was able to provide a daily capital income of more than a billion euro to the ten richest men alone throughout one of the most dramatic economic crises in a century (Ahmed et al. 2022)¹¹ should not be overstrained by increasing the daily income of millions by a couple of euro.

Ultimately, a higher appreciation of the value of the lifetime of all workers would be enforced through higher minimum wages, implementing the conviction that the human costs of low wages are too high to accept in order to allow a bunch of would-be entrepreneurs enact their fantasies of being successful business people.¹² Furthermore, the re-evaluation of the minimum pay levels would compel society to reconsider economic priorities and to clarify what work is deemed essential – and thus has to be rewarded appropriately – and what kind of goods and services are only being consumed because they are provided at deflated costs, i.e. at the expense of low-wage workers.

¹⁰ In extreme cases in which the provision of socially necessary services has to be secured but private enterprises fail to do so at affordable rates, these services could be socialized in which case the minimum wage would play less of a role to regulate wages anyway (see the discussion of wages in the public sector above).

¹¹ German billionaires as a whole increased their wealth by close to \$150bn between 2019 and 2020 (cf. UBS and PwC (2020)). At the same time, German retail workers – considered essential workers who faced an increased risk of infecting themselves – saw a decline in wages, with wages for full-time employees falling by 3.2 percent in 2020 compared to 2019 (Niesmann (2020)).

¹² Those companies, SMEs in particular, who would be willing to pursue a high-productivity, high-wage business model but are barred from doing so by insufficient access to investment and expertise should of course be given appropriate support. Accordingly, our paper on TRANSFORM Germany illustrates ways the public might help businesses adapt to a changing regulatory framework aimed at levelling up the economy by providing them with money, technology and expertise.

Extending dignity to all

The growth of a low wage sector in Germany has correlated with a shrinking coverage by collective bargaining agreements (CBA). In 1998, 76 percent of all employees in Germany were covered by CBA. By 2019, this number had fallen to just 53 percent (Destatis 2020). This development has had a significant effect on labour conditions, as employees without CBA coverage fare substantially worse, earning 11 percent lower wages when compared to workers in CBA-covered businesses of the same characteristics, i.e. industry, size. What is more, they have to work an additional 53 minutes per week for their already lower wages (Lübker & Schulten 2020). Stabilizing and expanding CBA coverage thus can be understood as a key tool at the legislator's disposal to bolster wage levels (cf. DGB 2017), in addition to a more ambitious minimum wage policy. Two economies directly neighbouring Germany's provide examples of how this might be achieved:

Austria features a system of collective bargaining, much alike the German: the trade unions of a respective sector and the employers that are organized in a sector's employers' associations collectively negotiated a CBA on a regular basis. Whereas in Germany membership in an employers' association is voluntary and it has even been permitted that businesses might associate themselves with employers' association without applying its CBA, under the Austrian system all businesses have to be part of employers' associations and have to apply the corresponding CBA. Although this concept is not difficult to grasp, its effects are profound, leading to 98 percent of employees in Austria to be covered by CBA (Zinke 2020). By following the Austrian example, making membership in a employers' association mandatory for businesses and banning non-CBA memberships, CBA coverage could be made universal in Germany.

The other example is France, where the state is taking a much more active stance in the regulation of working conditions. One of its central tools is the extension of CBA: rather than forcing all employers to (indirectly through their associations) participate in negotiating CBA, the French state instead extends CBA across whole branches, thereby ensuring that 99 percent of all employees enjoy CBA coverage (Dufresne & Maggi-Germain 2012; Zinke 2020). The possibility to extend the ambit of CBA exists under German law too. It is impeded by high hurdles however, chiefly the possibility of the employers' association to veto the extension (Schulten 2018). The German trade unions have been vocal in lobbying for a reform of the rules that govern the extension of CBA in Germany, namely towards a system in which it can only be blocked by a majority of votes within the responsible tripartite committee, removing employers' veto rights (Schulten 2018: 86). Such a reform would open up the possibility for

the state to cooperate with trade unions in taking a more active stance in ensuring CBA coverage throughout the economy, similar to established practices in France.

Again, increased CBA coverage would not punish businesses in general – instead it would mostly affect businesses whose management has built its fortune on paying their workers wages well below the generally accepted standard, as defined by existing CBA. By extending CBA coverage, the government would take a bold step towards extending dignity to all workers in the economy. What is more, it would provide an impulse similar to the one exercised by higher minimum wages by forcing structural changes within the economy to boost productivity.

This focus on higher wages to reinforce a focus on innovation and productivity increases, alongside active labour market policy, is not unheard of: It forms the backbone of what has been dubbed the “Swedish model”, developed by the leading economists of the Swedish trade union movement, Gösta Rehn and Rudolf Meidner (Erixon 2011; Guinan 2019). One of the basic insights of the Swedish model is that a modernisation of the economy might be facilitated under conditions favourable to workers by barring companies from offsetting their low productivity through low wages to stay competitive. Instead, companies would be forced to pay reasonable wages and coincidentally, to innovate. The bankruptcy of companies which would prove to be unable to adapt would in turn free up resources (credit, labour) for the expansion of other, more dynamic enterprises.¹³ This economic rationale helped transform the Swedish trade union movement into a proponent of a dynamic modernisation of the economy and a vanguard of creative destruction conducted by working class interests (Erixon 2011).

The fact that higher wages well beyond minimum wage increases induce productivity growth has been largely accepted in research (Grossmann 1929; Leontief 1986; Stirling 2019; Spencer & Slater 2020) for a long time. Developing a policy linking high wages and high productivity growth, supported by active state intervention, is a pressing issue if the post-crisis recovery is to lead to a levelling up of the economy. Understanding high wages not simply as a burden on companies but also as a central impulse for a more innovative economy constitutes one step in this direction.

¹³ An OECD working paper corroborates this point by pointing out that the continued support for so-called “zombie firms” would tie up economic resource and hinders the development of non-zombie firm. The report links the continued existence of these “Walking Dead” to lower average business investment and multi-factor productivity growth (McGowan et al. (2017)).

Making higher wages future-fit

Even though these two simple interventions would effectively eradicate Germany's low-wage sector and provide a massive impulse to companies to innovate to stay profitable, past evidence suggests that even ambitious wage policies run at risk to be hollowed-out over time (CEPR 2020) if their future development is not tied to increases in productivity and does not compensate for inflation. To prevent a gradual devaluation of the minimum wage and to establish a direct link between increased productivity and higher wage levels, policy makers might rely on a mechanism of wage determination long prominent in Germany: the productivity-oriented wage policy (Sauerland 2018). This policy suggests a mechanism that directly ties the development of wages to the development of productivity while also accounting for inflation:

$$\dot{W}_n = \dot{P}_n + \dot{I}$$

Meaning the annual increase of the nominal minimum wage per hour (\dot{W}_n) would be defined by the growth in productivity of the year (\dot{P}_n) plus the inflation rate (\dot{I}).¹⁴ Such a mechanism might be codified for future minimum wage increases, but policy makers might establish an even broader link between technological progress and social well-being and wealth. Already today, the development of the salaries of the members of the German Bundestag are indexed to the growth of average nominal wages (AbgG 2021: §11). Moving away from average nominal wages (an index which for instance pays little regard to the distribution of wages within the labour market) and indexing them to the minimum wage instead would forcefully make the point that the development of the income of those guiding the state and those labouring for minimum wages are guided by the same principles, signalling the commitment of the legislature to a new deal for workers.

Towards a wage and social policy of solidarity

But the salaries of parliamentarians, ministers and the likes constitute only a miniscule share of the total salaries paid by the state. By implementing a productivity-oriented wage policy for the CBAs covering all civil servants and other employees in the public sector, a direct link between increased productivity and higher wages might be established for its nearly five million middle class workers (Destatis 2019: 83), committing the state to become more innovative in its own

¹⁴ As Sauerland (2018) points out, one might also use a productivity-oriented wage policy as a tool to ward off both run-away inflation and low inflation by using the target inflation rate defined by the central bank rather than the actual inflation rate when adjusting wage levels. Alternatively, both variables, productivity and inflation, might be averaged out over a decade or so when calculated, rendering a productivity-oriented minimum wage policy a lever of stability of the wage system.

provision of services. At the same time, wages in the public sector exert competitive pressure on private employers, many of which, particularly in the care sector, already match or surpass public sector wages in order to attract employees. Accordingly, adopting a productivity-oriented wage policy increases in the public sector would force private employers to match those wage increases to stay competitive.¹⁵ Lastly, the state supplies income to millions of households out of employment in the form of pensions, child support and unemployment support which might likewise be indexed to productivity-growth.¹⁶ Doing so would guarantee that as they implement bold new policies to pressure companies to invest into new technologies and to innovate, policy makers would also commit themselves to making sure that the benefits of these productivity increases are widely shared across society – which in turn would ensure that aggregate demand stays strong, even in the case of transitionary unemployment (Stirling 2019).

At the same time, such a policy would incentivise a strategy of full employment and active labour market policies to supplement it to prevent social expenditure from ballooning. As the economy embarks on a daring push towards a technological upgrade unseen ever since the era of post-war prosperity, an overarching policy of productivity-oriented income increases would make sure that the benefits of this age of rapid dynamism would be widely shared, transforming technological into social progress. Productivity-oriented wage policies have contributed to transforming workers and their trade unions into advocates and driving forces for innovation in the past (Naples 1986; Erixon 2011) – extending it beyond wages and unto benefits would be tantamount to establishing a new social contract for an age of automation.

Valuing nature

As pointed out in the introduction to this document, German companies have not only realised their profits on the back of depressed wage levels, many have also made their profits on the back of rapidly deteriorating ecosystems, most prominently by causing high levels of greenhouse gas emissions. These high emissions reflect an undervaluation of ecological sustainability and the social costs of its violation. The cause of this undervaluation is simple: most of these costs are externalised, i.e. are borne out by the state and insurance companies –

¹⁵ The Swedish model similarly employed a wage policy of solidarity. Wages were generally increased to keep up with both inflation and with average productivity in the economy. This, again, forced less-productive companies to either adapt to keep pace or to vanish. While enforcing a high level of innovation throughout the economy, this policy also succeeded in limiting pay differences across the economy; see Erixon (2011); Guinan (2019).

¹⁶ Trade union economists have long called for a link between the development of the minimum wage and social benefits to be established to ensure that benefit recipients would participate in gradual wage growth and to thereby limit social polarisation (Horn et al. (2017)).

who have to compensate crop failures and the damages caused by natural disasters – and private households, who pay the prize for individual climate adaption as well as through increased mortality as heatwaves and other extreme weather ravages society (Stern 2014). The climate crisis ultimately induces massive economic costs, rendering a lack of climate protection the most costly alternative – yet, these costs are strongly dispersed, geographically (with people in the Global South contributing far less to climate change while being most affected by it (Oxfam 2015; Gore 2021; Ahmed et al. 2022)), institutionally (i.e. through the externalization of the socioeconomic costs of climate change to the state) and temporarily (with future generations being most affected by today’s emissions).

The externalization of the costs of ecological devastations – most urgently the unsustainable level of emissions – has enabled companies to generate profits at the costs of future generations for too long. This externalization has to be put to an end through bold policy making to prevent further damages to future generations. “*Après moi le déluge*” can longer be accepted to be the watchword of capital accumulation (Marx 1982: 381). There is ground for optimism however: by now, robust mechanisms to assess the carbon print of goods and services exist (e.g. life cycle assessment methods) and, even more crucially, there is a growing consensus within the scientific community that most, if not all, technologies are available to enable a much more sustainable economy. Just as the Frontiers prove that the organisational and technological innovations exist to implement massively higher productivity, so do leading experts argue that it is the rollout of existing technologies that is lagging behind when it comes to greening our economy (Puttfarcken 2021; Jacobson et al. 2022). The issue, again, mostly is not a lack of technological development, but lack of investment.

Investment is lacking because the economic case for rapid and massive investment into the greening of business activities is too weak, crucially because of the way the market is designed due to the lack of ambitious climate protection policy. A flagship policy suggested by leading economists is the introduction of a carbon tax to internalise the negative externalities of economic activities by setting a price for ecological damage caused by them. The societal costs of one ton of CO_{2eq} emissions is €195 (around £162) according to the Federal Environment Agency of Germany. As we have argued in our comprehensive study modelling a possible tax-and-dividend-scheme (Frey & Garcia 2022), private households might be shielded from the negative effects of ambitious carbon pricing through a tax-and-dividend scheme. As a matter

of fact, most households even stand to substantially benefit from such a scheme¹⁷ – and momentum for tax-and-dividend scheme seems to be building in the last years (cf. Frey & Garcia 2022): Support for a system of carbon dividends is particularly strong within the field of economics, inspiring the largest public statement of US economists in history, rallying 4 Former Chairs of the Federal Reserve, 28 Nobel Laureate Economists and thousands of rank-and-file colleagues behind the demand for carbon dividends (Akerlof et al. 2019). At the same time, evidence is mounting that an inclusive redistribution generated from carbon taxation is key to gaining political support for ambitious policy making (Klenert et al. 2018).

Beyond academia, an increasing number of prominent actors are calling for proposals along these lines too. From David Miliband’s proposal of tradeable personal carbon allowances in 2006, or the Green New Deal for Europe campaign demanding a tax-and-dividend system, to the contemporary German Greens’ *Energiegeld*, redistributive carbon pricing has increasingly gained traction in politics. Crucially, the idea has also gained popularity with parts of the labour movement, who have been long wary of additional indiscriminate consumption taxes, with the Macroeconomic Policy Institute of the German Hans-Böckler-Foundation, the premiere trade union think tank in Germany, demanding the introduction of a tax-and-dividend system to ensure a retributive implementation of CO₂-taxation (Gechert & Dullien 2021).

While the majority of the population stands to benefit from an introduction of a tax-and-dividend scheme, introducing a carbon price at roughly twice the price of the European Union Emissions Trading System would likely prove disruptive for a great number of businesses. Apart from providing massive funding to rapidly adapt to the changing economic environment (see below), the government would need to take care to prevent carbon leakage and unilateral deindustrialisation, for instance through CO₂ border adjustments (see Felbermayr 2019; Bellora & Fontagné 2020; Sund 2020). Expanding and increasing carbon pricing in tandem with massive public investment into greening the economy would however allow to utilise most potentials for mitigation identified by the IPCC in its latest report (Babiker et al. 2022)¹⁸ and curtail future destructive economic activities. At the same time, the expansion of investment

¹⁷ Our modelling for Germany for instance shows that a tax-and-dividend scheme might increase the income of the bottom 10 percent by almost 15 percent and would pay a net-dividend to 70 percent of the German population with the majority of the net-contributions coming from the top 1 percent income-group who cause runaway emissions and stand to lose 12 percent of their income under such a scheme (Frey and Garcia (2022: 48)). The redistributive effect of such a tax-and-dividend scheme would in turn help private consumers wither the necessary green inflation connected to internalising the societal costs of consumption.

¹⁸ The costing range provided by the IPCC ends at \$200, indicating that a carbon price that well exceeds this level (i.e. even the most costly options to reduce net emissions are less costly than the long-term effects of these emissions) would provide a strong impulse to implement reduction potentials.

and a regulatory environment pushing for more sustainable products (e.g. creating demand) would enable an economy of scale to take effect, driving down prices for sustainable technologies and exploiting further efficiency increases.

Should businesses turn out to be unable to adapt to the internalisation of the costs of the ecological consequences of their operation, this would demonstrate a simple, but pivotal truth: that these businesses have been profitable only at the expense of those who will have to bear the climate effects of these business practices long after their shareholders have cashed out. Or to put it more dramatically: that their short-term profit making comes at the cost of the immolation of large parts of humanity and the world's ecosystems.

Neither the degradation of our basis of existence nor the paltry wage levels suffered by millions are without alternatives: governments could take simple but decisive steps to help the economy shift change course towards a green economy that provides decent jobs to all. At the same time, these policies would help unleash the potentials of technological development hitherto handicapped by low wages and almost the lack of ambitious environmental policy, joining technological development, ecological sustainability and public well-being in a new social contract fit for an age of far-reaching economic transformation. Regulatory intervention to prize human labour and the environment more highly is not enough however – to prevent large scale, non-transitional unemployment and a dysfunctional disruption of the economy, the state should take an active role in shaping the transformation of the economy these interventions would trigger. In other words, the state should take an active role in embracing and directing creative destruction in the interest of working people and the environment. In our upcoming paper on *TRANSFORM Germany*, we will argue that this should come in the form of democratically governed public investment and democratic wealth formation.

References

- AbgG (2021) Gesetz über die Rechtsverhältnisse der Mitglieder des Deutschen Bundestages.
<https://www.gesetze-im-internet.de/abgg/AbgG.pdf>.
- Ahmed, N., Marriott, A., Dabi, N., Lowthers, M., Lawson, M. & Mugehera, L. (2022) *Inequality kills: The unparalleled action needed to combat unprecedented inequality in the wake of COVID-19 report*. Oxfam GB, Oxford, UK.
- Akerlof, G., Aumann, R., Baily, M., ... & Yellen, J. (2019) Economists' Statement on Carbon Dividends: As published in the Wall Street Journal on January 17, 2019.
<https://clouncil.org/media/EconomistsStatement.pdf>. Accessed 7/8/2021.
- Andrews, D., Criscuolo, C. & Gal, P. N. (2016) *The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy*.
- Babiker, M., Sugiyama, M., Cohen, B., Toribio Ramirez, D. & Blok, K. (2022) *Data for Figure SPM.7 - Summary for Policymakers of the Working Group III Contribution to the IPCC Sixth Assessment Report*. MetadataWorks.
- Baumann, A. & Bruttel, O. (2020) Fünf Jahre gesetzlicher Mindestlohn. Bilanz und Perspektiven. *Aus Politik und Zeitgeschichte* **70** (39-40), 4–10.
- Bellora, C. & Fontagné, L. (2020) *Possible carbon adjustment policies: An Overview: Research Report on behalf of the European Parliament Directorate-General For External Policies*.
- Bergfeld, M. & Farris, S. (2020) The COVID-19 Crisis and the End of the "Low-skilled" Worker.
<https://spectrejournal.com/the-covid-19-crisis-and-the-end-of-the-low-skilled-worker/>. Accessed 5/14/2020.
- Böckler (2020) Höherer Mindestlohn stärkt die Nachfrage. *Böckler-Impuls* (10).
- Breese, E. (2021) £15 minimum wage: Who is calling for it and could it happen? *The Big Issue*, September 28. <https://www.bigissue.com/news/15-minimum-wage-who-is-calling-for-it-and-could-it-happen/>. Accessed 2/22/2022.
- Brentano, L. (1893) *Über das Verhältniß von Arbeitslohn und Arbeitszeit zur Arbeitsleistung, 2.*, völlig umgearb. Aufl. Duncker & Humblot, Leipzig.
- Bruttel, O., Baumann, A. & Dütsch, M. (2019) Beschäftigungseffekte des gesetzlichen Mindestlohns: Prognosen und empirische Befunde. *Perspektiven der Wirtschaftspolitik* **20** (3), 237–253.
- Bundestag (2018) Antwort der Bundesregierung auf die Kleine Anfrage der Abgeordneten Pascal Meiser, Fabio De Masi, Jörg Cezanne, weiterer Abgeordneter und der Fraktion DIE LINKE: Entwicklung der Lohnquote in Deutschland. *Drucksache* (19/5019).
- C. Frey (2019) *The technology trap: Capital, labor, and power in the age of automation*.
- C. Frey & Osborne, M. A. (2017) The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change* **114**, 254–280.
- CEPR (2020) This is What Minimum Wage Would Be If It Kept Pace with Productivity - Center for Economic and Policy Research. <https://cepr.net/this-is-what-minimum-wage-would-be-if-it-kept-pace-with-productivity/>. Accessed 2/22/2022.
- Destatis (2019) Finanzen und Steuern: Personal des öffentlichen Dienstes 2019: Fachserie 14 Reihe 6.
https://www.destatis.de/DE/Themen/Staat/Oeffentlicher-Dienst/Publikationen/Downloads-Oeffentlicher-Dienst/personal-oeffentlicher-dienst-2140600187004.pdf?__blob=publicationFile. Accessed 3/1/2021.
- Destatis (2020) Tarifbindung von Arbeitnehmern.
<https://www.destatis.de/DE/Themen/Arbeit/Arbeitsmarkt/Qualitaet-Arbeit/Dimension-5/tarifbindung-arbeitnehmer.html>. Accessed 10/22/2020.
- Destatis (2021a) Saldo der Außenhandelsbilanz (Differenz zwischen Exporten und Importen von Waren) von Deutschland von 1991 bis 2020 (in Milliarden Euro).

- <https://de.statista.com/statistik/daten/studie/37793/umfrage/exportueberschuss-in-deutschland-seit-1999/>. Accessed 7/13/2021.
- Destatis (2021b) Volkswirtschaftliche Gesamtrechnungen: Inlandsproduktberechnung. Detaillierte Jahresergebnisse 2020. https://www.destatis.de/DE/Themen/Wirtschaft/Volkswirtschaftliche-Gesamtrechnungen-Inlandsprodukt/Publikationen/Downloads-Inlandsprodukt/inlandsprodukt-endgueltig-pdf-2180140.pdf?__blob=publicationFile. Accessed 8/1/2021.
- DGB (2017) *Positionen zur Stärkung der Tarifbindung*.
- DGB (2021) Tariffucht-Atlas: So viel kostet Tariffucht jedes Bundesland. <https://www.dgb.de/themen/++co++627c137e-2a72-11ec-b540-001a4a160123>. Accessed 10/25/2021.
- DRV (2021) *Rentenversicherung in Zeitreihen*, Stand vom 07.10.2021. Deutsche Rentenversicherung Bund, Berlin.
- Dufresne, A. & Maggi-Germain, N. (2012) Zwischen Staatsinterventionismus und Tarifautonomie – Die Allgemeinverbindlicherklärung von Tarifverträgen in Frankreich. *WSI-Mitteilungen* **65** (7), 534–540.
- Dustmann, C., Lindner, A., Schönberg, U., Umkehrer, M. & vom Berge, P. (2020) *Reallocation Effects of the Minimum Wage*.
- Erixon, L. (2011) A social innovation or a product of its time? The Rehn–Meidner model's relation to contemporary economics and the Stockholm school. *The European Journal of the History of Economic Thought* **18** (1), 85–123.
- Fedorets, A., Grabka, M. M., Schröder, C. & Seebauer, J. (2020) *Lohnungleichheit in Deutschland sinkt*. DIW - Deutsches Institut für Wirtschaftsforschung.
- Feenstra, R. C., Inklaar, R. & Timmer, M. P. (2015) The Next Generation of the Penn World Table. *American Economic Review* **105** (10), 3150–3182.
- Felbermayr, G. (2019) Grenzausgleich: Für Klima und Wirtschaft. <https://www.ifw-kiel.de/index.php?id=13370&L=1>. Accessed 11/8/2021.
- Frey, P. & Garcia, L. (2022) *Toll Gates and Money Pumps: Why carbon taxation could be a simple, fair and transformative policy instrument*.
- Gechert, S. & Dullien, S. (2021) *Steigender CO2-Preis: Warum der Klimabonus ideal für den sozialen Ausgleich ist*.
- Gore, T. (2021) *Carbon Inequality in 2030: Per capita consumption emissions and the 1.5°C goal*. Institute for European Environmental Policy, Oxfam.
- Grossmann, H. (1929) *Das Akkumulations- und Zusammenbruchsgesetz des kapitalistischen Systems: (zugleich eine Krisentheorie)*. Hirschfeld, Leipzig.
- Guinan, J. (2019) Socialising capital: looking back on the Meidner plan. *International Journal of Public Policy* (15), 38–58.
- Haldane, A. G. (2017) *Productivity Puzzles: Speech at the London School of Economics*.
- Herzog-Stein, A., Lübker, M., Pusch, T., Schulten, T., Watt, A. & Zwiener, R. (2020) *Fünf Jahre Mindestlohn - Erfahrungen und Perspektiven: Gemeinsame Stellungnahme von IMK und WSI anlässlich der schriftlichen Anhörung der Mindestlohnkommission 2020*, Düsseldorf.
- Hilmer, R., Kohlrausch, B., Müller-Hilmer, R. & Gagné, J. (2017) *Einstellung und soziale Lebenslage: Eine Spurensuche nach Gründen für rechtspopulistische Orientierung, auch unter Gewerkschaftsmitgliedern*.
- Horn, G. A., Behringer, J., Gechert, S., Rietzler, K. & Stein, U. (2017) *Was tun gegen die Ungleichheit?: Wirtschaftspolitische Vorschläge für eine reduzierte Ungleichheit*.
- IAB MAKRO (2021) *IAB-Arbeitszeitrechnung: Durchschnittliche Arbeitszeit und ihre Komponenten in Deutschland*.

- Jacobson, M. Z., Krauland, A.-K. von & Coughlin, S. J. et al. (2022) Low-cost solutions to global warming, air pollution, and energy insecurity for 145 countries. *Energy & Environmental Science*.
- Kaufman, J. A., Salas-Hernández, L. K., Komro, K. A. & Livingston, M. D. (2020) Effects of increased minimum wages by unemployment rate on suicide in the USA. *Journal of epidemiology and community health* **74** (3), 219–224.
- Klenert, D., Mattauch, L. & Combet, E. et al. (2018) Making carbon pricing work for citizens. *Nature Climate Change* **8** (8), 669–677.
- Koebe, J., Samtleben, C., Schrenker, A. & Zucco, A. (2020) *Systemrelevant, aber dennoch kaum anerkannt: Entlohnung unverzichtbarer Berufe in der Corona-Krise unterdurchschnittlich*.
- Krebs, T. & Drechsel-Grau, M. (2021) *Mindestlohn von 12 Euro: Auswirkungen auf Beschäftigung, Wachstum und öffentliche Finanzen*.
- Lawlor, E., Kersley, H. & Steed, S. (2009) *A Bit Rich: Calculating the real value to society of different professions*.
- Leontief, W. (1986) *Input-output economics*, 2. ed. Oxford Univ. Press, New York.
- Lordan, G. & Neumark, D. (2018) *People versus Machines: The Impact of Minimum Wages on Automatable Jobs*.
- Lubczyk, M., Murmann, S. & Murmann, M. (2020) *Auswirkungen des gesetzlichen Mindestlohns auf die Solo-Selbstständigkeit*. ZEW-Gutachten und Forschungsberichte. ZEW - Leibniz-Zentrum für Europäische Wirtschaftsforschung, Mannheim.
- Lübker, M. & Schulten, T. (2020) *Tarifbindung in den Bundesländern: Entwicklungslinien und Auswirkungen auf die Beschäftigten*, 2nd edn., Düsseldorf.
- Marx, K. (1982) *Capital I: A critique of political economy*. Penguin Books in association with New Left Review, London.
- McGowan, M., Andrews, D. & Millot, V. (2017) *The Walking Dead? Zombie Firms and Productivity Performance in OECD Countries*. OECD Publishing, Paris.
- Nachtwey, O. (2018) *Germany's hidden crisis: Social decline in the heart of Europe*. Verso, London, New York.
- Nachtwey, O. (2020) Corona und Klasse. *Philosophie Magazin*, March 26.
<https://www.philomag.de/artikel/corona-und-klasse>. Accessed 5/3/2020.
- Naples, M. I. (1986) The Unraveling of the Union-Capital Truce and the U.S. Industrial Productivity Crisis. *Review of Radical Political Economics* **18** (1-2), 110–131.
- Niesmann, A. (2020) Supermarkt-Angestellte verdienen weniger in Corona-Krise: Scharfe Kritik an Aldi, Lidl, Edeka und Co. *Redaktionsnetzwerk Deutschland (RND)*, November 25.
<https://www.rnd.de/politik/supermarkt-angestellte-verdienen-weniger-in-corona-krise-scharfe-kritik-an-aldi-lidl-edeka-und-co-2TTXAEUHQNDRNIWW7C7B5HNJR4.html>. Accessed 5/3/2022.
- OECD (2019) *GDP per hour worked (indicator)*.
- Oxfam (2015) *Extreme Carbon Inequality: Why the Paris climate deal must put the poorest, lowest emitting and most vulnerable people first*.
- Puttfarcken, L. (2021) Ergebnisse des Weltklimarats.
<https://klimasimulationen.de/weltklimarat/#5zukunft>. Accessed 8/14/2021.
- Riley, R. & Rosazza Bondibene, C. (2017) Raising the standard: Minimum wages and firm productivity. *Labour Economics* **44**, 27–50.
- RND (2019) Hartz IV: Staat stockte 2018 Löhne um fast 10 Milliarden Euro auf. *Redaktions-Netzwerk Deutschland*, November 13. Accessed 11/9/2020.
- Sauerland, D. (2018) produktivitätsorientierte Lohnpolitik.
<https://wirtschaftslexikon.gabler.de/definition/produktivitaetsorientierte-lohnpolitik-43729/version-267055>.
- Schiersch, A. (2019) *Frontiers und Laggards: Die Produktivitätsentwicklung deutscher Unternehmen*.

- Schulten, T. (2018) The role of extension in German collective bargaining. In: Hayter, S. & Visser, J. (eds.) *Collective agreements: Extending labour protection*. International Labour Office, Geneva, pp. 65–92.
- Spencer, D. & Slater, G. (2020) No automation please, we're British: technology and the prospects for work. *Cambridge Journal of Regions, Economy and Society* **13** (1), 117–134.
- Stern, N. H. (ed.) (2014) *The economics of climate change: The Stern review*. Cambridge University Press, Cambridge.
- Stirling, A. (2019) *Time for Demand: Boosting productivity with public investment, minimum wages and paid holiday*.
- Stone, J. (2021) Voters of all parties overwhelmingly support £15 minimum wage, poll finds. *The Independent*, October 01. <https://www.independent.co.uk/news/uk/politics/15-minimum-wage-starmer-labour-b1930057.html>. Accessed 2/22/2022.
- Sund, L. (2020) Was kann ein CO2-Grenzausgleich leisten? <https://makronom.de/der-mythos-vom-aufstieg-durch-bildung-36961>. Accessed 9/20/2020.
- Tober, S. (2022) *IMK Inflationsmonitor: Haushaltsspezifische Teuerungsraten: Wie stark unterscheidet sich die Belastung durch Inflation?*, Düsseldorf.
- UBS & PwC (2020) *Riding the Storm: Market Turbulence Accelerates Diverging Fortunes: Billionaires Insights 2020*.
- UNCTAD (2020) *From global pandemic to prosperity for all: avoiding another lost decade*, Geneva.
- Urban, H.-J. (2019) *Gute Arbeit in der Transformation: Über eingreifende Politik im digitalisierten Kapitalismus*. VSA Verlag, Hamburg.
- World Bank (2021a) CO2 emissions (kg per 2017 PPP \$ of GDP). <https://data.worldbank.org/indicator/EN.ATM.CO2E.PP.GD.KD>. Accessed 8/8/2021.
- World Bank (2021b) Electricity production from coal sources (% of total). <https://data.worldbank.org/indicator/EG.ELC.COAL.ZS>. Accessed 11/2/2021.
- World Bank (2021c) Manufacturing, value added (% of GDP). <https://data.worldbank.org/indicator/NV.IND.MANF.ZS>. Accessed 11/2/2021.
- Zinke, G. (2020) Europäische Lohnpolitik. *Bundeszentrale für politische Bildung*, November 01. <https://www.bpb.de/themen/arbeit/arbeitsmarktpolitik/318560/europaeische-lohnpolitik/>. Accessed 11/5/2021.

TRANSFORM Germany

A proposal for a public investment agency to boost productivity,
green the economy, and build democratic wealth

Philipp Frey

Executive summary

- German economic ‘success’ has come at a cost: a trade surplus, healthy tax revenue and low unemployment have been achieved on the back of wage suppression and stagnant incomes. This has stifled innovation and investment within a growing ‘Laggard’ sector of German businesses.
- Low productivity and wage growth has hit workers’ livelihoods, reduced tax receipts, and propped up an ecologically unsustainable economic model.
- We outline a plan for a German Green New Deal, mobilising €1,393bn over a decade, to help the German economy meet the demands of the twenty-first century.
- At its heart sits a new public investment agency, TRANSFORM, targeting a €93.6bn annual budget to boost productivity, kickstart a green transition and embed democracy in the economy, as well as a Universal Basic Dividend paid out to every German resident.
- Public investment has been a powerful, successful tool in the past: from the US New Deal to German post-war reconstruction. However, the challenges posed now by the climate crisis and automation are as great as any. A new public agency offers the chance to modernise the German economy and embed the long term thinking the next century, and beyond, requires.
- A German Green New Deal could source €139bn of annual funding through:
 - Cutting environmentally harmful or socially regressive subsidies (€20bn)
 - Reforming the tax system to distribute the costs of transformation fairly (€60bn)
 - A one-off tax on extreme wealth (€45bn)
 - Public borrowing (€15bn)
- As a democratic body, TRANSFORM’s investment priorities and founding principles would be guided by public concerns, helping to embed a longer-term economic view within popular debate.
- Return on investment generated through TRANSFORM could build up a social wealth fund, used to pay out a Universal Basic Dividend to all German residents.
 - This could pay out around €20bn annually after TRANSFORM’s first decade, rising to over €50bn over the span of the next fifty years
 - Matching funds could be reinvested into the social wealth fund to make it sustainable in the long-term and to pursue TRANSFORM’s mission to reshape the economy beyond the initial capitalisation phase

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Introduction: taking stock of the German economy¹

For the better part of two decades, German elites have prided themselves on the success story of the German economy. Indeed, its ascent has been impressive, at least when measured in terms of trade surplus, which has surged from just €59.1 billion in 2000 to €248.9 billion in 2016 (Destatis 2021). The export-focus of the German economy, subsidised by an underperforming currency kept low by economic disparities in the Euro area, has also ensured healthy tax revenues as well as low unemployment rates.

Hidden costs: low wages, stagnant productivity

But this success story has not come without significant costs. After the neoliberal labour market and welfare reforms of the mid-2000s, Germany saw a rapid rise in low-wage employment. Wages were depressed to such an extent that – purchasing power adjusted – real hourly wages for the bottom 40% of income earners had not recovered to 1995 levels by 2018 (Fedorets et al. 2020). More than two decades of economic development has, for millions of workers, led to little more than sinking hourly wages and stagnating incomes: While German GDP and exports were reaching ever new heights, the share of national income going to labour fell from 70.91% to just 63.6% in the course of half a decade (Bundestag 2018), while the share of low-wage employment grew from around 17% in 1995 to 23.7% in 2015 (Fedorets et al. 2020).

This wage suppression has allowed German companies to stay profitable and internationally competitive despite long-term trends of decreasing investment and sluggish productivity growth. However, the ability for many businesses to rely on low wages as a substitute for innovation and

¹ I would like to thank Will Stronge, Julian Siravo and Christoph Schneider for their feedback on an early draft of this paper, the PACT Zollverein in Essen for inviting us for a research residence on “transforming innovation” in autumn 2021, and Jack Kellam for his editorial work.

investment has created immense disparities between companies “specialised” in business models based on low investment and low wages (called “Laggards” in the research literature) and a smaller group of much more productive and better-paying companies (dubbed “Frontiers”). As a result, the productivity of Frontiers has been estimated as two and a half times that of their competitors in manufacturing, and five to seven times those in the service sector (Schiersch 2019: 18). The key factor distinguishing Frontiers from their competitors, whether large or small, is their capital-intensity (Schiersch 2019: 19f.), illustrative of the key role played by investment in increasing productivity.²

Overall, however, investment (measured as the share of GDP committed to gross capital formation) has been weak in recent decades:

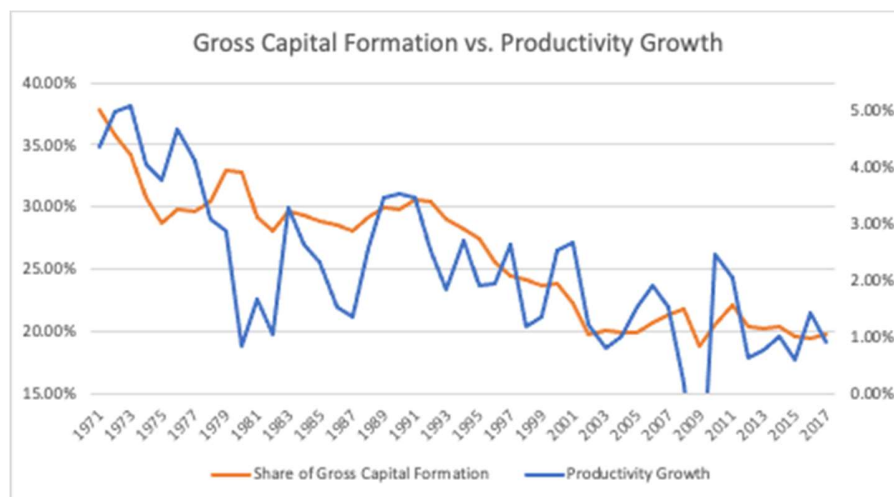


Figure 1: Gross Capital Formation vs. Productivity Growth Germany, 1971 to 2017 Source: Feenstra et al. 2015 and OECD 2019.³

German export success in recent decades coincided with a stabilisation – but no marked increase – in capital formation investment, oscillating at around 20% of GDP, after a marked decline from almost 38% of GDP in the early 1970s. At the same time, annual productivity growth fell from around 5% to just 1% today: an historic low facilitated by unusually weak wage pressure.

² This diagnosis corroborates similar analyses that have been put forward for the UK by the Chief Economist of the Bank of England (Haldane (2017)) and by the OECD on an international level (Andrews et al. (2016)).

³ In 2009, the German economy saw an isolated case of a drop in hourly productivity (-2.56%). This seemed to be a one-off effect of the financial crisis and is not displayed in the graph in order not to skew the representation of the rest of the data.

The costs of depressed wages have been principally borne by individual workers and their families, who have had to suffer material deprivation and/or overwork as they struggle to make ends meet at poor hourly wages. But this also comes at a cost to the state: between 2007 and 2018, €117 billion was paid in social security support to families with at least one member in employment, effectively subsidising poverty wages. The public costs of the low-wage sector do not end there, as low-wages have also contributed to low pension entitlements, condemning workers to spend their later years in poverty and the state to prop up their pensions. In addition, the state itself loses out on a significant amount of social security contributions and income taxes: up to €47.9 billion in 2021 according to the German Trade Union Confederation (DGB 2021).⁴

But it is not just workers and the state who have borne the costs of the internal devaluation laying behind the German economy's 'success story': the environment and growing ecological crisis has suffered too. In line with its heavy export focus, the German economy relies on a strong manufacturing sector – 20% of GDP in value added, compared to 11.2% in the US and 9% in the UK (World Bank 2021c). Manufacturing is characterised by high energy and resource use, and Germany has been slow to phase out energy production from coal (44% of all its electricity production in 2015, compared to 34% in the US and 23% in the UK (World Bank 2021b). Despite a fall in per capita emissions across recent decades, Germany's emissions levels are still unsustainably high, with 8.56 tons of CO₂ emitted per capita in 2018 (World Bank 2021a) and the economy greening at nowhere near the speed needed to enable future generations to live a sustainable and decent life.

⁴ This estimate likely is a rather conservative estimate as possible increases in consumption based taxes such as VAT on the €41.6 billion potential additional purchasing power of employees are not included.

Reversing the trend: a Green New Deal to TRANSFORM the German economy

Germany's recent economic 'success', therefore, has taken place not only on the back of millions of low-paid workers and the state, but also at the cost of a rapidly worsening climate crisis. The status quo is simply not sustainable: neither for workers on poverty wages, nor for the environment. As a route to remedying the multiple crises underlying false pretences of economic success, we outline how a German New Deal, with a new public investment agency – TRANSFORM – at its heart, could play a critical role in:

- 1) Accelerating investment in (green) innovation to boost productivity and meet the demands of the climate crisis.
- 2) Democratising the German economy, empowering a public voice in investment decisions.
- 3) Funding a universal basic dividend.

The challenges of the twenty-first century are significant. Boosting public investment through a democratically controlled agency such as TRANSFORM will not be alone sufficient to ensure they are overcome. Alongside targeted investment, we will need to draw upon ambitious regulatory interventions to boost wages (e.g. by increasing coverage from collective bargaining agreements or raising the minimum wage) and to green the economy (e.g. through carbon taxation and a ban on internal combustion engines coal-fired power generation). However, funding the innovation necessary to uplift productivity, deepen democracy, and offer a basic economic floor to all German residents will be an essential, necessary step on the journey.

TRANSFORM: public investment for economic renewal

To help the German economy meet the challenges of the twenty-first century, and overcome a number of its chronic flaws, we outline TRANSFORM: a public investment agency, charged with a budget of nearly €1 trillion, subject to democratic governance, and directed towards aims of social and ecological sustainability. Alongside financing the transformation necessary for a productive, green economy, TRANSFORM would also grow a social wealth fund to generate a universal basic dividend, providing an income floor for all German residents.

The establishment of such an agency would be a clear signal that after decades of deregulation and hand-wringing by climate diplomats and activists lobbying the private sector to change, a new economic common sense needs to be asserted: too many businesses have proven unable or unwilling to provide decent working conditions to their workers, and too hesitant to green their businesses, putting our collective future in jeopardy. The public sector therefore needs to take a leading role in shaping urgent, necessary economic transformation through mission-oriented public investment (Mazzucato & Penna 2015; Roberts et al. 2017; C. Frey 2019; Stronge & Harper 2019; Mazzucato 2021a).

In recent years, public investment and innovation funds have been proposed by a number of actors both on a national (WBGU 2018; IG Metall 2020; Dullien et al. 2021) and European level (Boot et al. 2020; Widuto & Jourde 2021) to help economies weather the challenges of climate change and technological transformation. This renewed focus on direct public investment makes economic sense: a decade of unprecedented low interest rates and extraordinary measures by central banks such as quantitative easing have failed to translate into higher investment rates. On the contrary, capital formation has remained depressed while speculative assets have ballooned. More targeted measures such as tax breaks for R&D-expenses or more generous write-off stipulations similarly have failed to increase investment across the board and led to windfall effects for frontier-companies (Berry et al. 2021). Against this backdrop, the potential of direct public investment is reinforced as the *most direct* lever to direct funds to green the economy and increase productivity.

The current attempt to drive up productivity and growth rates through providing a ‘favourable’ economic environment – and hoping that businesses *themselves* will create decent employment, relieving social security systems, generating greater tax revenue and also choose to invest in the

green transition – is not only inefficient, it also condemns the public to the role of a perpetual donor of subsidies with no clear return.

All in all, the effectiveness of “indirect value capture” – the belief that tax-breaks and public money for businesses will eventually lead to public good – is highly doubtful (McCann 2020). *Direct* public investment therefore offers a way forward by bringing investment decisions back into the public interest directly. Not only will this substantially increase the effectiveness of public spending, it also offers an opportunity to break with the role of the state as a ‘cash cow’ for private business. Rather than spending money with no clear return in sight, public investment should instead lead to public equity.

At the same time, a massive expansion of public funding for the private sector in exchange for public equity ought to be welcomed by businesses. As a source of cheap investment – unlike bank credit – it would not need to be repaid anytime soon. Instead, like capital stock, in exchange for a dilution of dividend payments to existing shareholders, disregarding the distribution of profits, it could be considered “free” money. This is particularly true for small and medium sized enterprises (SMEs) – the majority of “Laggards” in the German economy – which frequently find it difficult to access capital for new investment, perpetuating their subordinate position (Dienes et al. 2019: 9; Boot et al. 2020; OECD 2020).

Pricing the future: how much would TRANSFORM mobilise?

How much public investment could be mobilised by such a public investment agency? In 2019, a report from leading economists at the German Economic Institute (IW), funded by the Confederation of German Employers' Associations, and of the Macroeconomic Policy Institute (IMK) of the trade-union backed Hans-Böckler-Foundation estimated the amount of public spending needed to restore Germany's ailing public infrastructure, to modernise logistical and digital infrastructure, and expand education required for a green transition. Their final figure was roughly 457€ billion over the course of a decade – or around 45€ billion per year, equal to 1.3% of GDP (Bardt et al. 2019).

While the report represented a major break from the IW's long-standing scepticism of state intervention, it still falls short as a plausible account of the form and size of body needed for modern, transformative public investment: there is no mention of public equity formation or redistribution, the state continues to be seen largely as a funder of private business, and the budget is quite meagre — especially if viewed from an historical perspective.

Roosevelt's 'New Deal', for instance, amounted to around 40% of national GDP (Dupor 2021). By this standard, the 457€ billion euro projected by the IW/IMK appears quite moderate, amounting to only 13.2% of Germany's BIP in 2019 (Destatis 2022). **Using the historic New Deal as a basis, a sufficiently ambitious public investment program for Germany might be estimated at €1,393 billion.**⁵ Provided that €457 billion is set aside for investment into public infrastructure and education and old-fashioned subsidy schemes, this would leave €936 billion to be used for public investment by TRANSFORM to unleash a decade of historic, if not unprecedented, public investment.

Albeit far-reaching, a demand for an additional 4% of annual public spending over the course of a decade seems feasible not just in historical perspective, but also when compared to public spending internationally (cf. BMF (2020a)): German public spending is much lower (at 45.2% of GDP in 2019) than other developed economies such as Sweden (49.4%) or Denmark (49.2%), not to mention Belgium (52.1%), Finland (53.3%) or France (55.6%). It seems moderate, too, in

⁵ This rough estimate also matches the demand by critical economists for a much larger public investment program of 120 billion euro a year fairly closely, cf. Memorandum Gruppe (2021).

comparison to the amount of money spent on the last great transformation for the German economy, the reunification of Germany. Estimates vary between 1,500 and 2,000 billion euro spent between 1990 and 2010 – nearly equivalent to Germany’s GDP in the year 2000 (cf. Greive (2014)).

What could a €1,393 billion New Deal for Germany deliver in its first decade?

A more-than-trillion euro programme of public investment could provide the means to...

Roll out 5G and broadband nationally

€20bn (€2bn annually)

To provide widespread access to broadband-internet and comprehensive coverage of 5G, €20bn in total investment would be required in the next decade (cf. Bardt et al. 2019).

Provide a home for all

€50bn (€5bn annually)

Germany lacks decent and affordable housing. Providing an additional €5bn in public subsidies annually would help add 100,000 additional units per annum (cf. Günther 2022).

Modernise short and long distance public transport

€80bn (€8bn annually)

The long-distance train network of Germany alone is in need of an additional 60bn in public funding to make it ready for the first 21st century. But short-distance public transport is also in dire need of additional funding (cf. Bardt et al. 2019)

Upgrade education, from early years to lifelong learning

€109bn (€11bn annually)

Preparing workers for the workplaces of the future and enhancing the public sector's capacities for research should be a key focus of public investment in the upcoming years (cf. Bardt et al. 2019).

Boost productivity

€350bn (€35bn annually)

By providing public funds to invest into both classical automation technologies such as robotics as well as software automation and into optimised work processes and new business models, substantial productivity increases might be realised. As is, even optimistic “Industry 4.0” scenarios assume that private companies will only invest an additional of €10bn annually into new technologies over the coming decades (cf. Wolter et al. 2016). Providing more than €30bn in public investment annually would allow German companies to radically accelerate productivity growth.

Decarbonise the economy

€500bn (€50bn annually)

The total costs of decarbonising the German economy are estimated to amount to up to €500bn in the upcoming decade (cf. Bardt et al. 2019). 38bn euro alone would be needed to add a total of 27GW of sustainable energy capacity annually (17GW Solar, 7GW onshore-wind, 3GW offshore-wind).

Additional investment is needed for the greening of Germany's industrial manufacturing, e.g. by providing funding to electrify energy-intensive production based on sustainable energy (e.g. through electric arc furnaces) or to convert them to the use of green hydrogen (cf. Kobiela et al. 2020).

Financing the future: funding TRANSFORM

But how could TRANSFORM's expansive programme of public investment be funded?

Cutting harmful subsidies

A first step could be to divert public spending currently funding environmentally destructive activities, such as subsidies shielding Germany's energy intensive industrial manufacturing sector (most prominently the car industry), or the current practice of providing air travel tax free. In 2018 alone, researchers found that these amounted to €65.4 billion (Burger & Bretschneider 2021). Reducing these subsidies to increase public investment would be in line with the demand of Germany's Federal Environment Agency, which – supported by members of the scientific community and representatives of the Credit Institute for Reconstruction (Germany's public investment and development bank) – has argued precisely for a cut to this kind of subsidies and for new eco-taxes to be leveraged to fund a green innovation funds (Gibis et al. 2020).

In 2018, Germany also spent nearly €10 billion subsidising poverty wages (RND 2019), with depressed wage levels also costing the state €47.9 billion in 2021 in lost social security contributions and income taxes (DGB 2021). Taken together, subsidies and foregone taxes alone amount to more than €120 billion annually. Investing in an economy that provides affordable, sustainable energy and decent jobs to all, rather than subsidising poverty wages and fossil fuel consumption, would help the public leverage significant saving potentials.

Clamping down on tax evasion

Clamping down on tax evasion could also provide a significant source of additional income. In 2015, the German state collected €125 billion less in taxes than it was owed (Murphy 2019). Although the extensive burden of tax evasion on public finances is known, German tax authorities continue to be understaffed (ver.di 2017).

Redistributive reform of the tax system

This poor tax discipline persists despite a number of major recent tax breaks for the wealthy. The 2000s were not only characterised by labour market deregulation and social security cuts – they also saw a drop of the top tax rate from 53% in 1999 to 42% in 2005 (it now stands at 45%). At the same time, a flat tax on private capital income of 25% was introduced. According to Achim Truger (2013), one of Germany's premiere economists, the costs of these tax reforms alone amount to around €45 billion annually.

Accordingly, the potential to grow Germany's tax yield is significant. This is particularly true with regards to the wealthy – Germany has taxes below the Europe-wide average for corporate incomes (only 5.2% of German tax revenue derives from corporate income taxes, against an average of 9.6% across OECD countries) and taxes on property (2.9 vs. 5.5% of tax revenue) (OECD 2021). From a macroeconomic perspective, the scope to raise substantial additional tax revenue, given adequate political will, through increases in levies on corporate incomes and property to the OECD-average thus exists.

This assessment is corroborated by a number of actors: while the trade union think tank IMK provides a conservative estimate of €73 to €78 billion that might be raised through a revision of the

tax systems (Horn et al. 2017), the Netzwerk Steuergerechtigkeit (Network for Tax Justice) suggests that a large-scale overhaul of the tax system would close a “justice gap” of 75 to 100 billion euro annually (Trautvetter & Schwarz 2021).

One-off wealth tax

Case study: The *Lastenausgleich*

Additional wealth taxation provided the impetus behind one of the most ambitious and successful economic policies in Germany’s contemporary history: the *Lastenausgleich*. The *Lastenausgleichsgesetz* (“equalization of burdens act”) was introduced in Western Germany in 1952 to raise funds to rebuild a country devastated by the consequences of the Second World War. Funds were needed, among other things, to support refugees, rebuild businesses and (social) housing and to expand education (Albers et al. 2020). The *Lastenausgleich* resulted from extensive political debate on how to shoulder the hardships of reconstruction. It was agreed – save for a small amount of protected assets – to tax all wealth at 50%.

In total, 60% of then-GDP was raised through wealth taxation and put towards reconstruction efforts (Bach 2020). Rather than paying the whole levy in one installation, amortization payments were paid over several decades – in effect, transforming a one-time property levy into an ongoing form of wealth taxation, ensuring payments were sustainable (Albers et al. 2020).

The *Lastenausgleich* is considered one of the major success stories of the Federal Republic, helping to integrate millions of refugees and displaced persons, reduce social inequality and kickstart the German economy (Albers et al. 2020; Bach 2020).

The modern German economy is significantly more wealthy than the shell that emerged from the Second World War, as are individual citizens, particularly at the top. Even if – in designing a new one-off wealth tax – we ensured a generous ‘allowance’ of €1 million per person to be exempt from taxation, the amount of ‘taxable wealth’ owned by the rich in excess of this would still total €3.19 billion (Bach 2020: 52). A new wealth levy of 25% on this could therefore raise nearly €800 billion, and would only burden a small fraction of the population who own assets in excess of €1 million (around 1.5 million individuals, or 2.3% of the population). It would also not be exceptionally harsh,

as that levy would only compensate for the quarter of a century lost in wealth taxation at a going rate of 1% that has been lost due to inaction by the government.⁶ Spread out over a decade, such a levy would amount to a temporary annual wealth taxation of 2.5% – however, considering that only parts of the funding for TRANSFORM might need to be raised through a one-time wealth levy, even more restrained approaches might suffice too:

As calculations by the German Institute for Economic Research (DIW) have shown, implementing even only a one-time wealth levy with a progressive taxation starting at as little as 10% on wealth in excess of €2 million and going up to 30% on wealth in excess of €30 million per person could generate €471 billion in tax revenue – and it would only affect the extremely small strata of German multimillionaires (0.6% of the population).⁷ Such a levy would raise substantial funds for public investment with the vast majority of the population profiting from improved public services and the transformation towards a sustainable economy while keeping the burden even on the net contributors minimal.⁸

In a similar vein, reforming inheritance tax might contribute substantially to the funding of TRANSFORM. The DIW, for instance, estimates that around €397 billion are gifted and inherited annually in Germany (Tiefensee & Grabka 2017). At the same time, inheritance and gift taxes generated as little as €11.1 billion in revenue – an effective tax rate of under 3%. Although this in part due to allowances for small inheritances,⁹ the German tax system heavily favours heirs of capital assets, one of the most unequally distributed assets forms. While inheritances and gifts of €0.5 to €2.5 million are taxed by an average of 11.4%, the tax rate drops to below 1% for gifts above €20 million (Trautvetter & Schwarz 2021: 16). From 2011 to 2014, for instance, as few as 1,256

⁶ The existing wealth taxation in Germany was suspended in 1997 because its design privileged real estate owners whose assets were continued to be priced at their 1964 value for taxation purposes, whereas other assets (e.g. stocks) were priced at their market price. Rather than fixing this obviously discriminatory practice, the government has refused to remediate it, in effect disabling the wealth tax permanently in contempt of the constitution which stipulates wealth taxation, cf. Ötsch and Troost (2020).

⁷ For a detailed discussion on how a one time wealth levy might be implemented, also see Bach (2020).

⁸ Take for instance a childless couple owning assets worth five million euro total. At an allowance of €2 million per person, only €1 million would be taxed under such a scheme. At a tax rate of 10% due to be paid over the course of a decade, this would amount to €10,000 annually – surely an amount that can easily be covered by the cash flow generated by investing parts of these assets (invested at a net profit rate of 4% after accounting for income taxes and inflation, their estate should allow them to generate a capital income of €200,000 annually).

⁹ Children for instance may inherit €400,000 per person tax free and even acquaintances qualify for €20,000 in inheritance tax allowance.

individuals inherited a total of €122.5 billion in company shares tax-free. In total, 93% of company inheritances and gifts of above €20 million were tax-free (Bach & Mertz 2016).

To help even out the burden of an increase in inheritance tax, just as with the *Lastenausgleich*, increases might be delayed and paid over the course of a decade or two (Bach 2020). Alternatively, new inheritance and gift taxes might be leveraged to build up public equity in companies – this would in no way affect the capital stock of these companies, and thus shield employment, but would ensure public participation in future dividends at the cost of diluted shares of existing shareholders (Horn et al. 2017; Bach 2020; Memorandum Gruppe 2020). Ending the privileged status and leveraging a tax of 30% on inheritances in excess of €20 million and more could generate more than €9 billion in additional annual tax revenue (Bach & Mertz 2016) – relatively speaking a rather small amount of tax revenue, yet when put into perspective to the extremely small (and privileged) group of people affected by it (only 314 individuals per year) not insignificant.¹⁰

Of course, additional taxation vectors also exist – the DIW for instance estimated that a financial transaction tax might raise €18 to €44 billion annually (Schäfer 2015)¹¹ – but focusing on wealth taxation offers the chance to tackle wealth disparities directly and enjoys broad public support (BMAS 2021). It thus appears to be an adequate policy response to decades of depressed wages and surging wealth at the top (Albers et al. 2020; Ötsch & Troost 2020; Schröder et al. 2020). And it seems normatively sound to let those contribute most to the costs of the transformation of our economy, who have been pocketing the profits generated by it at great cost to the public and the environment. A reform of wealth taxation nonetheless should not lead to neglect of other progressive reforms of the taxation system, such as the abolition of the flat tax on capital income and increasing the historically low levels of taxation on company profits.

¹⁰ These estimates largely do not account for adoptive behaviour by those taxed. Clearly, there is a risk that some of the rich might try to hide their wealth or transfer it to tax havens. A one-time wealth levy has a clear advantage in this respect: it can be based on a date in the past, mitigating most of the risks of tax evasion (cf. Bach (2020); Ötsch and Troost (2020)). Yet, by implementing the simple principle that any assets that were left undeclared to the state might be seized by it, by hiring sufficient tax investigators and by strengthening international cooperation against tax evasion, the risks inherent to wealth taxation too might be mitigated to a degree. In any case, the alternative seems even less desirable: the public ought not sink so low to allow itself to be degraded to begging offenders to pay their due share – and given the historic level of tax evasion despite massively eroded taxation levels (see above), endearing oneself by lowering taxation pressure in the hopes that the rich might be appeased has failed too.

¹¹ A transaction tax would also have the benefit that it would make speculation less attractive, potentially redirecting some capital into more socially useful forms of investment.

Public borrowing

Alongside reforms to taxation, there is also substantial scope for additional borrowing in Germany: in 2019, its debt-to-GDP ratio stood at 59.5% compared to a European average of 85.9%. Germany could afford to take up an additional quarter of its GDP in debt and would still be below the average of the euro area, while mobilising €868 billion in funding for additional public investment (BMF 2020b). Financing part of TRANSFORM's activity through public debt could help avoid escalation of the distributive conflicts entailed by increased taxation. At the same time, since the strong economic stimulus provided by hundreds of billion euro public investment would likely induce a rapid expansion of GDP (cf. Horn et al. 2014), the debt-to-GDP ratio might be kept stable even when taking on moderate additional debt.

There are not only pragmatic reasons to finance part of investment in a better future through public borrowing. Since one of the key objectives of increased public investment is securing a sustainable future for future generations, it seems justifiable to involve them in bearing the costs of building their collective inheritance. Ultimately, they will be key beneficiaries of bold economic policy today, inheriting a less devastated planet and the opportunity to grow up supported by stronger public infrastructure and better job prospects. In any case, the cost of *not* investing would cost future generations even more dearly than a slightly increased debt-to-GDP ratio. Finally, they would also share in the public equity generated through TRANSFORM's investment activities, offering an evident economic benefit to increasing debt today, in distinction to many contemporary public spending programs who subsidise the continuation of a deeply unsustainable way of living and whose positive effects are largely limited to the here and now.¹² As a result, economists have frequently argued for public investment funds to be financed by public debt, in addition to wealth taxation (Corneo 2017; DiEM25 2017; Horn et al. 2017; McCann et al. 2018; Roberts & Lawrence 2018; Lawrence et al. 2020).

¹² Similarly, the chance to use the largest spending programs of the past two decades – the bail-outs of countless companies during the world financial crisis and the recent pandemic, followed by the energy crisis caused by the Russian war against Ukraine and decades of failure in transforming our energy systems – to enable public capital formation has been ruthlessly neglected by ruling politics, despite critique of academics as well as trade unionists, cf. IG Metall (2009); Hickel (2020); Lawrence et al. (2020); Lonergan and Blyth (2020); Memorandum Gruppe (2020); Phillips and Rozworski (2020).

Not all of TRANSFORM’s budget could reasonably be refinanced through public debt and nor should it – after decades of stagnating wages, an eroding labour share of national income and surging wealth of the rich (Bundestag 2018; Schröder et al. 2020), large parts of additional public investment can and should be financed through wealth taxation and a wealth levy and the suspension of socially and environmentally harmful subsidies. This would contribute to intra- as well as inter-generational justice (McCann et al. 2018). Even utilising only a third of the total public saving, taxation and debt potential indicated above would suffice to comfortably fund additional public investment of around €140 billion annually – and these estimates do not even account that economic rescue programs might similarly be remodelled to form part of TRANSFORM-investment, mobilising this public spending for a strategy of social wealth building (IG Metall 2009; Chapman 2020; Guinan & O’Neill 2020; Memorandum Gruppe 2020).

Funding scenario: “wealth levy plus”

Source	Potential (€bn)	Our suggestion (€bn)
Redistributive reform of the tax system	75	60
Wealth levy	47	45
Cut harmful subsidies	120	20
Public borrowing	86	15
Clamp down tax evasion	125	0
Financial transaction tax	44	0
Total	497	140

Figure 2: Funding scenario “wealth levy plus”

This funding ‘scenario’ focuses heavily on leveraging wealth taxation - both in the form of a continuous wealth tax as well as through a one-time levy - to counteract some of the extreme wealth

inequalities that have grown in recent decades. Combined with a modest amount of additional borrowing and by exploiting only a small share of the saving potential that exists in the form of environmentally harmful and socially regressive subsidies, this increased mobilisation of private wealth for public investment would suffice to finance a rapid transformation of the German economy. Additional savings from subsidies and funds from a financial transaction tax might serve as a strategic reserve, should the tax revenue from wealth taxation underperform, for instance due to increased tax avoidance. At the same time, increased tax avoidance would reinforce the importance of a bold crackdown on tax evasion, which already now might raise substantial tax revenue.

The question is not whether there is enough money in the economy to fund ambitious economic policy or whether the tools exist to leverage it – the real question is whether a sufficient political momentum can be developed to match past ambitions of public investment programs. Or whether, despite an increasing dysfunctionality of our energy systems and labour markets and a rapidly exacerbating climate crisis, politics will remain restrained to an auto-destructive tinkering around the edges.

Boosting productivity, embedding democracy

Having established the need for a public investment agency, capable of mobilising nearly €1 trillion to enact the upgrade in productivity, and green transformation that the German economy desperately requires, this section offers more detail on the democratic structure necessary for an effective body, and suggests a number of core principles to guide TRANSFORM's decision-making.

A democratic transformation

TRANSFORM should be constituted as a public agency. Much like the national Credit Institute for Reconstruction (KfW), its core aim would be directing public funds for investment in the private sector. The establishment of a new public agency provides a number of advantages:

- **Offers institutional recognition:** The establishment of a new public body would make the transformation of the economy institutionally recognisable.
- **Disrupts the status quo:** It would mitigate the risk that existing structures (e.g. in personal as well as administrative processes) lead to obstructive path dependencies (Wolf 2021).
- **Bypasses balanced budget provisions:** It would help bypass the state's balanced budget provisions (Dullien et al. 2021).
- **Embeds democracy:** Rather than upgrading an existing institution such as the KfW, the statutes of a new public agency and its foundation might be democratically negotiated.

This final advantage is particularly important: although a number of public investment vehicles exist today, their management boards are not democratically elected. Democratic control over these institutions is, at best, minimal and heavily mediated. The KfW, for instance, is supervised by the Federal Ministry of Finance, currently controlled by the fiscally conservative FDP, who have a very small electoral mandate.

In contrast, the particular structures and principles of TRANSFORM could and should be widely debated in public, and implemented through a process of popular consultation. Its key principles,

for instance, could be set by an elected constituent assembly, and TRANSFORM's administrative board could either be nominated by parliament (rather than the executive) or elected directly. Placing TRANSFORM, in this way, under democratic governance and decoupling it from the executive would allow it to extend its horizons to long-term economic policy – particularly significant with regards to pursuing green investment – rather than remaining subject to the short-term whims of in- and outgoing administrations. Even more importantly, it would wrest public investment from the hands of technocratic management and open its design up to the public, introducing an additional degree of accountability and transparency into the process (Roberts & Lawrence 2018).

This could form a significant step in making (long term) economic policy a more central concern of public debate and encourage new social actors and stakeholders to engage with economic policy and democratic processes in a new way. The elections for the administrative boards of the German social security system institutions are, for instance, heavily dominated by the trade union movement. Elections to determine the composition of TRANSFORM's board, supervising the distribution of hundreds of billion of euros, might not only mobilise political parties and trade unions, but a wide range of civil society actors, such as environmental groups who may look to exert greater influence in the future development of the German economy (cf. Lawrence 2019).

Basic principles

What might a democratically-mandated public investment agency prioritise as its basic principles? While this would, of course, rest with the outcomes of the democratic processes to design and govern TRANSFORM, we outline a range of potential core aims to help empower public investment to raise productivity, embed democracy and kickstart a green transition.

1. Boost productivity

The German economy suffers from large disparities in productivity, leading to a concentration of decent work conditions and profits within a relatively small number of “Frontier” businesses. To support high wages throughout the economy and make it future-fit, additional investment into new

technologies that increase productivity should be supported. This does not mean bankrolling research on some speculative new technologies (Mazzucato 2021b). To the contrary, research funding should mostly be concentrated on freeing established technologies from the existing patent regime hostile to shared productivity and prosperity. Public funding for research on automation technologies should be preconditioned on equity, i.e. intellectual property rights, that can then be leveraged by the public to organise widespread access to state-of-the-art technologies across the economy, helping bridge the existing productivity gap (McCann 2020).

In addition to providing funding to unlock automation technologies from the suffocating embrace of the current patent regime, TRANSFORM might provide extensive funding to businesses interested in introducing new technologies to increase productivity. This funding, likewise, should come in exchange for equity in these companies, enabling them to modernise without having to worry to quickly repay their loans. At the same time, TRANSFORM's equity share would give the public a say in the future of these companies and entitle the public to participate in their profits (see below). Through TRANSFORM, the public would thus become the premiere financier of the next wave of automation in the German economy - and its premiere profiteer.

2. Invest sustainably and responsibly

Public investment priorities can no longer be considered independently of the climate crisis. What would embedding TRANSFORM with a 'green' mindset entail? First, only those companies that can demonstrate business plans complying with sectoral reduction paths matching the Paris Agreement's ambition ought to be eligible for public investment. Second, TRANSFORM should additionally focus on investments which boost the speedy rollout of sustainable energies and emission mitigation measures (Puttfarcken 2021; Jacobson et al. 2022).

As a result, TRANSFORM would be unable to invest in any fossil fuel infrastructure. At the same time, 'exclusion' criteria could be set even more broadly. The Norwegian Pension Fund, one of the largest social wealth funds in the world, does not, for instance, invest in tobacco companies or companies whose primary business model is built around certain types of weapons or coal extraction and burning. It also does not invest into companies who contribute to severe environmental damage, gross corruption, other particularly serious violations of fundamental ethical norms and/or

human rights violations (Norges Bank Investment Management 2020). TRANSFORM may choose to go beyond this, banning investment in all kinds of arms production, as well as restricting investment into industries such as gambling, alcohol and other drugs, advertisement, nuclear, and so on.

Finally, special funding might be earmarked to support all-out conversions of harmful industries, by redirecting the productive potentials of arms manufacturers towards socially useful production, such as that proposed by workers at the UK's LUCAS factories in the 1980s (Smith 2014; Cooley 2016).

3. Embed democracy

By attaching further investment conditions, TRANSFORM could look to deepen democratic structures within the German economy by ensuring businesses implement legally binding collective bargaining agreements to give their workers a voice in how new workplace technologies are implemented, as well as guarantee job security and additional training (Haipeter 2020). It could also actively intervene at the company level by claiming seats on the supervisory board of companies – and by establishing supervisory boards where they do not exist yet (Molitor 2022).¹³ Organisations represented on TRANSFORM's board and their allies would, as a result, likely find a greater voice in businesses across Germany – and even if the composition of TRANSFORM's administrative board was instead determined indirectly through delegation by parliament, it is likely that political parties would look to acknowledge their political allies, for instance by nominating members of environmental pressure groups or the trade unions.

Not only would this help shift economic policy into a subject of wider public deliberation, such a democratisation of supervisory boards would also imply significant material redistribution, as illustrated by an established practice of the German trade union movement: it is customary (and enforced) that employee representatives on such boards donate most of their substantial

¹³ Corporate governance in Germany generally features a two-tier board system with corporations having a management board and a separate supervisory board who monitors and advises the management board. Its establishment is mandatory under the Companies Act for companies with 500 and more employees. Supervisory boards can be established in companies of any size on a voluntary basis however – and they are even stipulated for cooperatives of all sizes. Far-reaching management decisions can require the consent of the supervisory board and the supervisory board appoints the members of the management board and can withdraw appointments, cf. Gieseke and Sick (2022).

remuneration to the trade unions' Hans-Böckler-Foundation. In effect, parts of the money paid to board members in German corporations thus ends up funding critical research and lobbying efforts, with the foundation raising two thirds of its total funds of €72.7 million (nearly €50 million annually) through donations from these supervisory board mandates (see HBS (2020)). Democratising access to the supervisory boards further could thus also levy funds for environmental pressure groups and other parts of civil society.

If it wished, TRANSFORM could go even further and follow trade unions (cf. DGB 2022) in demanding the 'gold standard' of full parity of worker representatives in supervisory boards – as it has already established in Germany's coal, iron and steel industries (IMU 2020) – thereby turning TRANSFORM-supported companies into trailblazers of a more democratic economy.¹⁴ Not only would this deepen democratic participation in the economy, it would also improve economic performance, given that economic codetermination in the boardroom have been demonstrated to lead to additional investment and higher productivity, higher long-term profitability, less risky economic strategies and thus higher resilience in economic crises and increased trust and loyalty towards their companies of the staff (Mueller & Stegmaier 2017; Jirjahn & Smith 2018; Redeker 2019; Rapp et al. 2019; Campagna et al. 2020; Jäger et al. 2021).

This shouldn't be surprising: workers have a material interest in additional investment at their workplace, as it reduces the risk of relocation and increases job security. At the same time, increased productivity makes higher wages more feasible. Since their interest is long-term job security, they have little interest in economic strategies that optimise short-term shareholder profits but jeopardise the long-term sustainability of their corporation. And it is much easier to achieve a deeper mandate for the corporate policy of the top echelon of your organisation if it is co-determined by you.

Finally, TRANSFORM could also consider earmarking funding for more radical forms of democratic enterprises – such as cooperatives or the take-over of existing companies by their

¹⁴ Employees get to elect 1/3 of the supervisory board's members in corporations with between 500 and 2,000 employees. In larger corporations, they get to determine half the members of the supervisory board as well as the vice-chair of the board. The Chair of the board is elected by the shareholders however and their vote functions as tie-breaker in case no agreement can be reached. In the coal, steel and iron industries, this advantage of the shareholder representatives has been abandoned in the interest of a real parity of employee and shareholder representatives in the supervisory boards. As TRANSFORM's managing board would be democratically elected, the representatives of TRANSFORM's (i.e. the public's) shares in the company might conceivably serve as a tie-breaker in the interest of workers in cases where public interest and the interests of the corporations' workers converge, empowering the voice of workers and the public in the economic transformation.

employees – as an additional route to strengthen democratic participation in the economic sphere (Barrott et al. 2017; DiEM25 2017; Lawrence et al. 2019).

4. Support working time reduction

As well as democratic instruments, investment from TRANSFORM could also be made conditional on specific improvements in working conditions within companies. Not only would recipients be required to pay decent wages set through a collective bargaining agreement – implementing strategies to reduce the working time of their workers on the path towards a four day week could also be a central condition.

Specific additional funding might be offered to companies, in the form of a ‘Shorter Working Time Subsidy’ (Frey et al. 2020) to support the transition to a four-day working week. This would help ensure that increasing productivity generated by TRANSFORM investment is not exclusively channelled into increased output and increased consumption for workers and instead reinforce a development model that reconciles accelerated technological progress and economic moderation.

In this way, TRANSFORM could ensure that its funding not only contributes to democratising the economy but also supports companies leading the way towards a more just and sustainable future of work. This ‘pioneer’ function could be underwritten by a dedicated employer certification to indicate that a product was manufactured (or service provided) by a company paying decent wages, offering a four-day work week, working sustainably and to a large extent being governed by the public and its workers (Stronge & Harper 2019).

5. Diversify investment

While much of TRANSFORM’s strategy will be grounded in direct investment in exchange for public equity, there are also a wider range of funding instruments it could explore in order to support specific economic and political objectives.

In the first instance, existing research funding might be redirected to refine and liberate not just automation technologies but all kinds of production techniques by moving them beyond a patent

regime impeding innovation potential within the economy (Andrews et al. 2016; Tyfield et al. 2017; McCann 2020; Akcigit & Ates 2021; Mazzucato 2021b). TRANSFORM, in addition, should receive the Intellectual Property generated through the research it commissioned (see above) and could use it to promote innovation across other TRANSFORM-supported companies. Licensing fees might also be waived for non-profits and paid in equity by companies, reducing economic pressure from businesses while making sure the fruits of technological progress will be widely shared (McCann 2020). Existing research and development funding by the state could in this way also be appropriated in the interest of the general public, rather than often constituting little more than a stealth subsidy for shareholders.

TRANSFORM might also promote regional start-up incubators and SME accelerators. Not only do many start-ups and SMEs struggle to attract capital, many also lack in-house capacities to manage rapid socio-technical transformations within their own companies. Supporting business operations through the provision of business spaces, digital services (such as support in accounting and webhosting), training, networking and consulting – all in turn paid in the form of equity – could help smaller companies cope with the stress a changed regulatory environment and the increasingly complex business environment of the near future would put them under. TRANSFORM could thus in a part serve as a democratised venture capital fund and long-term angel investor for large parts of today’s “Laggards” (Hind 2019).

Lastly, TRANSFORM could help shape the market to prioritise products manufactured in a sustainable way. A key instrument in this could be price guarantees committing the public to cover the (transitional) price differentials of sustainably produced commodities compared to their conventionally produced competition (Mazzucato 2021b). This would provide companies with the necessary security for large investments with otherwise risky amortisation over a long period of time. Even industry associations have by now taken up demanding “Carbon Contracts for Difference” (VCI 2022): supplying these funds through TRANSFORM in exchange for equity would ensure that the public sees a return on its support, not just bearing the costs and risks of innovation, but also enjoying its profits.

Building a basic dividend

As well as directing investment towards socially advantageous outcomes – from boosting productivity, to strengthening democracy and reducing working time – TRANSFORM could provide a further lever to modernise the German economy: taking the public’s return on financial investment, to be added to a social wealth fund that would then pay out a universal basic dividend to all German residents. On the one hand, this would help to develop TRANSFORM’s democratic legitimacy, offering all residents a ‘stake’ in its development through a rising dividend payment. On the other, a dividend scheme could also offer a basis from which to develop the institutions and mechanisms required for a future, more expansive ‘universal basic income’ scheme.

Investment in redistribution

A Universal Basic Dividend (UBD), financed principally through returns from TRANSFORM’s investment, would offer a way to sediment the body’s redistributive quality, aiming to ensure that everyone shares the wealth generated by a more productive and sustainable economy. Establishing a UBD would provide a direct connection between public capital formation and individual income, effectively democratising access to capital income.

Attaching a social wealth fund and UBD to TRANSFORM would also serve an important political purpose: aside from facilitating fairer economic participation, it would add significant public legitimacy and buy-in to the institution, and help cement its place as a long term component of German economic and industrial strategy. Transparency and clear liabilities, democratic governance and a sense of individual ownership are key to ensure that a critical public would continue to observe and control this central economic institution; the establishment of a UBD would make sure that the public maintains a strong material interest in TRANSFORM and its good management.

Similarly, a UBD funded by TRANSFORM could help to generalise some of the comforts wealthy households already enjoy today: a supplementary income from capital, a wealth stock to be passed down generationally and a say in how the economy is run. In an age in which increased concentration of wealth and the consequential unequal distribution of the fruits of technological progress threaten to deepen social polarisation further and further, this appears particularly relevant (DiEM25 2017; Roberts et al. 2017; McCann et al. 2018; Roberts & Lawrence 2018). A UBD

connected to public investment into new technologies would, in contrast, both accelerate technological development and ensure its benefits are widely shared (Roberts et al. 2017).

Delivering the dividend

Who would receive the UBD?

The UBD could be paid annually to **all adult residents in Germany** following the yearly management report from TRANSFORM's board. A focus on residents ensures the inclusion of non-citizens who live and work in Germany and therefore contribute to its economic success, while excluding citizens who have moved their primary residence to tax havens for avoidance purposes (Corneo 2017; McCann et al. 2018).¹⁵

Dividends for under-18s could be held back and paid as a lump sum as they reach adulthood, offering a fund to draw upon at a period often marked by significant life changes – helping with rent deposits or further education, and so on – currently the prerogative of children from wealthier households.¹⁶

How much would the UBD pay out?

Total revenue generated from TRANSFORM's investments could be split evenly between funding dividend payments and allowing for further, sustainable investment.¹⁷ What might this mean in terms of an annual payment to German residents?

To estimate the distributive potential of TRANSFORM's UBD, we have assumed an annual net real return (i.e. after accounting for inflation and management costs) of 4%. This is below the 6%

¹⁵ Recipients of pensions might be included however in order to not restrict people's freedom to spend their retirement age wherever they want after having contributed to Germany's economic success over several decades.

¹⁶ For a discussion of some of the benefits of lump sum payments to young people, see McCann et al. (2018); Roberts & Lawrence (2018).

¹⁷ To prevent the UBD from becoming pro-cyclical however (e.g. increasing as the economy expands but shrinking in times of crisis), payments might be smoothed over a number of years in order to prop up consumption in times of crisis, cf. Corneo (2017); McCann et al. (2018).

sometimes assumed in scientific literature (Corneo 2017) and well below the recent annual net return of the Norwegian Pension Fund of 7.7%. It is also well below the 4.6% annual net return realised by the Norwegian Pension Fund throughout the nearly quarter of a century of its existence (Norges Bank Investment Management 2022). As such, an annual net real return of 4% represents a conservative estimate, frequently used in literature on Social Wealth Funds (McCann et al. 2018; Roberts & Lawrence 2018).

At annual investment of €93.6 billion (€1,393 billion, subtracted the €457 billion required for public infrastructure, spread out over one decade, see Section Two), a slow contraction of the German population in line with the UN's medium population projections (UN 2022) and an equal split of the 4% annual net return between UBD payments and continued reinvestment, we end up with the following estimate of TRANSFORM's first 11 years, represented in Figure 3:

Year	1	2	3	4	5	6	7	8	9	10	11
Total volume of TRANSFORM investment (billion euro)	93.6	189.1	286.5	385.8	487.1	590.4	695.9	803.4	913.0	1,024.9	1,043.2
Share of initial capitalisation	100%	99%	98%	97%	96%	95%	94%	93%	92%	91%	90%
Annual Investment (billion euro)	93.6	95.5	97.4	99.3	101.3	103.3	105.4	107.5	109.7	111.9	20.5
Total annual UBD (billion euro)		1.9	3.8	5.7	7.7	9.7	11.8	13.9	16.1	18.3	20.5
UBD in euro per capita		22,48	45,43	68,88	92,85	117,35	142,40	168,04	194,27	221,12	248,61

Figure 3: Projected potential Universal Basic Dividend fund, first decade

As we can see, due to its gradual capitalisation, TRANSFORM's UBD would develop dynamically in the first decade of operations, surging from just €22 per person to nearly €250.

While an annual payment of €250 euro per person might not sound like much, as a form of additional capital income, it could nevertheless be significant to the poorest individuals struggling to make ends meet, or offer the chance to set some money aside for times of need.

If we move to consider the macroeconomic effects at the aggregate level of the whole German economy, the potential of even a 'small' payment of €250 per person becomes clear. Ultimately, this amounts to an economic stimulus of more than €20 billion annually spent and/or reinvested into the German economy as TRANSFORM matures towards the end of its first decade.

Even a relatively small UBD payment acquires greater significance if accumulated over a longer period of time: the lump sum paid to a child born in the year TRANSFORM is established would amount to more than €3,000 when they turn eighteen. Using half of the annual net return of TRANSFORM to fund further investment also unlocks the power of compound interest yielded by long-term, continued public investment, as illustrated by this long-term projection of TRANSFORM's UBD and investment potential if we look further into its future, fifty years down the line (see Figure 4).

Not only does an inflation-adjusted UBD almost triple within five decades, so does overall capitalisation, compared to an initial value of €936 billion. This illustrates that by channelling half of TRANSFORM's returns into reinvestment, a continuous funding stream can be maintained that helps to grow the UBD sustainably and to keep TRANSFORM relevant for future economic development.

Given TRANSFORM's focus on public wealth formation, one might argue that some of its initial funding sources ought to remain temporary: the one-off wealth levy will expire, money saved from removing socially and environmentally harmful subsidies ought eventually to be redirected to public services, and additional public borrowing cannot be maintained indefinitely. However, other sources, such as revenue from standard wealth, inheritance and gift taxation could continue to fund TRANSFORM indefinitely, given that this would help to maintain a clear connection between the taxation of private wealth and the formation of public wealth.

Year	50	51	52	53	54	55	56	57	58	59
Total volume of TRANSFORM investment (billion euro)	2,225.3	2,268.9	2,313.4	2,358.8	2,405.1	2,452.2	2,500.3	2,549.4	2,599.4	2,650.4
Share of initial capitalisation	42%	41%	40%	40%	39%	38%	37%	37%	36%	35%
Annual Investment (billion euro)	43.7	44.5	45.4	46.3	47.2	48.1	49.0	50.0	51.0	52.0
Total annual UBD (billion euro)	43.7	44.5	45.4	46.3	47.2	48.1	49.0	50.0	51.0	52.0
UBD in euro per capita	593,38	606,61	620,14	633,98	648,14	662,62	677,43	692,59	708,09	723,92

Figure 4: Projected potential Universal Basic Dividend fund, from 50 years and later.

Furthermore, the UBD could be further strengthened by consolidating existing public equity (e.g. shares in Volkswagen, Deutsche Bahn and so on) into TRANSFORM (McCann et al. 2018),¹⁸ and leveraging future ‘bail-out’ programs in times of crisis to generate equity in the interest of the UBD (IG Metall 2009; Hickel 2020; High Pay Center 2020; Lawrence et al. 2020; Lonergan & Blyth 2020; Memorandum Gruppe 2020; Phillips & Rozworski 2020). TRANSFORM might eventually even be opened up to private investment, soaking up private capital and offering it a direction and purpose, through strengthening a public agency aimed at a more democratic, innovative and green economy. While additional revenue generated through these investments would benefit private investors, the voting rights and socioeconomic influence generated through their investment could be leveraged to advance the agenda set by TRANSFORM’s stake- and shareholders – the general public.

¹⁸ In exchange, some of the capital needed to provide decent public services could be raised through TRANSFORM if these public services can realistically generate a decent return in a socially responsible manner.

Conclusion

For decades, those in charge of economic policy have preached that the market knows best and that state intervention into the economy is doomed to fail. The state was subjected to austerity while wealth taxation and top tax rates were cut and wages were suppressed. As a result, productivity grew slower and more unevenly, public infrastructure eroded and social inequality surged as the progress of technology was privately appropriated. Perhaps most alarmingly, political polarisation grew in tandem with social polarisation and the planet started burning. Renewed public investment, coupled with a push for a more democratic and green economy and a UBD offers a way out of the difficult socioeconomic conditions of our time. It offers unprecedented access to investment capital and new technologies to businesses, better working conditions and a voice in the workplace to workers and a socioeconomic assertiveness unknown to the public for decades. In sum, it offers no less than the establishment of a new social contract, linking technological innovation, ecological sustainability and prosperity for all.

Bibliography

- Akcigit, U. & Ates, S. T. (2021) Ten Facts on Declining Business Dynamism and Lessons from Endogenous Growth Theory. *American Economic Journal: Macroeconomics* **13** (1), 257–298.
- Albers, T. N. H., Bartels, C. & Schularick, M. (2020) *The Distribution of Wealth in Germany 1895-2018*.
- Andrews, D., Criscuolo, C. & Gal, P. N. (2016) *The Best versus the Rest: The Global Productivity Slowdown, Divergence across Firms and the Role of Public Policy*.
- Bach, S. (2020) *Vermögensabgabe DIE LINKE. Aufkommen und Verteilungswirkungen: Forschungsprojekt im Auftrag der Fraktion DIE LINKE. im Bundestag und der Rosa-Luxemburg-Stiftung*, Düsseldorf.
- Bach, S. & Mertz, T. (2016) Vor der Erbschaftssteuerreform: Nutzung der Firmenprivilegien hat Minderjährige zu Multimillionären gemacht. *DIW Wochenbericht* **83** (36), 812–820.
- Bardt, H., Dullien, S., Hüther, M. & Rietzler, K. (2019) *Für eine solide Finanzpolitik: Investitionen ermöglichen!*
- Barrott, C., Brown, C. M. & Cumbers, A. et al. (2017) *Alternative Models of Ownership: Report to the Shadow Chancellor of the Exchequer and Shadow Secretary of State for Business, Energy and Industrial Strategy*.
- Berry, C., Evemy, J. & Yates, E. (2021) *The Relationship Between Firm Financing and Investment in Productivity in a Very Low Interest Rate Environment*.
- BMAS (2021) *Sechster Armuts- und Reichtumsbericht der Bundesregierung*.

BMF (2020a) *Staatsquoten im internationalen Vergleich*.

BMF (2020b) *Staatsschuldenquoten im internationalen Vergleich*.

Boot, A. W. A., Carletti, E., Kotz, H.-H., Krahnert, J. P., Pelizzon, L. & Subrahmanyam, M. (2020) *Corona and financial stability 4.0: Implementing a european pandemic equity fund*.

Bundestag (2018) Antwort der Bundesregierung auf die Kleine Anfrage der Abgeordneten Pascal Meiser, Fabio De Masi, Jörg Cezanne, weiterer Abgeordneter und der Fraktion DIE LINKE: Entwicklung der Lohnquote in Deutschland. *Drucksache* (19/5019).

Burger, A. & Bretschneider, W. (2021) *Umweltschädliche Subventionen in Deutschland*, Aktualisierte Ausgabe 2021, Dessau-Roslau.

C. Frey (2019) *The technology trap: Capital, labor, and power in the age of automation*.

Campagna, S., Eulerich, M., Fligge, B., Scholz, R. & Vitols, S. (2020) *Entwicklung der Wettbewerbsstrategien in deutschen börsenorientierten Unternehmen: Der Einfluss der Mitbestimmung auf die strategische Ausrichtung und deren Performanz*.

Chapman, A. (2020) Bailouts: creating the new normal | New Economics Foundation.

<https://neweconomics.org/2020/04/bailouts-the-new-normal>. Accessed 5/10/2022.

Cooley, M. (2016) *Architect or bee?: The human price of technology*, New edition. Spokesman, Nottingham.

Corneo, G. (2017) *Ein Staatsfonds, der eine soziale Dividende finanziert*.

Destatis (2021) Saldo der Außenhandelsbilanz (Differenz zwischen Exporten und Importen von Waren) von Deutschland von 1991 bis 2020 (in Milliarden Euro).

<https://de.statista.com/statistik/daten/studie/37793/umfrage/exportueberschuss-in-deutschland-seit-1999/>. Accessed 7/13/2021.

Destatis (2022) Volkswirtschaftliche Gesamtrechnungen - Bruttoinlandsprodukt, Bruttonationaleinkommen, Volkseinkommen.

<https://de.statista.com/statistik/daten/studie/1251/umfrage/entwicklung-des-bruttoinlandsprodukts-seit-dem-jahr-1991/>. Accessed 6/1/2022.

DGB (2021) Tariffucht-Atlas: So viel kostet Tariffucht jedes Bundesland.

<https://www.dgb.de/themen/++co++627c137e-2a72-11ec-b540-001a4a160123>. Accessed 10/25/2021.

DGB (2022) *Antrag B004: Tarifbindung und Mitbestimmung stärken*.

DiEM25 (2017) *European New Deal: A comprehensive economic & social policy framework for Europe's stabilisation, sustainable recovery & democratisation*.

Dienes, C., Ivens, S., Nielen, S., Wolter, H.-J. & Nüse, L. (2019) *Produktivität von kleinen und mittleren Unternehmen in Deutschland*.

Dullien, S., Rietzler, K. & Tober, S. (2021) *Ein Transformationsfonds für Deutschland*.

Dupor, B. (2021) How Recent Fiscal Interventions Compare with the New Deal. *Federal Reserve Bank of St. Louis*, July 13. <https://www.stlouisfed.org/publications/regional-economist/third-quarter-2021/how-recent-fiscal-interventions-compare-new-deal>. Accessed 8/4/2021.

Fedorets, A., Grabka, M. M., Schröder, C. & Seebauer, J. (2020) *Lohnungleichheit in Deutschland sinkt*. DIW - Deutsches Institut für Wirtschaftsforschung.

Feenstra, R. C., Inklaar, R. & Timmer, M. P. (2015) The Next Generation of the Penn World Table. *American Economic Review* **105** (10), 3150–3182.

Frey, P., Jones, P., Khurana, I., Kikuchi, L. & Stronge, W. (2020) *Time For Change: the four-day week as a strategy for unemployment*.

Gibis, C., Kosmol, J., Matthey, A., Schubert, T. & Wehnemann, K. (2020) *Nachhaltige Wege aus der Wirtschaftskrise: Umwelt und Klima schützen, Beschäftigung sichern, sozialverträgliche Transformation einleiten*, Aktualisierte Ausgabe 2021, Dessau-Roslau.

Gieseke, F. & Sick, S. (2022) *Übersicht zu den Rechten und Pflichten des Aufsichtsrats nach dem Mitbestimmungsgesetz*, 2. überarbeitete Auflage.

- Greive, M. (2014) Ost-Förderung: Deutsche Einheit kostet 2.000.000.000.000 Euro. *WELT*, May 04. <https://www.welt.de/politik/deutschland/article127595786/Deutsche-Einheit-kostet-2-000-000-000-000-Euro.html>. Accessed 8/4/2021.
- Günther, M. (2022) Bezahlbarer Wohnbau 2022: Neubau - Umbau - Klimaschutz.
- Guinan, J. & O'Neill, M. (2020) Only bold state intervention will save us from a future owned by corporate giants. <https://www.theguardian.com/commentisfree/2020/jul/06/state-intervention-amazon-recovery-covid-19>. Accessed 7/7/2020.
- Haipeter, T. (2020) Digitalisation, unions and participation: the German case of 'industry 4.0'. *Industrial Relations Journal* **51** (3), 242–260.
- Haldane, A. G. (2017) *Productivity Puzzles: Speech at the London School of Economics*.
- HBS (2020) *Jahresbericht 2019: Den Wandel gestalten. Arbeit und Mitbestimmung der Zukunft*.
- Hickel, R. (2020) Die Kosten der Coronakrise: Wer begleicht die Rechnung? *Blätter für deutsche und internationale Politik* (10/2020), 105–112.
- High Pay Center (2020) Conditions are critical: why publicly-funded bail-outs for private companies must include social and environmental conditions. https://highpaycentre.org/wp-content/uploads/2020/08/conditions_are_critical_web_version.pdf. Accessed 5/10/2020.
- Hind, D. (2019) *The British Digital Cooperative: A New Model Public Sector Institution*.
- Horn, G. A., Behringer, J., Gechert, S., Rietzler, K. & Stein, U. (2017) *Was tun gegen die Ungleichheit?: Wirtschaftspolitische Vorschläge für eine reduzierte Ungleichheit*.
- Horn, G. A., Gechert, S., Rietzler, K. & Schmid, K. D. (2014) *Streitfall Fiskalpolitik: Eine empirische Auswertung zur Höhe des Multiplikators*.
- IG Metall (2009) Aktiv aus der Krise - Gemeinsam für ein GUTES LEBEN: Aktionsplan der IG Metall. https://www.boeckler.de/pdf/v_2009_03_11_ig_metall.pdf.

- IG Metall (2020) Mit Fonds die Zulieferindustrie retten. *IG Metall*, September 09.
<https://www.igmetall.de/politik-und-gesellschaft/wirtschaftspolitik/industriepolitik/mit-fonds-die-zulieferindustrie-retten>. Accessed 9/15/2020.
- IMU (2020) The supervisory boards in Germany. <https://www.imu-boeckler.de/en/the-supervisory-boards-in-germany-19329.htm>. Accessed 4/10/2021.
- Jacobson, M. Z., Krauland, A.-K. von & Coughlin, S. J. et al. (2022) Low-cost solutions to global warming, air pollution, and energy insecurity for 145 countries. *Energy & Environmental Science*.
- Jäger, S., Schoefer, B. & Heining, J. (2021) Labor in the Boardroom. *The Quarterly Journal of Economics* **136** (2), 669–725.
- Jirjahn, U. & Smith, S. C. (2018) Nonunion Employee Representation: Theory and the German Experience with Mandated Works Councils. *Annals of Public and Cooperative Economics* **89** (1), 201–233.
- Kobiela, G., Samadi, S. & Kurwan, J. et al. (2020) *CO2-neutral bis 2035: Eckpunkte eines deutschen Beitrags zur Einhaltung der 1,5-°C-Grenze*.
- Lawrence, M. (2019) *Owning the future: toward the democratic economy*.
- Lawrence, M., Buller, A., Balnes, J. & Hager, S. (2020) *Commoning the Company*.
- Lawrence, M., Pendleton, A. & Mahmoud, S. (2019) *Co-operatives unleashed: Doubling the Size of the UK's Co-operative Sector*.
- Lonergan, E. & Blyth, M. (2020) Beyond Bailouts. https://www.ippr.org/files/2020-03/1585237065_beyond-bailouts-march2020.pdf. Accessed 5/10/2020.
- Mazzucato, M. (2021a) *Mission economy: A moonshot guide to changing capitalism*. Allen Lane an imprint of Penguin Books, London.
- Mazzucato, M. (2021b) *The Advanced Research and Invention Agency Bill: Written evidence submitted by Professor Mariana Mazzucato, Foundating Director of IIPP, UCL Institute for Innovation and Public Purpose*, London.

Mazzucato, M. & Penna, C. C. R. (2015) The Rise of Mission-Oriented State Investment Banks: The Cases of Germany's KfW and Brazil's BNDES. *SSRN Electronic Journal*.

McCann, D. (2020) *Commoning Intellectual Property: Public funding and the creation of a knowledge commons*.

McCann, D., Lansley, S. & Schifferes, S. (2018) Remodelling Capitalism: How Social Wealth Funds could transform Britain. In: McCann, D., Schifferes, S. & Lansley, S. et al. (eds.) *Social Wealth Funds in the UK*, pp. 7–67.

Memorandum Gruppe (2020) *Solidaritätspaket zur Krisenbewältigung: SONDERMEMORANDUM zur Corona-Krise als Ergänzung zum MEMORANDUM 2020*.

Memorandum Gruppe (2021) *Memorandum 2021: Corona - Lernen aus der Krise! Alternativen zur Wirtschaftspolitik*. PapyRossa-Verlag, Köln.

Molitor, A. (2022) Für mehr Tempo beim mitbestimmten Wandel: Böckler-Konferenz für Aufsichtsräte 2022. <https://www.boeckler.de/de/tagungsberichte-18029-aufsichtsratekonferenz-fur-mehr-tempo-beim-mitbestimmten-wandel-42065.htm>. Accessed 7/11/2022.

Mueller, S. & Stegmaier, J. (2017) The Dynamic Effects of Works Councils on Labour Productivity: First Evidence from Panel Data. *British Journal of Industrial Relations* **55** (2), 372–395.

Murphy, R. (2019) The European tax gap: A report for the Socialists and Democrats Group in the European Parliament.

Norges Bank Investment Management (2020) *Responsible investment 2019: Government Pension Fund Global*, Oslo.

Norges Bank Investment Management (2022) *Government Pension Fund Global: Annual Report 2021*, Oslo.

OECD (2019) *GDP per hour worked (indicator)*.

OECD (2020) *OECD Economic Surveys: Germany 2020*. OECD.

OECD (2021) *Revenue Statistics 2021: Initial impacts of COVID-19 on OECD tax revenues*.

Ötsch, R. & Troost, A. (2020) Reichtum rückverteilen: Plädoyer für die Wiedererhebung der Vermögenssteuer mit progressivem Tarif.
https://www.rosalux.de/fileadmin/rls_uploads/pdfs/rls_papers/Papers_4-20_Reichtum_onl.pdf.
Accessed 1/28/2021.

Phillips, L. & Rozworski, M. (2020) Why We Need Economic Planning.
<https://tribunemag.co.uk/2020/03/why-we-need-economic-planning>. Accessed 4/3/2020.

Puttfarcken, L. (2021) Ergebnisse des Weltklimarats.
<https://klimasimulationen.de/weltklimarat/#5zukunft>. Accessed 8/14/2021.

Rapp, M. S., Wolff, M., Hennig, J. C. & Udoieva, I. (2019) *Mitbestimmung im Aufsichtsrat und ihre Wirkung auf die Unternehmensführung: Eine empirische Analyse vor dem Hintergrund der Finanz- und Wirtschaftskrise*. Hans-Böckler-Stiftung, Düsseldorf.

Redeker, N. (2019) *Unlocking Europe's Piggy Bank Policy Paper: Corporate Saving, Labor Power and Policies for Investment*.

RND (2019) Hartz IV: Staat stockte 2018 Löhne um fast 10 Milliarden Euro auf. *Redaktions-Netzwerk Deutschland*, November 13. Accessed 11/9/2020.

Roberts, C. & Lawrence, M. (2018) Our Common Wealth: A Citizens' Wealth Fund for the UK.
<https://www.ippr.org/files/2018-04/cej-our-common-wealth-march-2018.pdf>. Accessed 1/10/2020.

Roberts, C., Lawrence, M. & King, L. (2017) Managing automation: Employment, inequality and ethics in the digital age. <http://www.ippr.org/publications/managing-automation>. Accessed 1/10/2020.

Schäfer, D. (2015) *Fiskalische und ökonomische Auswirkungen einer eingeschränkten Finanztransaktionssteuer: Gutachten im Auftrag der SPD-Fraktion*.

Schiersch, A. (2019) *Frontiers und Laggards: Die Produktivitätsentwicklung deutscher Unternehmen*.

Schröder, C., Bartels, C., Göbler, K., Grabka, M. M. & König, J. (2020) *MillionärInnen unter dem Mikroskop: Datenlücke bei sehr hohen Vermögen geschlossen – Konzentration höher als bisher ausgewiesen*. DIW - Deutsches Institut für Wirtschaftsforschung.

Smith, A. (2014) Socially Useful Production.

Stern, N. H. (ed.) (2014) *The economics of climate change: The Stern review*. Cambridge University Press, Cambridge.

Stronge, W. & Harper, A. (2019) *The Shorter Working Week*.

Tiefensee, A. & Grabka, M. M. (2017) Das Erbvolumen in Deutschland dürfte um gut ein Viertel größer sein als bisher angenommen. *DIW Wochenbericht* **84** (27), 565–570.

Trautvetter, C. & Schwarz, Y. (2021) *Jahrbuch Steuergerechtigkeit 2021*.

Truger, A. (2013) Verlorene Milliarden.

<https://www.boeckler.de/de/magazin-mitbestimmung-2744-verlorene-milliarden-5238.htm>. Accessed 7/25/2020.

Tyfield, D., Lave, R., Randalls, S. & Thorpe, C. (2017) Introduction: beyond crisis in the knowledge economy. In: Tyfield, D. (ed.) *The Routledge handbook of the political economy of science*. Routledge, London, pp. 1–18.

UN (2022) *World Population Prospects 2022. Online Edition*.

VCI (2022) *VCI-Positionspapier zum Thema Carbon Contracts for Difference*.

ver.di (2017) Personalbedarf im Öffentlichen Dienst - Deutschland wird kaputt gespart. <https://bundeslaender-nrw.verdi.de/++co++f5bcd2dc-a4e2-11e7-b5fc-52540066e5a9>. Accessed 8/5/2017.

WBGU (2018) *Zeit-gerechte Klimapolitik: Vier Initiativen für Fairness*, Berlin.

Widuto, A. & Jourde, P. (2021) *Just Transition Fund*.

Wolf, H. (2021) Die Tücken der Administration. Zur LINKEN Regierungspraxis in Berlin. *Zeitschrift Luxemburg*.

Wolter, M. I., Mönnig, A. & Hummel, M. et al. (2016) *Economy 4.0 and its labour market and economic impacts: Scenario calculations in line with the BIBB-LAB qualification and occupational field projections*, Nürnberg.

World Bank (2021a) CO2 emissions (kg per 2017 PPP \$ of GDP).

<https://data.worldbank.org/indicator/EN.ATM.CO2E.PP.GD.KD>. Accessed 8/8/2021.

World Bank (2021b) Electricity production from coal sources (% of total).

<https://data.worldbank.org/indicator/EG.ELC.COAL.ZS>. Accessed 11/2/2021.

World Bank (2021c) Manufacturing, value added (% of GDP).

<https://data.worldbank.org/indicator/NV.IND.MANF.ZS>. Accessed 11/2/2021.