



OFFICE OF TECHNOLOGY ASSESSMENT
AT THE GERMAN BUNDESTAG

Som, Oliver
Kinkel, Steffen
Kirner, Eva
Buschak, Daniela
Frietsch, Rainer
Jäger, Angela
Neuhäusler, Peter
Nusser, Michael
Wydra, Sven

Future Potentials and Strategies of non-research-intensive Industries in Germany – Impacts on Competitiveness and Employment

Summary

October 2010
Working report no. 140





SUMMARY

Non-research-intensive sectors and firms have played a comparatively subordinate role in the economic and innovation policy debate up to now. Due to the strong focus of the political discussion on research-intensive areas, little significance has been attributed in the past to the potentials of the non-research-intensive branches and businesses for Germany as an industrial location. The reason behind this is that areas with intensive research and development (R&D) have significantly higher growth rates and, according to the arguments of the new growth theory, are best placed to contribute to the country's international competitiveness. The present innovation report focuses on non-research-intensive sectors and firms and demonstrates which direct and, above all, also indirect contributions these branches make towards Germany's international competitiveness and which future potentials result from this situation.

The role of non-research-intensive sectors and companies has attracted increasing attention in the scientific debate in recent years. It is increasingly well known that these areas continue to represent a significant sector of the economy, even in developed industrialized nations and play an important role for the respective national economy and the innovation system. There is still relatively little information about what these sectors actually contribute. Equally, relatively little is known about the competitive and innovation strategies of non-research-intensive firms. Although it is known that these firms scarcely conduct formal research and development and thus rarely pursue a classical, R&D-based innovation strategy, up to now there has only been sporadic evidence of which alternative strategies they choose in order to succeed in their own, in part highly competitive markets. Obviously, there are other ways and means, besides an explicit research orientation, for firms to be competitive without conducting in-house R&D.

The innovation report is divided into three main parts. In the first section the focus is on the economic relevance of non-research-intensive branches. Based on potential analyses, we show the direct and indirect spill-over effects non-research-intensive branches have on growth and employment in German industry as a whole. By contrast, the second section concentrates on the company level and investigates which competitive and innovation strategies non-research-intensive firms in German industry utilize to achieve long-term success with their products against stiff competition. One emphasis is placed on the skills and qualification needs of these businesses, among others. The third section provides a synthesis of both investigative perspectives. It summarizes the insights gained



at the macroeconomic and individual company level into an overall picture and on this basis derives options for policy/political action.

In processing these research issues the report is backed up by extensive empirical data, both at branch and also enterprise level. The study of the overall economic significance of the non-research-intensive industries is based on official statistical data at the national and international level and includes, besides macroeconomic variables like production, value added, export and employment, in addition indicators of the innovation process (e.g. R&D, patent and other innovation activities). The analyses at the microeconomic level are primarily based on data from a telephone survey of more than 200 non-research-intensive enterprises, as well as 88 particularly research-intensive companies, which for the first time provided information in this form on topics like market environment, competitive strategy, available competence/skills, ability to absorb and implement external information, protection and meaning of different forms of knowledge or future opportunities and risks. German data from the *European Manufacturing Survey 2009* conducted by Fraunhofer ISI are referred to for complementary evaluations of certain issues at the company level.

IMPORTANCE AND CONTRIBUTION TO VALUE ADDED

In Germany, as the result of structural change, the macroeconomic share of value added of manufacturing industry as a whole and of the non-research-intensive industrial sectors in particular has sunk continuously since 1970. Nevertheless, these still contribute around 41% to industrial value added (This means value creation of manufacturing industry). This share even amounts to 73% in the EU-14 average, and can be explained by the fact that, in Germany, so-called »sophisticated consumer technology« (for example, mechanical engineering and automobile construction) plays an especially large role, compared with other countries. The USA and Japan also record a higher value added share of the non-research-intensive sectors compared with Germany. Despite the steadily increasing importance of the service sector for the value added of the economy as a whole, in all industrialized countries, non-research-intensive sectors in manufacturing industry continue to provide an essential share in industrial value creation. Interesting, too, is the dynamics of non-research-intensive sectors over the course of time. Contrary to the assumption that sectors change their R&D-intensity over time, analyses of available OECD data between 1975 and 2006 were unable to provide evidence of great changes in the average R&D-intensity of sectors. There are neither sectors which have developed from non-research-intensive to research-intensive in this time period, nor sectors which have

transformed themselves from formerly research-intensive to non-research-intensive sectors as a result of technology life cycles. Non-research-intensive sectors remain structurally stable over several decades and can obviously survive in the market even without raising their R&D-intensity.

Non-research-intensive sectors are however not synonymous with the group of non-research-intensive businesses. The branch or firm level represents two distinct levels of observation. All industrial branches are composed of a colorful mix of firms with varying degrees of research intensity. Admittedly, the share of non-research-intensive firms per branch varies, but these firms are found to varying degrees in every branch of manufacturing industry.

MARKET ENVIRONMENT AND COMPETITIVE STRATEGIES

The market environment for non-research-intensive companies is more difficult than for research-intensive firms, as they are much more frequently active in largely saturated or even shrinking markets. In addition, their products can generally be more easily substituted than products from research-intensive firms, presumably due to their generally lower product complexity. In order to remain competitive despite these difficult framework conditions, non-research-intensive firms must survive cut-throat competition and convince their clients by performing better than their competitors. This is achieved by prioritizing the orientation towards very high quality, adapting the products to specific customer requirements and short delivery times which are also facilitated by the close spatial proximity to customers. The product price plays a comparatively subordinate role as a priority competitive factor. Although costs are certainly an important factor, non-research-intensive companies in Germany still do not compete pre-dominantly via the price of their products and services. They are better or quicker, but not necessarily cheaper, than their rivals. In this way, they occupy a niche which can be quite attractive to firms in a developed high-wage country such as Germany: producing high quality and delivering customer-specific products of low research intensity at top-bracket prices – at least to some extent. Examples for such successful niches with growth potential include technical and functional textiles, sustainable and high-quality foods or lightweight and low-wear metal and plastic parts, among others.

Companies in non-research-intensive sectors are domestically oriented to a strong degree. They buy their primary products from mainly domestic sources and are therefore less dependent on imports. At the same time, they have lower direct exports when compared with research-intensive sectors, although they



contribute substantially to German exports indirectly through their connections to suppliers and buyers. Moreover, non-research-intensive industries have recorded the comparatively highest increases in foreign sales turnover over the last few years. Additionally, on a company level, it is apparent that non-research-intensive enterprises in the industrial value chain are equally split between final product manufacturers and suppliers. Companies from the traditionally strong German export sectors of mechanical engineering and automotive industry form part of the customer group of non-research-intensive suppliers. Consequently, non-research-intensive firms make an important indirect contribution on the customer side to Germany's export strength via the supply of high quality and internationally competitive primary products. However, non-research-intensive companies usually only have production facilities in Germany and have hardly any foreign investments. The majority of their most important markets, customers, suppliers and competitors are also located in Germany. This strong domestic alignment, which is characterized, on the one hand, by intensive interrelations with companies from other sectors, and by mainly national customer structures, on the other, can also result in non-research-intensive companies not being as directly dependent on globally-induced short- and medium-term demand fluctuations to the same extent as firms which are strongly oriented towards exports.

EMPLOYMENT AND QUALIFICATION

Non-research-intensive sectors employ around half the industrial employees or 11% of all employees in Germany. Since these sectors are more labor-intensive on average than research-intensive branches, additional demand effects also trigger a higher direct effect on employment. However, these branches not only make an essential direct contribution to employment in Germany, but also an indirect one. They are interrelated with upstream suppliers in such a way that additional jobs are created there as well, if there is a growth in demand. To a considerable extent, indeed approx. 45%, of these indirect employment effects are caused in service sectors.

Non-research-intensive sectors do indeed employ a much lower share of academics compared with research-intensive branches, but these sectors are indirectly responsible for the creation of knowledge-intensive jobs in their supplier sectors. The indirect effect on academic positions (among them also substantial numbers of jobs for female academics) emanating from non-research-intensive sectors, is higher than the indirect effect triggered by research-intensive sectors. This is probably due to the fact that, to a large extent, these sectors demand machines, other capital goods and knowledge-intensive services whose production requires

many highly qualified workers at the relevant suppliers. This supposition is also corroborated by findings in the company survey conducted which show that many non-research-intensive companies invest heavily in process technology and at least to some extent shop externally for innovative technology solutions.

Non-research-intensive sectors also make a substantial contribution towards stabilizing the revenues of social security systems. In these sectors, additional demand impulses directly and indirectly induce positive effects on jobs with mandatory social security contributions. These effects are larger than the corresponding effects of research-intensive sectors.

In addition, it can be stated that non-research-intensive companies offer significant job creation potential for semi-skilled and unskilled workers. They employ almost twice as many low-skilled workers – one third of the workforce than particularly research-intensive firms. At the same time, they do not use temporary workers more frequently than other companies; the average share of temporary positions in the workforce is 7% which is almost exactly the same as the share in especially research-intensive firms. This result is actually quite remarkable, since it could be assumed that non-research-intensive companies in particular, whose production structures are characterized by higher labor intensity and the tendency towards simpler tasks, would use temporary workers more for flexible utilization of their production.

INNOVATION, KNOWLEDGE AND ABSORPTIVE CAPACITY

Non-research-intensive sectors have by definition low expenditures for R&D, however, they indirectly trigger additional R&D activities in their suppliers. A considerable portion of the R&D activities involved in the production of their competitive products are undertaken in the more research-intensive supplier branches. In this manner, non-research-intensive branches contribute by means of their R&D spill-over effects, similar to the situation with jobs for academics, mainly indirectly towards strengthening Germany as a research and development location.

Compared with research-intensive branches, non-research-intensive branches have on average not only lower R&D expenditures, but also lower expenditures for innovation as a whole. However, there are significant differences between individual non-research-intensive sectors. Innovation expenditures include, besides pure R&D outlays, among other items also investments in fixed assets, investments in training, expenses for patenting and licenses as well as market-



SUMMARY

ing expenditures for innovations. Non-research-intensive branches invest in part considerable sums on innovation in these fields, whereby these expenditures outside of formal R&D are accorded great significance in these sectors. The analyses at company level have confirmed: investments in machines and plants (process innovations) and sales/marketing (opening up new markets) play an important role for non-research-intensive firms. These investments are made either to expand the firm's position in an existing market or to open up new markets entirely.

In view of the very low significance of formal research and development in these branches and companies, it is at first glance surprising that the majority of the patents applied for in Germany are filed in non-research-intensive technology fields. Their share has declined slightly, but still ca. 40% of the total number of patent applications are filed in non-research-intensive technology areas. This is however not a uniquely German phenomenon. In other industrialized countries these »non-research-intensive patents« also continue to constitute a considerable share of the total patent applications.

On the other hand, the company survey clearly illustrated that non-research-intensive firms (at about 40%) apply for patents significantly less often than particularly research-intensive firms (over 70%) in order to secure their competitive edge/knowledge advantage. An explanation for this apparent contradiction lies among other things in the fact that research-intensive companies also apply for patents in non-research-intensive technology fields. One example for this is an automobile concern (research-intensive enterprise), which applies for patents in the area of metal forming (non-research-intensive technology field). Against this background, it must be said that the technology-field-related patent analysis to assess the patenting propensity of certain corporate groups (e.g. non-research-intensive firms) is only of limited use.

Innovation plays a significant role also for non-research-intensive firms. Interesting in this context is that the most important innovation goals of non-research-intensive firms are more frequently found in the areas of process innovation and service innovation than is the case for research-intensive companies. Although product innovation plays the main role for almost half of the non-research-intensive firms investigated, it is still less often the primary innovation goal than in research-intensive companies. The relatively high prioritization of process innovations also contributes towards the non-research-intensive firms largely being on a par with research-intensive companies in utilizing innovative process technology. They are very capable of successfully applying innovative process technologies in their enterprises.

In the context of product innovations, it is remarkable that more than one third of the non-research-intensive firms state that they want to increase their market share primarily through new products. This proves that successful new product development can take place in these businesses, despite low direct investments in R&D. In addition, over 60% of the non-research-intensive firms rely on a »first mover« or pioneer strategy to protect their competition-relevant knowledge. Compared with especially research-intensive firms, this share is smaller, but the majority appears to be in a position to at least partially recognize the needs of the market at an early stage and offer market-oriented, technical or process innovations.

The »absorptive capacity« of a business describes its ability to perceive suggestions and insights from the outside world, to evaluate and implement them in the firm and exploit them to improve the competitive position. The analyses of firms' absorptive capacity prove impressively that this is not in the least correlated with their research and development intensity. This applies not only to the technological, but also the customer-related absorptive capacity. If technological developments are of great relevance for the competitiveness of the respective company, then non-research-intensive firms are definitely capable of developing a similar or even superior technological absorptive capacity as especially re-search-intensive companies.

ECONOMIC OPPORTUNITIES AND RISKS

Non-research-intensive enterprises had, like all businesses in Germany, to cope with a substantial decline in sales due to the financial crisis. More than half of them suffered declining sales figures as expected in the crisis year of 2009. Nevertheless, the businesses surveyed did not consider this development to be life threatening. With the exception of single companies, those interviewed estimated the losses suffered as manageable, a quarter even as largely unproblematic. Thus one cannot speak of a particular threat to non-research-intensive firms by external shocks like the most recent global economic crisis. Nearly a quarter of the respondents were able to notch up a rising sales trend, despite the financial crisis. Interestingly, especially research-intensive and non-research-intensive firms assess the impacts of the economic crisis very similarly, though possibly for different reasons.

Non-research-intensive firms see the greatest opportunities for future growth in the coming five years in the exploitation of new (sales) markets, in particular foreign target markets, as well as in more intensive handling of existing mar-



ket segments. The increasing competition via the product price, especially from competitors from abroad, is named as a significant risk factor. This shows in part the vulnerability of the present competitive position of German non-research-intensive firms, which are strongly focused on domestic markets. Non-research-intensive businesses see good opportunities in developing the innovation aspect, albeit less frequently than particularly research-intensive firms. Non-research-intensive firms explicitly mention product innovations, new technologies and process innovations, in order to be able to defend or expand their competitive position in the long term. On the whole, innovations appear to play a key role for the future competitiveness of these firms, also and because of the condition of low R&D. It cannot be assumed per se that these firms possess a lower propensity to innovate.

Risks for future business success were strongly affected by the current economic situation and the resulting impacts of declining demand and limited resources for investment, both from the customer side as well as from the own side. Up to now, however, as the analysis of the sales trend in the non-research-intensive companies in the surveyed period showed, they managed to weather the effects of the economic crisis despite this critical assessment pretty well. In this context, the stricter lending regulations as a result of the crisis remain a critical issue, which could also have negative consequences for investment projects and for the pre-financing of customer orders.

OPTIONS FOR ACTION

From the findings presented, various policy *options* can be derived. It should be noted on principle that demarcating non-research-intensive sectors versus sectors of higher quality consumer or cutting-edge technology merely serves to analyze a more or less reliable population of various research-intensive enterprises in a statistically limitable manner. In reality, however, there are *no cutting-edge technology sectors, but only cutting-edge technology enterprises*, and they turn up again in relevant shares also in non-research-intensive sectors.

Measures and programs in *economic, innovation and technology policy* which are limited to high-tech sectors would thus completely disregard essential pillars of the Germany economic system. Against this background, it must be emphasized that the »High-tech Strategy« (HTS) of the federal government, in particular, is not exclusively focused on enterprises allegedly from the leading-edge technology sectors, but also offers appropriate incentives and instruments for the technologically and competitively well set-up enterprises from the less re-

search-intensive sectors to also participate. A balanced consideration of both areas, taking the complementarities and respective strengths into consideration, could promise higher stimulating potentials to strengthen the innovative capacity and competitiveness of the German economy. Opportunities to participate exist already, but should be communicated more actively, as alone the name »High-tech Strategy« might suggest a concentration on research-intensive branches. Even through the further development of the High-tech Strategy (HTS 2) with its focus on the areas of need arising from the global challenges climate/energy, health/nutrition, mobility, security and communication, in which Germany would like to become a pioneer with the aid of significant problem-solving contributions based on key technologies, this possible misinterpretation has not been eradicated. More explicit information about the possibilities for firms from the non-research-intensive sectors to take advantage of the existing offers would be a help here.

In economic policy terms, the strong domestic orientation of non-research-intensive industrial areas offers the chance, when deploying measures to stimulate the economy, to achieve higher domestic value added and employment effects in these firms than by solely stimulating more research-intensive sectors. Due to the high labor intensity of these sectors, additional demand could also trigger increased direct employment effects, which would mean jobs created primarily in Germany because of the predominantly domestically oriented enterprise and location structures. In addition, due to the intensive linkages with up-stream, often research-intensive equipment suppliers significant employment effects could also be indirectly generated, which due to the strong domestic orientation of upstream procurement of intermediate and primary goods will also mainly take place in Germany.

The findings presented have manifold implications for *innovation and technology policy*. Basically, it must be remembered that isolated consideration of the significance of research-intensive and non-research-intensive sectors for the innovation capacity and competitiveness of German industry clearly does not go far enough. Non-research-intensive sectors are closely tied to more research-intensive sectors by intensive linkages, so that their demand in these supplier sectors triggers additional research and development activities and thus also provides additional jobs in this area. Non-research-intensive firms are not per se cut off from technological developments outside their company or their branch. Quite the contrary, the absorptive capability of these firms indicates that they are as capable as particularly research-intensive firms of perceiving and implementing technological developments and benefiting from knowledge and technology diffusion to improve their future competitiveness.



SUMMARY

Based on growth theory considerations, it appears at first logical to make increased efforts to strengthen the innovation capacity and competitiveness of non-research-intensive firms, so that they undertake R&D continuously or raise their R&D-intensity significantly above the low-tech threshold. This approach assumes that non-research-intensive companies in Germany have no real medium- to long-term perspective, which according to the results presented here, must at least be questioned.

An approach to be considered in parallel could be to take the identified strengths of the non-research-intensive firms as the starting point for innovation policy measures. This, however, requires an extended view of *innovations*. Future growth potentials cannot be generated only through technical product innovations, but also through technical or organizational process innovations as well as service innovations in industry. In these areas, non-research-intensive firms with respect to intervening features such as size or product complexity do not have quantifiable disadvantages compared with research-intensive companies. Against this background, it should be a complementary goal of innovation policy, industrial associations and enterprises to ensure and expand the strengths of non-research-intensive firms in the field of technical and non-technical process and service innovations.

A key to this endeavor will be to *offer complementary innovation incentives* for non-research-intensive firms and *not merely to stimulate R&D activities*. Crucial for technical and non-technical product and process innovations of non-research-intensive firms and also of research-intensive companies are in particular internal competences and skills, on the one hand, to market and support the »diffusion« of own innovations, on the other hand, for the successful adoption of external developments and concepts (»absorptive capacity«). This often requires *sufficient innovation expenditures* beyond expenditures on R&D, for example, on the sales side in the area of developing customer-specific adaptations (customization), construction, (service-) design or marketing outlays or from the adoption angle, for investments in capital assets of training.

One option for *technology and innovation policy* would then be to increasingly provide broader innovation incentives which also take into account the diffusion and adoption of innovations and the required linkages and interactions of non-research-intensive and research-intensive enterprises and sectors. Concrete approaches here could be, besides the supply-oriented promotion of technologies, for example, measures to accelerate diffusion processes on the demand side or early integration of non-research-intensive (end) user enterprises in pre-competitive joint projects or to promote the early interaction with research-intensive

players in other appropriate platforms or »arenas«. Further measures beyond the actual focus of technology and innovation policy could target the design of innovation-friendly framework conditions through appropriate concepts in educational policy, regulation, public procurement and taxation.

In this context, the *indicator* »R&D expenditures« respectively »R&D-intensity« as a measure of the innovation and absorptive capacity of companies and sectors should be critically questioned. The analyses conducted have clearly showed that the R&D-intensity is not demonstrably linked to the technological and customer-related absorptive capacity of firms and therefore does not seem to be an appropriate indicator for this. In science and research, however, R&D-intensity is still frequently utilized as an indicator for a company's absorptive capacity. However, the explanatory power of the indicator R&D intensity for the innovative capacity of a business should be questioned, if one is using a holistic understanding of innovation. The ability to develop and implement technical and non-technical product, process and service innovations necessitates, as shown above, many and varied competences beyond classical research and development. The construct of innovation expenditures could be one suitable approach to developing more appropriate input indicators for a company's innovation capabilities in a holistic sense. Rather more difficult is the task of developing suitable output indicators for each innovation field which permit cross-branch and cross-sector comparisons. The EU is planning to take on the task of »Developing a new Indicator to Measure Innovation« within the framework of its *Europe Strategy 2020*.

For *labor market policy*, the presented results are simultaneously a chance and a challenge. On the one hand, the non-research-intensive companies in manufacturing industry are one of the last segments which offer, comparatively speaking, attractively paid jobs in manufacturing for lowly skilled workers compared, for example, with the low-wage sectors in many service areas. Also against this background, the preservation and possibly specific support for the non-research-intensive industrial areas in Germany should have a relevant policy priority. On the other hand, in these areas of industry, the shares of semi-skilled and unskilled workers in total employment, as well as total employment on the whole, are in decline. This is likely to exacerbate the already existing problems of semi-skilled or unskilled workers in the labor market even further. Against this background, the question arises, how, in cooperation with labor market policy, interest groups, unions and management, to promote relevant *concepts for the need-oriented further qualification of low skilled workers* which take the specific needs of non-research-intensive industry as the starting point. Going further, this will also have well known implications for the education system.



SUMMARY

Even non-research-intensive firms see the need for action here, because they are increasingly finding less suitable applicants, even for their requirements. The widely discussed »shortage of skilled workers« will not spare these branches, either today or in the future.

Finally, *financial and economic policies* are required. To date, the non-research-intensive firms have coped surprisingly well with the impacts of the economic crisis. In order to keep it this way, the stricter lending policy resulting from the crisis, which could become a bottleneck not only for further investment projects to modernize production, but also for pre-financing customers' orders, should preferably not be overdrawn. As many of the non-research-intensive firms are planning investments in the next five years, overly restrictive lending should be avoided as far as possible, or more attractive alternatives offered if required, in order not to nip the burgeoning growth impulses in these areas prematurely in the bud.

The Office of Technology Assessment at the German Bundestag is an independent scientific institution created with the objective of advising the German Bundestag and its committees on matters relating to research and technology. Since 1990 TAB has been operated by the Institute for Technology Assessment and Systems Analysis (ITAS) of the Karlsruhe Institute for Technology (KIT), based on a contract with the German Bundestag



**OFFICE OF TECHNOLOGY ASSESSMENT
AT THE GERMAN BUNDESTAG**

BÜRO FÜR TECHNIKFOLGEN-ABSCHÄTZUNG
BEIM DEUTSCHEN BUNDESTAG

KARLSRUHER INSTITUT FÜR TECHNOLOGIE (KIT)

Neue Schönhauser Straße 10
10178 Berlin

Fon +49 30 28491-0
Fax +49 30 28491-119

buero@tab-beim-bundestag.de
www.tab-beim-bundestag.de