Human Capital: Incentive and Job Design

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Jan-Oliver Strych

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Referent: Prof. Dr. Martin E. Ruckes

Korreferent Prof. Dr. Martin Klarmann

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Dedicated to my parents Uwe and Ute Strych

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Chapter 1:

Introduction

As the UNESCO (2005a) points out in their World Report 2005, we live in a knowledge society as the outcome of the third industrial revolution driven by new technologies such as information technology and globalization. As indication that knowledge creation became more and more important for firms, the UNESCO (2005b) documents in its Science Report 2005 that industrial funds for research and development in the U.S. had an annual growth rate of 5.6 percent from 1953 to 2001 (in constant dollar terms). Gera and Mang (1998), for instance, show for Canadian firms that between 1971 and 1991 the Canadian industrial structure has become more knowledge-based and technology-intensive and competitive advantage stems from innovations and ideas.

Part of the current knowledge society is a learning society in which the people never stop learning, i.e., internalizing knowledge (UNSECO, 2005a). Economic literature denotes learning as human capital acquisition (e.g., Prendergast, 1993). Jorgenson and Fraumeni (1989), for instance, document that the share of investments in human capital relative to all investments (both human and nonhuman capital investments) in the United States from 1949 to 1984 is always more than 80 percent. In addition, Gera and Mang (1998) show that in Canada the service industry where human capital is dominant as production factor has experienced the highest growth rates in gross output than any other industry between 1971 and 1991.

Since human capital is an intangible asset of the firm (Brynjolfsson et al., 2002), but cannot be recognized on the balance sheet (Coenenberg et al., 2012), firm's market capitalization is usually greater than their book value of equity (e.g. Chan et al., 1999; Hall, 2001).

These findings suggest that firms' economic success depends strongly on human capital.[1] Economic literature, however, identify some problems that make it difficult for firms and employees to profit from human capital.

[1] Consistently, the OECD (1996) ascertains that the knowledge management including its creation, acquisition, transfer, and exploitation drives economic performance that is addressed by the knowledge management literature (e.g. Polanyi, 1966; Nonaka, 1994, Davenport and Prusak, 1999; Ambrosini and Bowman, 2001; Tsoukas and Vladimirou, 2001).

This dissertation is designed to shed light on how firms design incentives and jobs to solve these problems firms encounter during the lifecycle of human capital: At the beginning, an employee can acquire two types of human capital (Becker, 1962): First, it can be firm-specific so that the employee cannot utilize it in other firms. Second, it can be general so that he can utilize it in other firms. To illustrate both types, I assume a young professional who starts his career in a firm after graduating at university where he likely acquired general human capital. In the firm, however, he undergoes trainings in his first month to get equipped with firm-specific skills (i.e., firm-specific human capital acquisition).

If the young professional acquires firm-specific human capital, a dual moral hazard problem can arise if such human capital is nonverifiable (Prendergast, 1993, Kahn and Huberman, 1988): On the one hand, if the young professional invests in nonverifiable firm-specific human capital, the firm may extract rents from this specific investment by, for example, not compensating him for it. It is possible because such compensation is not enforceable before a court and hence the firm cannot credibly commit to it. On the other hand, if the firm pays for such human capital acquisition, the young professional has no incentive to subsequently acquire it.

On the contrary, if human capital is general, Becker (1962) states that the firm is not willing to pay for it because the employee can leave the firm (see for this inalienability of human capital argument, for instance, Hart and Moore, 1994) and then can utilize it in another firm. Regarding the young professional, it is unlikely that the firm pays his university tuition fees. These problems raise the following research question:

> ***RQ1: How do firms motivate their employees to acquire firm-specific and general human capital?***

Chapter 2 of the dissertation addresses this research question by exploring empirically how incentive design including promotion incentives and performance pay is related to firm-specific and general human capital acquisition. Consistent with Prendergast (1993), if nonverifiable human capital is firm-specific and leads to higher employee's productivity on the next job he is promoted to, I document a positive relation of promotion incentives with such human capital acquisition. On the contrary, I find no relation of individual performance pay and its acquisition.

In addition, if human capital is general, I document a positive relation of individual performance pay to its acquisition and no relation of promotion incentives to its acquisition.

Once the young professional has acquired human capital, the firm and even the employee himself face the problem to evaluate it properly. This problem, for instance, occurs if the firm aims to assign an employee to a job in which he can utilize his human capital in the most profitable way. Consequently, Chapter 3 of the dissertation addresses the following research question:

RQ2: How do firms learn about employees' human capital?

Consistent with Ortega (2001) who shows theoretically that job rotation as one component of job design enables the firm to learn about employees' job-specific human capital, I find empirically that firm's uncertainty about employees' job-specific human capital is positively related to the adoption of job rotation. Further, I document that the firm also adopts job rotation if it is uncertain about job-specific nonhuman capital or if employees' job performance is influenced by an exogenous shock.

After several years in the firm, the formerly young professional has acquired a lot of valuable human capital. Since the firm has learned about its high value after rotating him with others on different jobs, the firm promotes him to the CEO position. As CEO, he faces discretion because he knows best how to utilize his human capital to optimize firm performance (Prendergast, 2002; Ortega, 2009). Corporate governance literature, however, finds that such discretion also enables the CEO to misappropriate firm's assets rather than add value to the firm (e.g., Jensen, 1986; Shleifer and Vishny, 1997). Consequently, Chapter 4 of the dissertation addresses the following research question:

RQ3: How do firms alleviate moral hazard problems caused by CEOs' discretion due to their high value of human capital?

A recent strand of literature about so-called internal governance addresses such moral hazard problems by examining a situation in which a subordinated manager disciplines a myopic CEO to invest in the firm rather than privately consume firm resources (Fama, 1980; Acharya et al., 2011).

Acharya et al. (2011) explore theoretically the following mechanism: The CEO depends on cash flows provided by a subordinated manager who will become the next CEO in the future. As a result of such promotion incentives, he is motivated to provide cash

flows before getting promoted if the current CEO undertakes long-term investments whose return the manager can appropriate when he is CEO. They predict that CEO's contribution to firm's cash flows must neither be very small nor very large to maximize firm value under this mechanism of internal governance. Consistent with their findings, I document empirically in selected S&P 500 firms that the relation of firm's long-term investments and CEO's contribution to firm's cash flows is hump-shaped.

In addition, I find that internal governance is more effective (i.e., aforementioned hump-shaped relation is more pronounced) if the CEO is likely myopic.

In Chapter 5, the dissertation concludes and presents some suggestions for future research.

Chapter 2:

Promotion Incentives, Performance Pay, and Human Capital Acquisition

2.1 Introduction

This Chapter provides empirical evidence how promotion incentives and performance pay are related to nonverifiable human capital acquisition contingent on its grade of firm specificity.[2] If human capital is nonverifiable, courts, for instance, cannot observe and cannot assess it and thus cannot enforce any contract on it (Prendergast, 1993). If human capital is firm-specific[3] an employee can utilize it only in the same firm (Becker, 1962). Thus, its previous acquisition reflects a specific investment by the employee in his firm. To illustrate this, I assume an engineer who takes additional trainings in his leisure time to acquire firm-specific skills about new production processes (i.e., nonverifiable firm-specific human capital).

According to Prendergast (1993) and Kahn and Huberman (1988), this situation may cause a dual moral hazard problem as follows: First, the engineer's firm cannot credibly commit to future compensation for such human capital because it is able to behave opportunistically and extract rents from the engineer's specific investment: It can, for instance, reduce the sensitivity of his performance pay on his measured output.[4] This is possible because compensation contingent on such human capital is not enforceable before a court due to its nonverifiability and the engineer cannot utilize that human capital elsewhere because of its firm-specificity. Second, the firm can pay for the training: The engineer, for instance, gets days off for the training. Then, the employee can behave opportunistically by using training time for private activities rather than training because once his firm has paid for it he has no incentive to subsequently acquire it.

[2] Some analysis in this chapter is based partially on a research project with Patrick Göttner.
[3] Alternative concepts of specific human capital in the literature: Task-specific (Gibbons and Waldman, 2004), industry-specific (Neal, 1995), vintage-specific (Violante, 2002), occupation-specific (Kambourov and Manovskii, 2009), and job-specific (e.g., Kwon, 2006).
[4] For a discussion see Prendergast and Topel (1993). For an example see Cheatham et al. (1996) who report about the film industry that studios adjust accounting figures to be able to renege on writers' compensation contracts that are contingent on the economic success of their movies measured by those accounting figures.

Addressing that dual moral hazard problem, Prendergast (1993) predicts in his theoretical model that an employee acquires nonverifiable firm-specific human capital through trainings only if he gets promoted to another job with a higher wage level. Then, the higher wage level is the compensation for preceding human capital acquisition. That compensation is feasible because the firm can credibly commit to it by assigning it to jobs rather than directly to certain human capital. Prendergast (1993) predicts that promotion incentives are only effective if the training leads to higher employee's productivity on the next job rather than on the current job.

Consistently, empirical analysis in this Chapter documents that promotion incentives are positively related to nonverifiable firm-specific human capital acquisition whereas individual performance pay (i.e., piece rates or productivity payments) is not related to such acquisition. Following Becker (1962), I identify nonverifiable firm-specific human capital acquisition as employer-provided or -paid training that likely improves employee's productivity more on the next job than on the current job.

Subsequently, if human capital is general rather than firm-specific, i.e., can also be utilized in other firms (Becker, 1962), I hypothesize that individual performance pay is feasible because the employee can threaten the firm to leave if it does not commit to future compensation for such human capital. Consistently, I find that individual performance pay is positively related to such general human capital acquisition.

All my findings are robust against model specification concerns. Moreover, I compare my results to results with on-the-job training. Further, I discuss findings about alternative performance pay schemes such as a profit sharing plan and equity compensation.

My study contributes to the strand of human capital literature that addresses incentives for human capital acquisition (e.g., Siemsen et al., 2005; Hashimoto, 1979). To my knowledge, this study is the first which documents Prendergast's (1993) model predictions about the relation of promotion incentives and nonverifiable firm-specific human capital acquisition. The positive relation of human capital acquisition and promotion incentives is also reflected in Lazear and Rosen's (1981) statement as follows: 'A contest provides the proper incentives for skill acquisition prior to coming into the position'. Besides, I also analyze individual performance pay. Since I differentiate between two grades of specificity of human capital, I complement some

studies about human capital acquisition that do not take specificity and its implication on the provision of performance pay into account. Siemsen et al. (2005), for instance, predict in their theoretical model that human capital acquisition increases with individual performance pay while not taking specificity into account. Hashimoto (1979) shows theoretically and empirically that human capital acquisition through on-the-job training is related to individual performance pay but does not address its specificity.

My findings also contribute to the knowledge management literature (e.g. Polanyi, 1966; Nonaka, 1994, Davenport and Prusak, 1999; Ambrosini and Bowman, 2001; Tsoukas and Vladimirou, 2001) by documenting which incentives firms provide if knowledge internalization (i.e., human capital acquisition) is required and if such knowledge is nonverifiable and firm-specific or general.

For my study, I choose a sample of 22,788 employees from the Fourth and Fifth European Working Conditions Survey (EWCS) conducted in 2005 and 2010, respectively. My sample is not restricted to a single firm (Gibbs, 1995), industry (Grund and Kräkel, 2012), group of similar jobs (Kwon, 2006; Gibbons and Murphy, 1992), country, or years. As an advantage, this enables me to control for job and employee heterogeneity. An additional methodological advantage of my study is the proxy variable for the provision of promotion incentives: It reflects prospects for career advancement perceived by the employee who knows which next job he is eligible for. On the contrary, the literature usually choose the prize (wage spread) as proxy for promotion incentives and does not control for the case that the employee is, in fact, eligible for the job for which the prize is calculated (e.g., Kale et al., 2009; Gibbs, 1995; De Varo, 2006; Kwon, 2006). Moreover, my approach makes it easy to cope with the large heterogeneity of employees in my sample because I do not need to identify the corresponding prize of the next job the employee is eligible for. Consequently, I expect that my proxy variable is less noisy in measuring promotion incentives than the prize variable because the former refers more likely to the next job.

The remainder of the Chapter is organized as follows: In Section 2 I formulate my hypotheses based on Prendergast's (1993) model. Section 3 describes the sample and variable and model specifications. Section 4 presents the empirical analysis. Section 5 provides robustness analyses. Section 6 concludes and presents some suggestions for future research.

2.2 Theoretical background and hypotheses

Addressing the aforementioned dual moral hazard problem, Prendergast (1993) demonstrates theoretically that promotion incentives induce the employee to acquire nonverifiable firm-specific human capital through training under two conditions. First, such human capital increases productivity more on the next job than on the current job. Second, it is firm-specific because then the firm commits itself credibly to compensate for such acquisition by paying a higher wage on the next job.[5]

He models an employee who can train to acquire skills and the firm can assign him to two different jobs, an easy and a difficult job. The employee's ability before training is not known by the firm and the employee. Further, he assumes that low ability employees fit better to the easy job whereas high ability employees to the difficult job. After training the firm can observe employee's ability and decides on whether or not it assigns him to the difficult job that is considered a promotion.

Further, Prendergast (1993) assumes if the employee is promoted to the difficult job, he gets a higher wage that is regarded as compensation for such training.[6] He shows that the firm is willing to pay the higher wage if the employee is more productive on the difficult job after the training and such productivity increase outweighs the higher costs the firm incurs by the higher wage. Then, the firm is better off to promote him because it maximizes its profits. Consequently, the employee is induced to train because the firm is able to commit credibly to the higher wage as compensation for training.

To illustrate this, consider the production engineer who learns how to steer a new robotic arm. If he is promoted to a supervisor position, that skill does not increase his productivity as supervisor because he will not use the robotic arm any more. Hence, the firm does not profit from the training and is willing neither to promote him to the position nor to pay a higher wage than the wage in the engineer's previous job. Since the engineer anticipates it, he will not train. Consequently, employee's productivity must increase sufficiently more in the next job than in the current job to render promotion incentives effective.

[5] He abstracts from reputation or relational contracts as means against firm's opportunistic behavior (e.g., Bull, 1987; Baker et. al., 2002).

[6] In the literature about promotion incentives such as Lazear and Rosen (1981) the wage spread as difference of the higher wage on the next job and lower wage on the current job is denoted as the prize.

Moreover, Prendergast (1993) concludes that a simple change in the employee's job title such as from a consultant to a senior consultant cannot provide incentives for training because there is no change in employee's productivity after training so that the firm does not earn more and due to this has no reason to pay a higher wage.

Consequently, I formulate my first hypothesis:

H1: The provision of promotion incentives is positively related to nonverifiable firm-specific human capital acquisition that increases employee's productivity on the next job sufficiently more than on the current job.

Subsequently, I relax Prendergast's (1993) assumption of firm-specific human capital and analyze general human capital. According to Becker (1962), human capital is general if the employee can also utilize it in other firms. Then, the firm can credibly commit to future compensation schemes such as individual performance pay because the employee threatens the firm to leave the firm if it reneges on it. Hence, an individual performance pay contract is feasible reflected by my second hypothesis:

H2: The provision of individual performance pay is positively related to nonverifiable general human capital acquisition.

2.3 Sample description and specification of variables and models

2.3.1 Sample description

I use cross-national data from the Fourth and Fifth European Working Conditions Survey (EWCS)[7] conducted in 2005 (4th) and 2010 (5th) by the European Foundation for the Improvement of Living and Working Conditions along residents of the EU and other European countries aged above 15.[8]

The surveys consist of questionnaire-based interviews at the homes of the respondents from 35 countries[9]. They aim at giving insight into the European working environment and concern areas as communication and management structures, work-life balance, organization of work, and payment structures.

Response rates are 44.2 percent (European Foundation for the Improvement of Living and Working Conditions 2010) and 47 percent (European Foundation for the Improvement of Living and Working Conditions 2005), respectively.

The original data sample contains 73,496 observations. I exclude state institutions, industries referring to armed forces or household activities because in those cases compensation structures are different from private, profit-oriented firms. Furthermore, I exclude self-employed and non-employed respondents. After exclusion of missing values, I am left with a set of 25,645 valid cases. For my main analyses, I restrict the sample to 22,788 employees who have been working at least for one year in their firm.[10]

Due to the random route selection and the large number of observations, I do not expect that the same respondent or firm is contained twice in the sample which guarantees that there are no cluster effects regarding a respondent or firm. Moreover the random route selection makes any selection bias unlikely.

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[7] Data is publicly available on http://www.eurofound.europa.eu

[8] The Fourth and the antecedent EWCSs have been used in several studies: Nienhüser and Matiaske (2006) study the compensation of temporary agency workers in European firms. Daniels et al. (2007) investigate the interdependence between job discretion and health outcomes. Ortega (2009) uses the data to analyze the relation between job discretion and performance pay. In Chapter three I also use EWCS data for an empirical study about the employer learning argument of job rotation.

[9] The countries include EU-27 countries (Austria, Belgium, Bulgaria, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovenia, Slovakia, Spain, Sweden and United Kingdom) and Norway, Croatia, Turkey, Switzerland, Albania, Former Yugoslav Republic of Macedonia, Kosovo and Montenegro.

[10] As robustness analysis, I also analyze the entire sample.

2.3.2 Specification of variables

2.3.2.1 Proxy variable for firm-specific human capital acquisition

As proxy for nonverifiable firm-specific human capital acquisition, I choose the binary variable EMPLOYER_PROVIDED_TRAINING which is set to '1' if the employee has undertaken a training which his employer has provided or paid for over the 12 months preceding the date of the interview.[11]

In the aforementioned example, the engineer attends a training about new production processes that is presented by the Chief Technology Officer of the firm.

This type of training is related to firm-specific human capital because Becker (1962) states that the firm is only willing to pay for firm-specific human capital acquisition. Further, I assume that this type of training reflects human capital that improves employee's productivity more on the next job than on the current job.[12]

2.3.2.2 Proxy variable for nonverifiable general human capital acquisition

As proxy for general human capital acquisition, I choose the binary variable EMPLOYEE_PAID_TRAINING which is set to '1' if the employee has undertaken a training which he paid himself for over the 12 months preceding the date of the interview. Becker (1962) assigns the term 'general human capital' to human capital that the employee pays for. The firm is not willing to pay for it because the employee can leave the firm and profit elsewhere from that human capital while the firm cannot benefit from it.

Regarding the example, employee-paid training occurs if the engineer pays for taking engineering classes at university which teach him engineering skills that enhances his job performance in his firm but can also be utilized in other firms.

It is noteworthy that I do not assume that general human capital acquisition is verifiable. It is only essential that other firms are also able to use it. This does not necessarily mean that a court can assess it. To support this assumption, I argue as follows: The engineer's new skills, for instance, cannot likely be assessed by a court represented by judges who studied law. I doubt that the judges can trust other firms which can verify those skills. The reason for it is that other firms as competitors of the employee's current firm are

[11] All variable definitions are described in Table 2.7 in the appendix of this Chapter.
[12] I return to empirical evidence about this assumption in the empirical results Section and robustness analysis Section.

likely reluctant to reveal the true value of employee's human capital because if they do so, the court can enforce compensation for those skills and due to this the employee does not need to leave his current firm and join them.

2.3.2.3 Proxy variables for incentives of interest

Promotion incentives

As proxy variable for the provision of promotion incentives, I choose the variable PROM_INCENTIVES that is based on the question 'My job offers good prospects for career advancement.' Its values range from '0' ('strongly disagree') to '4' ('strongly agree') on a five-step metric scale. As aforementioned, I deviate from the existing literature with this measure because I do not use the prize (wage spread) as the proxy for promotion incentives (e.g., Kale et al., 2009; Kwon, 2006; Gibbs, 1995; De Varo, 2006; Bognanno, 2001) but employee's perception of them. This approach makes it easy to cope with the substantial heterogeneity of employees in my sample because I do not need to identify the corresponding prize of the next job each employee is eligible for.

Individual performance pay

As individual performance pay I regard the provision of piece rates or productivity payments. So, I define a binary variable, INDV_PPAY, whose value is '1' if the employee's remuneration includes 'piece rate or productivity payments'.

Though my sample also includes data about group-based performance pay such as a profit sharing plan and equity compensation, I choose individual performance pay for testing my hypothesis because it is at least noisy in reflecting employee's performance and value of his human capital (Holmström, 1982). Then, the firm learns very well about the impact of recently-acquired human capital on employee's performance and thus can behave opportunistically by, for example, increasing performance objectives or using creative accounting for performance measurement.[13]

Besides, if the firm can commit to future individual performance pay, it does not suffer from free-riding by the employee as group-based performance pay does (Holmström, 1982). The ratchet effect literature such as Weitzman (1980) and Freixas et al. (1985) supports my assumption that the firm is likely to renege on future individual

[13] Creative accounting, for instance, is less possible for firm-wide performance measurement because I expect that shareholders and other stakeholders usually scrutinize firm performance measurement.

performance pay if it has learnt about task productivity and due to this employee's productivity.

2.3.2.4 Control variables

Since the sample is very heterogeneous, it is important to include several control variables which can be correlated with promotion incentives, individual performance pay and the training variables.

To begin with, I control for alternative incentives: I define the dummy variable PROFIT_SHARE (i.e., profit sharing plan) with value '1' if the employee's remuneration includes 'payments based on the overall performance of the company where [he] works'. If his remuneration includes 'income from shares in the company [he] works for', I set the dummy variable EQUITY_COMP (i.e., equity compensation) to '1'.

I include the dummy variable COMPLEX_TASKS whose value of '1' indicates if the job contains complex tasks. Ortega (2009) documents empirically a positive relation between job complexity and the provision of performance pay. Kettenring et al. (2014) show that the provision of promotion incentives and complexity are positively correlated.

To control for uncertainty about already-acquired human capital, I include a five-step scaled variable, OWN_IDEAS measuring how much the employee 'can apply his own ideas'.[14]

I include ISCO_X dummy variables reflecting the International Standard Classification of Occupations code X to control for employee's type of occupation.

Since I assign managerial skills to human capital,[15] I control for it by the binary variable SUBORDINATES that exhibits a value of '1' if the employee has at least one subordinate and by the dummy variable ISCO_1 representing management positions.

I also include ISCED_X as an indicator for the level X of education according to the International Standard Classification of Education (ISCED) code. Hereby, I follow

[14] See for a more detailed discussion and analysis of OWN_IDEAS Chapter 3.

[15] I assume that managerial skills are also utilizable after being promoted to the next rank. So, it is general human capital in the sense of Becker (1962). An indication of this can be found in Oyer and Schaefer (2005) who state that managers can change firms easily due to similar accounting standards and information systems across firms. Besides, personal knowledge about senior's subordinates might get lost after his promotion because his subordinates change. In this case, managerial skills also belong to human capital specific to the current job.

several studies which use the level of education as a proxy for employee's ability (see, e.g., Gibbs, 1995; Kwon, 2006; De Varo, 2006) which I regard as general human capital. I begin with level 3 which represents upper secondary education and leave the levels 0-2 to the constant.

Additionally, I interpret the level of education as proxy for employee's private human capital acquisition costs. My argument is that a better-educated employee is able to acquire human capital less costly in comparison to her worse-educated peer group: An unskilled worker with no high school degree must, for instance, exert more effort to earn a MBA degree than an employee with a bachelor degree. Following this argument, I expect that a higher level of education is related to a higher probability of human capital acquisition.

In line with other studies about incentives (e.g., Gibbs, 1995; De Varo, 2006; Kwon 2006; Baker et al., 1994), I include firm tenure, TENURE. In the literature, it is usually used as a proxy for firm-specific human capital that has been acquired up to date.

If an employee approaches retirement age, promotion incentives will lose their effectiveness because the promotion chance is, then, very low (e.g., Gibbons and Murphy, 1992; De Varo, 2006). Therefore, I add employee's age represented by AGE and its squared version, AGE*AGE, as control variables to address nonlinearity in this variable.

I also account for potential female-male differences in compensation structure and include the respondent's gender as variable, GENDER.

To control for the possibility that measurement of individual output is not possible and consequently the provision of performance pay is less likely, I include ASSESSMENT as a binary variable carrying '1' if the employee's work performance have been assessed formally and regularly in the previous twelve months and '0' otherwise. In addition, I include the dummy variable QUALITY_STANDARDS that measures if the employee must meet 'precise quality standards' that also controls for measurability of performance.

For several reasons, I also include a variable, ROTATING_TASKS, indicating if the employee rotates tasks. First, it can be correlated with promotion incentives because task rotation as proxy variable for job rotation is regarded as mechanism to learn skills for career advancement (Saari et al., 1988). Second, it can be correlated with individual

performance pay and training variables because firms may use it to commit credibly to compensation contracts consistent with Ickes and Samuelson (1987) who show theoretically that job rotation mitigates the ratchet effect that also relates to the problem that firms may renege on individual performance pay contracts. Third, task rotation can help the firm to assess human capital (Ortega, 2009) so that is can be correlated to training variables.

I construct a variable for noise, NOISE, which expresses the intensity of job interruptions which has different effects on the optimal use of incentives (e.g. Lazear and Rosen, 1981; Milgrom and Roberts, 1992).

Since the fundamental problem of multi-tasking described by Holmström and Milgrom (1991) occurs if an employee has at least one other job besides his main job, I expect higher likelihood of provision of incentives that are supposed to induce the employee to concentrate on the main job. I control for the existence of other jobs represented by the binary variable OTHER_JOBS.

Furthermore, I address different development levels of education and economic systems among the European countries by including country dummies, COUNTRY_X. Moreover, I control for the size of the workplace/local unit of establishment with UNIT_SIZE_X.[16]

In order to take into consideration different levels of risk, earnings and regulations across industries, I include industry dummies according the NACE (i.e. in French: Nomenclature Statistique des Activités Economiques dans la Communauté Européenne) code.

Since my sample contains observations either from 2005 or 2010, I control for time effects by including a year dummy variable, YEAR2010, into the model. For example, in a bad economic environment the provision of promotion incentives is less likely than in good economic times.

2.3.3 Descriptive statistics

Descriptive statistics of my variables of interest including the mean and the standard deviation for my main sample of 22,788 employees are shown in *Table 2.1*.

[16] The corresponding question addresses the size of the local establishment or workplace so that it can only be regarded as lower bound of the real firm size. In spite of this drawback, Ortega (2009) also uses these variables in his regression models and European Foundation for the Improvement of Living and Working Conditions (2010) interpret it as firm size in its survey.

Promotion incentives are on average with a value of 1.680 below the midpoint of its scale of 2 indicating that the majority of employees are not optimistic about further career advancement and thus unlikely overstate answers to that question.

The most frequently provided type of pecuniary incentives is individual performance pay (INDV_PPAY) such as piece rates or productivity payments (15.0 percent) followed by a profit sharing plan (14.2 percent), whereas equity compensation is rare (3.5 percent).

Employer-provided trainings (EMPLOYER_PROVIDED_TRAINING) are prevalent (28.8 percent) while employee-paid trainings (EMPLOYEE_PAID_TRAINING) are rare (4.6 percent).

Noise at the workplace (NOISE) with a mean of 1.26 seems to be low on average relative to a midpoint of its scale of 1.5.

58.9 percent have complex tasks and 48.4 percent rotate tasks. OWN_IDEAS with a mean of 2.41 relative to the midpoint of its scale of 2 shows that the majority of all employees is able to apply its own ideas.

Performance of 39.9 percent of the employees has been assessed regularly and 76.4 percent must meet precise quality standards. 6.2 percent of all employees are managers (ISCO 1) and 16.9 percent have subordinates.

55.8 percent of the employees are male with an average age of 40.1 years who have been working in the firm for 9.1 years on average.

The most (least) employees live in Belgium (7.0 percent) (Albania (0.5 percent)), work in NACE 2, i.e. manufacturing and mining sector (27.1 percent) (NACE 3, i.e. electricity, gas and water supply sector (1.4 percent)), are service worker, shop and market sales worker (17.6 percent) (skilled agricultural and fishery workers (0.9 percent)) and completed upper secondary education (45.3 percent) (second stage of tertiary education (1.0 percent)). Most of employees (32.5 percent) work in a workplace with 10 and 49 employees whereas the least of them (2.2 percent) in a workplace with one employee. Only 6.6 percent of all employees have other jobs than their main job. 61.7 percent of observations were made in 2010.

I estimate a Pearson correlation matrix of all independent variables to check for multicollinearity problems (shown in *Table 2.2*). I measure neither any correlation

coefficients among variables of interest above critical levels of 0.8 (see for a thorough analysis about multicollinearity Mason and Perreault, 1991) nor variance inflation factors (vif) for the variables of interest below the critical value of 10 (Kennedy, 2008), So, I conclude that my analyses do not suffer from multicollinearity problems

Table 2.1: Descriptive statistics. Variables are defined as described in Table 2.7.

	Entire sample (N = 22,788)	
Variables	**Mean**	**Standard Deviation**
EMPLOYER_PROVIDED_TRAINING	0.288	0.453
EMPLOYEE_PAID_TRAINING	0.046	0.210
ON_THE_JOB_TRAINING	0.315	0.464
PROM_INCENTIVES	1.680	1.193
INDV_PPAY	0.150	0.357
PROFIT_SHARE	0.142	0.349
EQUITY_COMP	0.035	0.184
JOB_LOSS_PROB	1.305	1.218
QUALITY_STANDARDS	0.764	0.425
COMPLEX_TASKS	0.589	0.492
OWN_IDEAS	2.409	1.377
ROTATING_TASKS	0.484	0.500
AGE	40.083	11.430
TENURE	9.127	8.801
ISCED_0_2	0.249	0.432
ISCED_3	0.453	0.498
ISCED_4	0.069	0.254
ISCED_5	0.220	0.414
ISCED_6	0.010	0.099
SUBORDINATES	0.169	0.375
ASSESSMENT	0.399	0.490
GENDER	0.558	0.497
NOISE	1.255	0.948
OTHER_JOBS	0.066	0.248
ISCO_1	0.062	0.240
ISCO_2	0.087	0.283
ISCO_3	0.140	0.347
ISCO_4	0.136	0.343
ISCO_5	0.165	0.371
ISCO_6	0.009	0.094
ISCO_7	0.176	0.381
ISCO_8	0.118	0.323
ISCO_9	0.106	0.308
NACE_1	0.025	0.157
NACE_2	0.271	0.444
NACE_3	0.014	0.118
NACE_4	0.097	0.296
NACE_5	0.227	0.419
NACE_6	0.063	0.242
NACE_7	0.071	0.257
NACE_8	0.050	0.219
NACE_9	0.102	0.302
NACE_10	0.009	0.093
NACE_11	0.072	0.258
UNIT_SIZE_1	0.022	0.148
UNIT_SIZE_2_4	0.145	0.353
UNIT_SIZE_5_9	0.180	0.384
UNIT_SIZE_10_49	0.325	0.468
UNIT_SIZE_50_99	0.105	0.306
UNIT_SIZE_100_249	0.098	0.298
UNIT_SIZE_250_499	0.049	0.217
UNIT_SIZE_500+	0.075	0.263
YEAR2010	0.617	0.486

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Table 2.2: Correlation matrix. Variables are defined as described in Table 2.7. Entire sample (N=22,788) is applied here. Asterisks denote statistical significance at the 0.01(***), 0.05(**) and 0.10(*)-level.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 EMPLOYER_PROVIDED_ TRAINING	1														
2 EMPLOYEE_PAID_ TRAINING	0.096***	1													
3 ON_THE_JOB_TRAINING	0.410***	0.065***	1												
4 PROM_INCENTIVES	0.225***	0.058***	0.181***	1											
5 INDV_PAY	-0.005	0.015**	0.032***	0.018***	1										
6 PROFIT_SHARE	0.178***	0.019***	0.132***	0.153***	0.098***	1									
7 EQUITY_COMP	0.092***	0.026***	0.062***	0.092***	0.050***	0.283***	1								
8 JOB_LOSS_PROB	-0.101***	0.008	-0.046***	-0.163***	0.047***	-0.080***	-0.062***	1							
9 GENDER	0.034***	-0.010	0.021***	0.081***	0.071***	0.076***	0.052***	-0.003	1						
10 TENURE	0.042***	-0.032***	-0.004	-0.054***	-0.016**	0.059***	0.082***	-0.121***	0.086***	1					
11 AGE	-0.011*	-0.047***	-0.056***	-0.169***	-0.030***	0.018***	0.038***	-0.034***	0.013**	0.522***	1				
12 AGE*AGE	-0.020***	-0.048***	-0.058***	-0.169***	-0.032***	0.009	0.034***	-0.034***	0.018***	0.516***	0.988***	1			
13 SUBORDINATES	0.151***	0.068***	0.075***	0.195***	-0.009	0.135***	0.099***	-0.082***	0.098***	0.101***	0.069***	0.057***	1		
14 ISCO_1	0.109***	0.035***	0.059***	0.146***	-0.014**	0.145***	0.112***	-0.058***	0.053***	0.042***	0.054***	0.047***	0.370***	1	
15 NOISE	0.167***	0.041***	0.126***	0.096***	-0.043***	0.104***	0.065***	-0.047***	-0.021***	0.038***	-0.038***	-0.044***	0.170***	0.127***	1
16 OTHER_JOBS	0.036***	0.036***	0.031***	-0.011	0.018***	0.001	0.004	0.005	0.016**	-0.040***	-0.020***	-0.020***	0.021***	-0.010	0.033***
17 COMPLEX_TASKS	0.177***	0.055***	0.158***	0.187***	0.027***	0.119***	0.066***	-0.040***	0.119***	0.075***	0.019***	0.009	0.160***	0.111***	0.222***
18 OWN_IDEAS	0.156***	0.057***	0.076***	0.279***	-0.019***	0.110***	0.064***	-0.171***	0.076***	0.066***	0.053***	0.048***	0.216***	0.145***	0.157***
19 ROTATING_TASKS	0.083***	0.010	0.115***	0.021***	0.009	0.033***	0.018***	0.010	0.024***	-0.008	-0.064***	-0.067***	0.038***	-0.017**	0.139***
20 ASSESSMENT	0.237***	0.050***	0.236***	0.176***	0.050***	0.157***	0.098***	-0.036***	0.027***	0.007	-0.033***	-0.035***	0.123***	0.097***	0.124***
21 QUALITY_STANDARDS	0.071***	0.016**	0.074***	0.077***	0.061***	0.014**	0.014**	-0.030***	0.077***	0.051***	-0.009	-0.013*	0.061***	0.006	0.067***

Table 2.2 cont'd

	16	17	18	19	20	21
1 EMPLOYER_PROVIDED_ TRAINING						
2 EMPLOYEE_PAID_ TRAINING						
3 ON_THE_JOB_TRAINING						
4 PROM_INCENTIVES						
5 INDV_PAY						
6 PROFIT_SHARE						
7 EQUITY_COMP						
8 JOB_LOSS_PROB						
9 GENDER						
10 TENURE						
11 AGE						
12 AGE*AGE						
13 SUBORDINATES						
14 ISCO_1						
15 NOISE						
16 OTHER_JOBS	1					
17 COMPLEX_TASKS	0.003	1				
18 OWN_IDEAS	0.018***	0.199***	1			
19 ROTATING_TASKS	0.022***	0.090***	0.031***	1		
20 ASSESSMENT	0.006	0.151***	0.110***	0.088***	1	
21 QUALITY_STANDARDS	-0.000	0.182***	0.047***	0.100***	0.116***	1

2.3.4 Specification of models

2.3.4.1 Firm-specific human capital acquisition

To test H1, I regress EMPLOYER_PROVIDED_TRAINING on PROM_INCENTIVES and INDV_PPAY in the following probit regression model, M1:

$$\text{EMPLOYER\_P ROVIDED\_TR AINING} = \Phi(\beta_0 + \beta_1 PROM\_INCENTIVES + \beta_2 INDV\_PPAY + \beta' controls + \varepsilon)$$

I calculate clustered robust standard errors by choosing year, country and industry dummy variables as cluster variables.[17] Besides, I calculate McFadden's likelihood ratio index (LRI) (McFadden, 1974) to measure goodness of fit.

If PROM_INCENTIVES possesses a positive and statistically significant coefficient, H1 is confirmed.

2.3.4.2 General human capital acquisition

To test H2, I regress EMPLOYEE_PAID_TRAINING on INDV_PPAY in the following probit regression model, M2:

$$\text{EMPLOYEE\_P AID\_TRAINI NG} = \Phi(\beta_0 + \beta_1 PROM\_INCENTIVES + \beta_2 INDV\_PPAY + \beta' controls + \varepsilon)$$

Again, I calculate clustered robust standard errors by choosing year, country and industry dummy variables as cluster variables and McFadden's likelihood ratio index (LRI) (McFadden, 1974) to measure goodness of fit.

If PERFORMANCE_PAY exhibits a positive and statistically significant coefficient, H2 is supported.

I estimate M1 and M2 with a sample of employees who have been working with the firm for at least one year to rule out that the training took place while they were not in the current firm and provided with the incentives of interest, PROM_INCENTIVES and INDV_PPAY or, even, unemployed.[18] Otherwise, my analysis could suffer from endogeneity problems because if the training took place before joining the current firm, there could be a reverse causality of training on incentive design.

[17] See Petersen (2009) for the necessity of clustered robust standard errors.
[18] I also provide estimations with the entire sample in the robustness analyses Section.

2.4 Empirical results

2.4.1 Firm-specific human capital acquisition

My results from M1 are illustrated in *Table 2.3*. Since the coefficient on PROM_INCENTIVES is positive and significant at the one percent level, H1 is confirmed reflecting a positive relation of promotion incentives with nonverifiable firm-specific human capital acquisition.

The coefficient on INDV_PPAY is statistically insignificant. Hence, there is no relation of individual performance pay with nonverifiable firm-specific human capital. Even though Prendergast (1993) does not model performance pay explicitly,[19] his assumption indicates that individual performance pay cannot induce employees to train. To support this argument, I refer to the ratchet effect literature (e.g. Weitzman, 1980; Freixas et al., 1985) that also assumes that the firm will behave opportunistically and renege on future individual performance pay contracts once it has learnt about task productivity. As a result, the employee is reluctant to exert maximum effort that I also assign to training effort. This finding contradicts Siemsen et al. (2005) and Hashimoto (1979) who show theoretically positive relations of individual performance pay with on-the-job learning. The reason for it is that they do not address nonverifiability of such learning and accompanying commitment problems.

It is noteworthy that PROFIT_SHARE exhibits a positive and statistically significant at the one percent level coefficient. As group-based performance pay, it is likely related to cooperative tasks (Wageman, 1995; Wageman and Baker, 1997; Siemsen et al., 2007; Hwang et al., 2009; Drago and Turnbull, 1988). In this case, performance measurement is very noisy (Holmström, 1982) and due to this less likely supports opportunistic behavior by the firm. Besides, manipulating performance measurement to understate employee performance is less possible, because I expect that firm performance measurement is scrutinized by many stakeholders and shareholders. Further, if the firm profits from opportunistic behavior, the employee also benefits from it through the higher firm performance caused by its opportunism. On the contrary, EQUITY_COMP has no statistically significant relation to the training.

[19] In fact, he assumes that the wage cannot be conditioned on human capital or output because both are nonverifiable.

Table 2.3: Main models about human capital acquisition. Variables are defined as described in Table 2.7. Standard errors are clustered robust with year, country and industry variables as cluster variables and reported in parentheses. Asterisks denote statistical significance at the 0.01(***), 0.05(**) and 0.10(*)-level.

	M1 (PROBIT)	**M2 (PROBIT)**
Sample	**Entire sample**	**Entire sample**
Variables	**EMPLOYER_ PROVIDED_ TRAINING**	**EMPLOYEE_PAID_ TRAINING**
PROM_INCENTIVES	0.124***	0.008
	(0.010)	(0.015)
	Marginal effect: 0.034***	Marginal effect: 0.001
INDV_PPAY	-0.044	0.099**
	(0.032)	(0.045)
	Marginal effect: -0.012	Marginal effect: 0.009
PROFIT_SHARE	0.210***	-0.014
	(0.029)	(0.047)
	Marginal effect: 0.058***	Marginal effect: -0.001
EQUITY_COMP	0.036	0.172**
	(0.051)	(0.073)
	Marginal effect: 0.010	Marginal effect: 0.015**
GENDER	0.099***	-0.013
	(0.023)	(0.034)
TENURE	0.002	-0.003
	(0.001)	(0.003)
AGE	0.019***	-0.003
	(0.006)	(0.009)
AGE*AGE	-0.000***	-0.000
	(0.000)	(0.000)
SUBORDINATES	0.140***	0.220***
	(0.028)	(0.041)
ISCO_1	0.263***	0.311***
	(0.059)	(0.091)
NOISE	0.074***	0.039**
	(0.011)	(0.019)
OTHER_JOBS	0.140***	0.209***
	(0.038)	(0.055)
COMPLEX_TASKS	0.136***	0.095***
	(0.022)	(0.036)
OWN_IDEAS	0.051***	0.028**
	(0.008)	(0.014)
ROTATING_TASKS	0.142***	0.054*
	(0.021)	(0.032)
ASSESSMENT	0.355***	0.085**
	(0.022)	(0.034)
QUALITY_STANDARDS	0.116***	0.026
	(0.027)	(0.038)
ISCED_3	0.037	0.087
	(0.032)	(0.054)
ISCED_4	0.155***	0.238***
	(0.046)	(0.072)
ISCED_5	0.168***	0.343***
	(0.039)	(0.068)
ISCED_6	0.210*	0.261*
	(0.107)	(0.149)
Year/industry/country/ size/occupation	YES	YES
Constant	-1.817***	-1.884***
	(0.176)	(0.276)
N	22,788	22,788
McFadden-LRI	0.1822	0.1055

To support my interpretation that EMPLOYER_PROVIDED_TRAINING reflects firm-specific human capital acquisition and training that leads to higher productivity on the next job than on the current job, I analyze some control variables in the following.

The positive coefficient (significant at the one percent level) on COMPLEX_TASKS that Ortega (2009) interpret as proxy variable for specific knowledge indicates that the training refers to firm-specific rather than general human capital acquisition.

Since OWN_IDEAS reflects the high value of employee's existent human capital, its positive and significant at the one percent level coefficient indicates that the training has likely a high intellectual level because only then it is able to add value to employee's already very valuable human capital. Since I argue that very intellectual skills are more valuable for managerial jobs, it is likely that human capital acquired by such training makes the employee more productive on the next job with a higher rank rather than on the current job with a lower rank.

The same argument is supported by findings about SUBORDINATES and ISCO_1: Both SUBORDINATES and ISCO_1 (managers) exhibit positive coefficients (significant at $y < 0.01$). In addition, the highest marginal effect on an occupation control variable is on ISCO_1 (not reported). Since managers are likely to learn managerial skills that I assume to be more valuable the higher they climb up the career ladder, it also supports the interpretation of the training as preparation for higher-rank jobs.

For ISCED_4, ISCED_5, and ISCED_6, I estimate positive marginal effects (significant at $p < 0.01$, 0.01 and 0.05, respectively, not reported) which rise with the level of education showing that training is undertaken by well-educated employees who have less acquisition costs compared to lower-educated employees. The fact that the marginal effects rise with the level of education also indicates that the training is related to a high intellectual level.

OTHER_JOBS exhibits a positive coefficient (significant at $p < 0.01$). This finding can reflect that there is an outside option for the employee so that the firm is less likely able to behave opportunistically on firm-specific human capital acquisition. Moreover, it can indicate that the firm provides the training to retain him. In this manner, I interpret it as an additional proxy variable for promotion incentives.

Since there are more career opportunities in bigger firms and the marginal effects (not reported) on the unit size (UNIT_SIZE_X) turn positive and rise with the size, I consider it an additional indication for a training that prepares employees to make career advancement.

ROTATING_TASKS can only provide mixed indication for my interpretation because task rotation as type of job rotation is regarded as mechanism to learn skills for career advancement (Saari et al., 1988) but also as remedy against the ratchet effect (Ickes and Samuelson, 1987) that is related to the firm's inability to commit to future compensation.

2.4.2 General human capital acquisition

In M2, INDV_PPAY exhibit a positive and statistically significant at the five percent level coefficient. This finding supports H2 indicating that individual performance pay is positively related to general human capital acquisition.

It is noteworthy that PROM_INCENTIVES exhibits a statistically insignificant coefficient. I suggest that promotion incentives could induce general human capital acquisition. However, if they are not provided, an employee can also be induced to train to get equipped with skills enabling him to leave the firm.

The fact that QUALITY_STANDARDS has no statistically significant relation to the employee-paid training indicates that such training is related to general human capital acquisition because quality standards are likely very firm-specific. The positive coefficient (significant at $p < 0.01$) on OTHER_JOBS also supports this interpretation.

Since equity compensation is seen as retention instrument (Oyer and Schaefer, 2005), I interpret it as a signal for the existence of employee's outside options. If the employee has outside options, he is more likely to acquire general human capital. The positive coefficient on EQUITY_COMP (significant at $p < 0.05$) supports this argument.

The positive coefficient on ISCO_1 (significant at $p < 0.01$) also supports this interpretation because I expect managers to leave the firm more likely because job opportunities are getting less the higher the rank (Gibbs, 2005).

The positive coefficient on COMPLEX_TASKS (significant at $p < 0.01$) indicates that the general human capital acquired in the employee-paid training can also be utilized on the current job.

2.5 Robustness analyses

2.5.1 Alternative model specifications

I also estimate M1 and M2 with squared versions of PROM_INCENTIVES, PROM_INCENTIVES*PROM_INCENTIVES and the logarithm of (PROM_INCENTIVES+1). Then, I yield the same qualitative results.[20]

If I do not restrict my sample to employees who have been working with the firm for at least one year and also include recently hired employees (not reported), I obtain the same qualitative results regarding the hypotheses.

2.5.2 Alternative proxy for firm-specific human capital

An alternative proxy variable for firm-specific human capital is on-the-job training, ON_THE_JOB_TRAINING, that is based on the question if the employee has undergone on-the-job training over the 12 months preceding the date of the interview. 31.5 percent of all employees have undertaken such training. I assume that ON_THE_JOB_TRAINING reflects very likely job-specific human capital acquisition that is part of firm-specific human capital acquisition: The engineer, for instance, gets on-the-job-training about a new machine configuration by his colleagues. However, if he is promoted to the production division manager, he does not necessarily utilize the knowledge about the machine configuration any more. The following analysis addresses this argument.

If I apply M1 with ON_THE_JOB_TRAINING as dependent variable denoted as M3(1), I observe a positive and statistically at the one percent level coefficient on PROM_INCENTIVES (depicted in *Table 2.4*).

This result, however, suffers from a misspecification error because if I include its squared version, PROM_INCENITVES*PROM_INCENTIVES, in the model, i.e., M3(2), its coefficient is negative.

[20] The coefficient on the logarithm of PROM_INCENTIVES is positive and statistically significant at $p < 0.01$ while the coefficient on PROM_INCENTIVES*PROM_INCENTIVES is statistically insignificant. According to Ai and Norton (2003), interaction terms with continuously scaled variables such as PROM_INCENTIVES in probit regression models suffer from wrong calculations of their coefficients and standard errors by statistics software. Due to this problem, I also estimate M1 and M2 as linear probability models (tot reported). In M1, the coefficient PROM_INCENTIVES*PROM_INCENTIVES is statistically significant at $p < 0.01$ whereas PROM_INCENTIVES itself not. Nevertheless, this finding still supports H1. In M2, we, again, observe statistically insignificant coefficients on all versions of PROM_INCENTIVES.

According to Ai and Norton (2003), interaction terms with continuously scaled variables such as PROM_INCENTIVES*PROM_INCENTIVES in probit regression models are not properly calculated by standard statistics software, I estimate the model as a linear probability model.[21] Then, the coefficient on PROM_INCENTIVES is positive and significant at the one percent level supporting H1.

It is noteworthy that now the coefficient on INDV_PPAY is positive and statistically significant at $p < 0.05$. This finding supports Siemsen et al. (2005), Hashimoto (1979) and Kwon (2006) indicating that on-the-job training is less exposed to the risk of opportunistic behavior by the firm.

Moreover, one can argue that employer-provided training is the same as on-the-job training so that the interpretation is not right that it measures human capital that is likely more productive on the next job. The employee does not characterize both trainings as the same because the two-way *Table 2.5* shows that a lot of employees mention on-the-job-trainings without mentioning employer-provided trainings.

[21] Wooldridge (2013) defends the use of linear probability models even if the dependent variable dichotomous.

Table 2.4: Robustness analyses. Variables are defined as described in Table 2.7. Standard errors are clustered robust with year, country and industry variables as cluster variables and reported in parentheses. Asterisks denote statistical significance at the 0.01(***), 0.05(**) and 0.10(*)-level.

Sample	**M3(1) (PROBIT)** **Entire sample**	**M3(2) (PROBIT)** **Entire sample**	**M3(3) (LPM)** **Entire sample**	**M4 (LPM)** **Employees with exclusive trainings**
Variables	**ON_THE_JOB_ TRAINING**	**ON_THE_JOB_ TRAINING**	**ON_THE_JOB_ TRAINING**	**EMPLOYEE_PAID_ TRAINING**
PROM_INCENTIVES	0.110***	0.167***	0.034***	-0.044**
	(0.010)	(0.028)	(0.003)	(0.019)
PROM_INCENTIVES* PROM_INCENTIVES	-	-0.015**	-	0.014***
		(0.007)		(0.005)
INDV_PPAY	0.079**	0.079**	0.021**	-0.058***
	(0.031)	(0.031)	(0.010)	(0.019)
PROFIT_SHARE	0.100***	0.100***	0.038***	0.059***
	(0.029)	(0.029)	(0.010)	(0.017)
EQUITY_COMP	0.008	0.009	0.006	0.024
	(0.056)	(0.056)	(0.019)	(0.034)
GENDER	0.064***	0.064***	0.020***	0.022
	(0.022)	(0.022)	(0.007)	(0.015)
TENURE	-0.001	-0.001	-0.001	0.002*
	(0.001)	(0.001)	(0.000)	(0.001)
AGE	-0.012**	-0.012**	-0.004**	0.017***
	(0.006)	(0.006)	(0.002)	(0.003)
AGE*AGE	0.000	0.000	0.000	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
SUBORDINATES	-0.000	0.000	-0.001	0.083***
	(0.028)	(0.028)	(0.009)	(0.018)
ISCO_1	0.065	0.064	0.018	0.098**
	(0.057)	(0.057)	(0.017)	(0.038)
NOISE	0.056***	0.057***	0.017***	0.010
	(0.010)	(0.010)	(0.003)	(0.007)
OTHER_JOBS	0.126***	0.126***	0.039***	0.013
	(0.037)	(0.037)	(0.012)	(0.023)
COMPLEX_TASKS	0.156***	0.155***	0.046***	0.000
	(0.023)	(0.023)	(0.007)	(0.015)
OWN_IDEAS	-0.005	-0.005	-0.001	0.029***
	(0.008)	(0.008)	(0.002)	(0.005)
ROTATING_TASKS	0.213***	0.213***	0.066***	-0.041***
	(0.018)	(0.018)	(0.006)	(0.013)
ASSESSMENT	0.401***	0.402***	0.133***	-0.028**
	(0.021)	(0.021)	(0.007)	(0.013)
QUALITY_STANDARDS	0.113***	0.113***	0.029***	-0.005
	(0.027)	(0.027)	(0.008)	(0.017)
Year/industry/country/ size/occupation/education	YES	YES	YES	YES
Constant	-0.854***	-0.865***	0.245***	0.006
	(0.173)	(0.173)	(0.055)	(0.114)
N	22,788	22,788	22,788	5,677
McFadden-LRI (PROBIT)/R^2 (LPM)	0.1367	0.1369	0.1604	0.1263

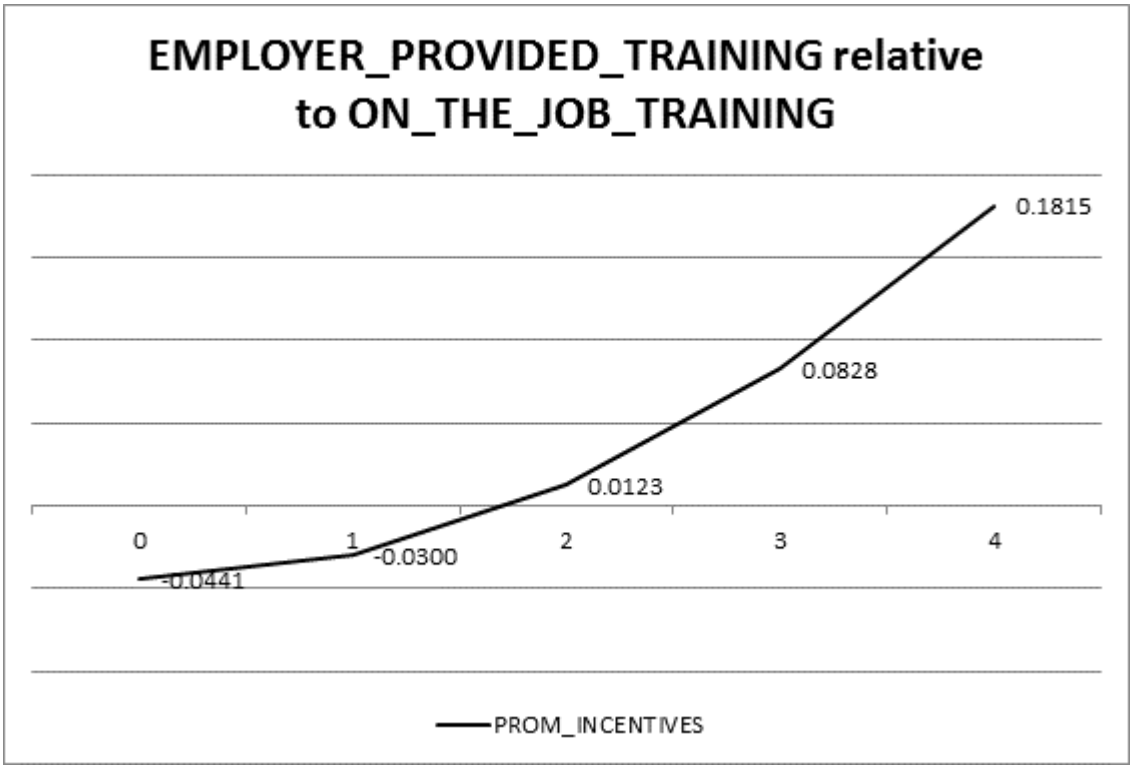
Table 2.5: Employer-provided trainings and on-the-job-trainings. Variables are defined as described in Table 2.7.

	ON_THE_JOB_TRAINING		**TOTAL**
EMPLOYER_PROVIDED_TRAINING	**0**	**1**	
0	13,079	3,140	16,219
1	2,537	4,032	6,569
TOTAL	15,616	7,172	22,788

Now, I consider the situation that an employee is supposed to choose one of two available trainings that are represented by EMPLOYER_PROVIDED_TRAINING and ON_THE_JOB_TRAINING. Consistent with Prendergast (1993), I expect that the employee will choose employer-provided trainings rather than on-the-job trainings if promotion incentives are provided. The reason for it is that I expect that employer-provided trainings increase more likely human capital that is more productive on the next job than on-the-job trainings.

To show this, I estimate a linear probability model (LPM) of M1 with a reduced sample containing 5,677 employees who have exclusively undergone one of the two types of trainings (depicted in Table 2.5) that I denote as M4.[22] Then, I obtain the following combined effect of PROM_INCENTIVES and PROM_INCENTIVES*PROM_INCENTIVES as shown in *Figure 2.1*: I observe that for high values of PROM_INCENTIVES the likelihood to prefer an employer-provided training relative to an on-the-job training is higher. This finding also supports H1.

Figure 2.1: Relation of PROM_INCENTIVES and EMPLOYER_PROVIDED_TRAINING relative to ON_THE_JOB_TRAINING.



[22] This approach is also used by Hwang et al. (2008) to show the relative importance of group-based pay over individual-based pay in conjunction with knowledge sharing.

2.5.4 Endogeneity concerns

2.5.4.1 Discussion

Problems of endogeneity can occur if an explanatory variable of interest is correlated with the disturbances (i.e., error term) of the model. Examples are an omitted variable bias caused by a reverse causality with the dependent variable (Green, 2013).

Since it refers to a time span from the time of the interview that does not exceed 12 months and the provision of the incentives is measured at the time of the interview, it is possible that the provision of incentives in place at the time of the interview are the reward of such training if the training was completed before the interview (i.e., reverse causality). As a result, PROM_INCENTIVES and INDV_PPAY can be endogenous.

I, however, regard this interpretation of the question as unlikely because of the following two reasons. [23] First, the firm and the employee need time to negotiate on a new incentive design so that it is unlikely that at the time of the interview the incentive design is different from the one before the training. Second, EMPLOYER_PROVIDED_TRAINING and EMPLOYEE_PAID_TRAINING do not rule out that the training is still ongoing at the time of the interview making a recent change in incentive design also unlikely.

2.5.4.2 Control for job loss probability

Another problem of endogeneity can arise from the following omitted variable bias: If the employee's likelihood of getting dismissed (omitted variable) is high and leads to a weaker perception of a promotion incentives (negative correlation), this omitted variable might be correlated positively with EMPLOYEE_PAID_TRAINING to find a new job or negatively related to EMPLOYER_PROVIDED_TRAINING. To rule out such omitted variable bias, I include in M1 and M2 a variable, JOB_LOSS_PROB, whose values range from '0' ('strongly disagree') to '4' ('strongly agree') answering the question if he might lose his job in the next six months. The results remain qualitatively the same (depicted in *Table 2.6*).

It is noteworthy that the coefficient on JOB_LOSS_PROB is negative for EMPLOYER_PROVIDED_TRAINING and positive for

[23] Kruse et al. (2008), for instance, apply a similar approach when they also regress training in the previous 12 months on the provision of group-based incentives as a profit sharing plan and then regard this as evidence that such incentives motivate training.

EMPLOYEE_PAID_TRAINING supporting my interpretation that the former is related to firm-specific human capital acquisition and the latter to general human capital acquisition.

2.5.4.2 Control for outside options

PROM_INCENTIVES and INDV_PPAY could be endogenous if they are correlated to an omitted variable that represents outside options. So, the positive correlation of PROM_INCENTIVES with EMPLOYER_PROVIDED_TRAINING can, for instance, be caused by such omitted variable and not by the incentives themselves. Due to this, I include in M1 and M2 a variable, OUTSIDE_OPTION, whose values range from '1' ('strongly disagree') to '5' ('strongly agree') answering the question whether the employee would get a new job with a similar salary if he lost his current job.

Since this variable is only available for the EWSC 2010 sample, I do not include it in my main analysis. Again, I obtain the same qualitative results (depicted in *Table 2.6*).

Interestingly, in both models its coefficient is positive. In M1, the finding indicates that the outside option disciplines the firm not to behave opportunistically against him because then he can threaten credibly to leave the firm. Concerning M2, I argue that outside options induce the employee to acquire general human capital that he can also utilize in a new firm.

Table 2.6: Robustness analyses. Variables are defined as described in Table 2.7. Standard errors are clustered robust with year, country and industry variables as cluster variables and reported in parentheses. Asterisks denote statistical significance at the 0.01(***), 0.05(**) and 0.10(*)-level.

	M5 (PROBIT)	**M6 (PROBIT)**	**M7 (PROBIT)**	**M8 (PROBIT)**
Sample	**Entire sample**	**Entire sample**	**Only 2010 data**	**Only 2010 data**
Variables	**EMPLOYER_ PROVIDED TRAINING**	**EMPLOYEE_PAID_ TRAINING**	**EMPLOYER_ PROVIDED TRAINING**	**EMPLOYEE_PAID_ TRAINING**
PROM_INCENTIVES	0.120***	0.013	0.152***	0.026
	(0.010)	(0.015)	(0.013)	(0.020)
INDV_PPAY	-0.042	0.096**	-0.043	0.134**
	(0.032)	(0.046)	(0.043)	(0.059)
PROFIT_SHARE	0.207***	-0.011	0.225***	0.010
	(0.030)	(0.047)	(0.039)	(0.060)
EQUITY_COMP	0.034	0.177**	-0.052	0.184**
	(0.051)	(0.073)	(0.061)	(0.089)
JOB_LOSS_PROB	-0.032***	0.041***	-	-
	(0.009)	(0.015)		
OUTSIDE_OPTION	-	-	0.035***	0.054***
			(0.013)	(0.018)
GENDER	0.100***	-0.014	0.099***	0.026
	(0.023)	(0.035)	(0.032)	(0.043)
TENURE	0.002	-0.002	0.002	-0.007*
	(0.001)	(0.003)	(0.002)	(0.003)
AGE	0.019***	-0.004	0.020***	-0.008
	(0.006)	(0.009)	(0.008)	(0.012)
AGE*AGE	-0.000***	-0.000	-0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
SUBORDINATES	0.138***	0.223***	0.072*	0.177***
	(0.027)	(0.041)	(0.038)	(0.054)
ISCO_1	0.261***	0.315***	0.319***	0.368***
	(0.059)	(0.092)	(0.079)	(0.113)
NOISE	0.076***	0.037**	0.058***	0.070***
	(0.011)	(0.019)	(0.014)	(0.026)
OTHER_JOBS	0.141***	0.209***	0.125**	0.095
	(0.038)	(0.055)	(0.049)	(0.080)
COMPLEX_TASKS	0.137***	0.092**	0.127***	0.157***
	(0.022)	(0.036)	(0.027)	(0.048)
OWN_IDEAS	0.048***	0.031**	0.050***	0.036*
	(0.008)	(0.014)	(0.011)	(0.020)
ROTATING_TASKS	0.143***	0.053*	0.142***	0.056
	(0.021)	(0.032)	(0.027)	(0.041)
ASSESSMENT	0.357***	0.084**	0.382***	0.125***
	(0.022)	(0.034)	(0.028)	(0.047)
QUALITY_STANDARDS	0.117***	0.026	0.112***	-0.000
	(0.027)	(0.039)	(0.035)	(0.054)
Year/industry/country/ size/occupation/education	YES	YES	YES	YES
Constant	-1.793***	-1.911***	-1.882***	-1.785***
	(0.176)	(0.275)	(0.208)	(0.355)
N	22,788	22,788	13,606	13,606
McFadden-LRI (PROBIT)	0.1827	0.1066	0.1881	0.1177

2.6 Conclusion

I provide empirical evidence about how promotion incentives and performance pay are related to nonverifiable human capital acquisition contingent on its grade of firm specificity.

Consistent with Prendergast (1993), if nonverifiable human capital is firm-specific and leads to higher employee's productivity on the next job, I document a positive relation of promotion incentives with such human capital acquisition whereas I find no relation of individual performance pay with such acquisition. On the contrary, if human capital is general, I document a positive relation of individual performance pay to its acquisition.

My findings are robust against some model specification concerns and against sample selection bias concerns. In addition, I rebut some endogeneity concerns.

Suggestions for future research

Concerning my methodology, it would be advantageous for further research to track employees in a panel dataset to yield more insight into their human capital acquisition dynamics over time and control for employee- and firm-fixed effects.

To conclude, the firm can steer precisely which type of human capital the employee chooses to acquire. Promotion incentives are positively related to firm-specific human capital acquisition whereas individual performance pay to job-specific and general human capital.

In addition, since in my sample employer-provided trainings representing firm-specific human capital acquisition are more prevalent than employee-paid trainings reflecting general human capital acquisition (i.e., 28.8 percent vs. 4.6 percent), employees are more concerned if and how they profit from firm-specific rather than general human capital acquisition. This finding leads to a possible answer to the question asked by Baker et al. (1988) and Prendergast (1999) why promotion incentives are prevalent: Firms prefer providing promotion incentives rather than performance pay to address these prevalent concerns.

2.7 Appendix

Table 2.7: Definitions of variables.

Variable	Question in EWCS 2005 (EWSC 2010)	Definition
Incentive proxy variables of interest		
INDV_PPAY	ef6b. What does your remuneration include: Piece rate or productivity payments? (ef7b. Thinking about your earnings from your main job, what do they include – Piece rate or productivity payments?)	Dummy variable that is set to '1' if compensation includes an individual bonus (e.g., piece rate or productivity payments) and to '0' otherwise
PROM_INCENTIVES	q37c. My job offers good prospects for career advancement (q77c. How much do you agree or disagree with statements describing some aspects of your job – My job offers good prospects for career advancement?)	Numeric variable that ranges from '0' ('strongly disagree') to '4' ('strongly agree')
Human capital acquisition proxy variables		
EMPLOYEE_PAID_ TRAINING	q28b_1. Have you undergone: Training paid for by yourself? (q61b. Over the past 12 months, have you undergone any of types of training to improve your skills or not - Training paid for by yourself?)	Dummy variable that is set to '1' if such employee-paid training has been undergone and to '0' otherwise
EMPLOYER_PROVIDED_ TRAINING	q28a_1. Have you undergone: Training paid for or provided by your employer, or by yourself if you are self-employed? (q61a. Over the past 12 months, have you undergone any of types of training to improve your skills or not - Training paid for or provided by your employer or by yourself if self-employed?)	Dummy variable that is set to '1' if employer-provided training has been undergone and to '0' otherwise
ON_THE_JOB_TRAINING	q28c. Have you undergone: On-the-	Dummy variable that is set to '1'

	job training? (q61c. Over the past 12 months, have you undergone any of types of training to improve your skills or not - On-the-job training?)	if on-the-job training has been undergone and to '0' otherwise.
Control variables		
AGE	hh2b. Age-Respondent (hh2b. Age – Respondent)	Numeric, continuous variable for years of age
ASSESSMENT	q30c. Over the past 12 months have you been subject to regular formal assessment of your work performance? (q62a. Over the past 12 months, have you – Been subject to formal assessment of your work performance?)	Dummy variable that is set to '1' if respondent has been subject to a formal work assessment and to '0' otherwise
COMPLEX_TASKS	q23e. Does your main paid job involve: complex tasks? (q49e. Generally, does your main paid job involve complex tasks?)	Dummy variable that is set to '1' if respondent's job involves complex tasks and to '0' otherwise
Country variables (COUNTRY_X)	Country where interview was conducted	Dummy variables for 35 European countries
EQUITY_COMP	ef6i. What does your remuneration include: Income from shares in the company your work for? (ef7i. Thinking about your earnings from your main job, what do they include – Income from shares in the company your work for?)	Dummy variable that is set to '1' if compensation includes stock of the firm and to '0' otherwise
GENDER	hh2a. Sex – Respondent (hh2a. Sex – Respondent)	Dummy variable that is set to '1' for a male respondent and '0' for female
Education variable (ISCED_X)	ISCED classification: the highest level of education or training	4 dummy variables indicating level (X) of education with value of '1' and '0' otherwise: (X = 0_2) Less than upper

		secondary education (not included) (X = 3) Upper secondary education (X = 4) Post-secondary including pre-vocational education (X = 5) Tertiary education – first level (X = 6) Tertiary education – advanced level
Industry variables (NACE_X)	NACE industry classification	Dummy variables for 11 included industries with X representing respective codes according to NACE nomenclature
JOB_LOSS_PROB	q37a. I might lose my job in the next 6 months. (q77a. How much do you agree or disagree with statements describing some aspects of your job - I might lose my job in the next 6 months?)	Numeric variable that ranges from '0' ('strongly disagree') to '4' ('strongly agree')
NOISE	q22a. How often do you have to interrupt a task you are doing in order to take on an unforeseen task? (q47. How often do you have to interrupt a task you are doing in order to take on an unforeseen task?)	Numeric variable that ranges from '1' (very often) to '5' (never)
Occupation variables (ISCO_X)	International Standard Classification of Occupations (ISCO)	8 dummy variables for different occupations with X representing respective codes according to ISCO nomenclature: (X=1) Legislators, senior officials and managers (X=2) Professionals

		(X=3) Technicians and associate Professionals (X=4) Clerks (X=5) Service workers and shop and market sales workers (X=6) Skilled agricultural and fishery Workers (X=7) Craft and related trades workers (X=8) Plant and machine operators and assemblers (X=9)Elementary occupations (not included)
OTHER_JOBS	q9a. Besides your main paid job, do you have any other paid job(s)? (q21. Besides your main paid job, do you have any other paid job(s)?)	Dummy variable that has a value of '1' for employees with more than one job and '0' otherwise
OUTSIDE_OPTION	Only available in EWSC2010 (q77f. How much do you agree or disagree with statements describing some aspects of your job - If I were to lose or quit my current job, it would be easy for me to find a job of similar salary?)	Numeric variable that ranges from '1'('strongly disagree) to '5' ('strongly agree')
OWN_IDEAS	q25j. Are you able to apply your own ideas in your work? (q51i. Select the response which best describes your work situation – You are able to apply your own ideas in your work)	Numeric variable that ranges from '1'(almost never) to '5' (almost always)
PROFIT_SHARE	ef6g. What does your remuneration include: Payments based on the overall performance of the company where you work? (ef7g. Thinking	Dummy variable that is set to '1' if compensation includes payments based on company performance and to '0' otherwise

	about your earnings from your main job, what do they include – Payments based on the overall performance of the company where you work?)	
ROTATING_TASKS	q26a. Does your job involve rotating tasks between yourself and colleagues? (q53. Does your job involve rotating tasks between yourself and colleagues?)	Dummy variable that is set to '1' if respondent faces task rotation with colleagues and to '0' otherwise.
QUALITY_STANDARDS	q23_a. Does your main job involve meeting precise quality standards (q49a. Generally, does your main paid job involve meeting precise quality standards?)	Dummy variable that is set to '1' if employee has to meet precise quality standards and '0' otherwise
SUBORDINATES	q7. How many people work under your supervision? (q17. How many people work under your supervision, for whom pay increases, bonuses or promotion depend directly on you?)	Dummy variable set to '1' if employee have at least one subordinate and to '0' otherwise
TENURE	q2d. How many years have you been in your company or organisation? (q12. How many years have you been in your company or organisation?)	Numeric, continuous variable for years of employment in current firm
UNIT_SIZE_X	q6. How many people in total work in the local unit of the establishment where you work? (q11. How many people in total work at your workplace?)	8 dummy variables with the size X: (X = 1) 1 (not included) (X = 2_4) 2-4 (X = 5_9) 5-9 (X = 10_49) 10-49 (X = 50_99) 50-99 (X = 100_249) 100-249 (X = 250_499) 250-499 (X = 500+) 500 or more

YEAR2010		Dummy variable is set to ‘1’ if interview took place in 2010 and to ‘0’ if in 2005

Chapter 3:

Job Rotation and Employer Learning About Human Capital

3.1. Introduction

Job rotation denotes employees' lateral transfers between jobs within the same firm (Campion et al., 1994). An example of job rotation is a car production employee who regularly changes his position along the assembly line, e.g., from installing engines to installing cockpits. Job rotation in such manufacturing firms is prevalent: Osterman (1994), for instance, documents that 55.6 percent of manufacturing establishments in his U.S. sample adopt job rotation while 43.4 percent of all firms including both service and manufacturing firms implement job rotation.[24]

Since in academia the term job rotation 'has one of the longer legacies among work practice innovations' (Cappelli and Neumark, 2001, p. 767), different arguments exist to explain why job rotation is adopted. One argument is that job rotation enables employer learning.[25]

My study is the first that tests directly Ortega's (2001) employer learning argument. Consistent with his theoretical model findings, I document that job rotation is adopted if the firm is uncertain about employees' job-specific human capital (e.g., employees' job-specific ability) or job-specific nonhuman capital (e.g., the applied technology) or if employees' job performance is influenced by an exogenous shock.

These three components can be illustrated in the above production example as follows: If the worker has problems to install an engine, it is not evident if he is not able to follow the instructions (low value of his job-specific human capital), if the applied technology to assist the employee to install it is not productive (low value of job-specific nonhuman capital) or if the engine was not assembled properly (exogenous shock).

[24] See for more about the prevalence of job rotation Osterman, 2000; Pil and MacDuffie, 1996; Gittleman et al., 1998; Eriksson and Ortega, 2006.

[25] Throughout this Chapter, I use the term 'firm' as synonym for an employer or a principal whereas an employee is an agent.

If another employee is assigned to the job according to a job rotation policy, the firm is able to identify the cause of the problem more accurately: Job rotation, for instance, eliminates the influence of job-specific nonhuman capital on employees' performance measurement because as a common component of production for both employees it is factored out if the firm compares employees' job performances.

For my analysis, I choose a comprehensive employee-based sample containing 26,957 observations from 35 European countries provided by the Fourth and Fifth European Working Conditions Survey in 2005 and 2010, respectively. The observations include all possible occupations, ranks, and industries.

Since the sample is employee-based, my study has the advantage relative to other studies such as Eriksson and Ortega (2006) that it allows to observing uncertainty about job-specific human capital and nonhuman capital and an exogenous shock at different employee-job matches and thus can control more precisely for employee and job heterogeneity.

In contrast to other studies about job rotation, my results are more representative because those studies are restricted either to one country (e.g., Osterman, 1994, 2000; Cappelli and Neumark, 2001; Eriksson and Ortega, 2006) or to one firm (e.g., Campion et al., 1994; Kusunoki and Numagami, 1998).

I assume adoption of job rotation if the employee rotates tasks because I interpret a task as a job and task rotation denotes employees' lateral transfers to different tasks within the same firm. To identify Ortega's (2001) three types of uncertainty, I proceed as follows: First, if a job includes complex tasks, I regard such a situation as one in which the firm is uncertain about job-specific nonhuman capital. Second, if the employee is able to apply his own ideas in his job, I assume that the firm is uncertain about job-specific human capital. Third, I measure the likelihood of an exogenous shock (i.e., noise in performance measurement) as the frequency of unforeseeable interruptions of the employee's tasks.

In addition to the employer learning argument of job rotation, literature provides two alternative arguments, the so-called employee motivation and the employee learning argument. The employee motivation argument addresses psychological motivation through mitigating boredom on monotonous jobs (e.g., Walker and Guest, 1952): The

employee's change of job could make his work more interesting and consequently could motivate him.

The employee learning argument addresses that job rotation helps the employee to learn new things (Eriksson and Ortega, 2006): The employee, for instance, has to learn more about the car, in particular its different parts and how they depend on each other (e.g., Aoki, 1986). Then, he can use this knowledge to optimize the handover process along the assembly line. Another objective of employee learning is to obtain all skills that are necessary for career advancement (Saari et al., 1988): The car production employee learns all steps of the production process to become eligible for a supervisor position.

My findings do not support these alternatives. Moreover, they are consistent with complementary theories advancing the employer learning argument.

The remainder of the Chapter is organized as follows: In Section 2, I provide a literature review about all arguments of job rotation and infer my hypotheses from Ortega's (2001) model. Section 3 contains a sample description and model specifications. Section 4 presents empirical results and discusses their consistency with alternative arguments of job rotation. Section 5 provides robustness analyses and Section 6 concludes.

3.2 Literature review and hypotheses

3.2.1 Literature review

My analysis is designed to shed light on the employer learning argument of job rotation. In the following, I review the literature about this argument and its alternatives, the employee motivation and employee learning argument.

3.2.1.1 Employer learning

Concerning the employer learning argument, the theoretical literature usually differentiates between two dimensions. The first dimension denotes the learning object, i.e., if the firm learns about employee productivity (e.g., Ortega, 2001; Meyer, 1994; Arya and Mittendorf, 2006a, 2006b) or about task productivity (e.g., Arya and Mittendorf, 2004; Ickes and Samuelson, 1987). The second dimension refers to two underlying information distributions between the firm and the employee. First, the firm and the employee are a priori symmetrically uncertain about the learning object. Second, the employee is better informed than the firm about the learning object. In the latter case, moral hazard problems such as concealing information about task productivity through exertion of lower effort, i.e., the so-called ratchet effect (Ickes and Samuelson, 1987), are arising.

Inspired by the job matching literature such as Jovanovich (1979) and Miller (1984), Ortega (2001) addresses the firm's problem of matching employees with jobs if an employee's job-specific human capital (employee productivity) or job-specific nonhuman capital (task productivity) are a priori symmetrically unknown to both the firm and the employee. He finds that a job rotation policy is economically superior over a specialization policy (i.e., employee stays on the same job for several periods of time) regardless of any level of uncertainty about both types of capital and an exogenous shock. Further, he shows that the firm learns about the value of employees' job-specific human capital by comparing different employees on the same job. Since I base my hypotheses on his model, I present it in greater detail when I formulate my hypotheses.

Meyer (1994) also analyzes how job assignments can reveal information about employees' abilities. The main difference to Ortega (2001) is that in her model seniors' abilities are learnt when their subordinates rotate (i.e., switch seniors). Then, job rotation is not about revelation of the rotating employee's abilities.

While Ortega (2001) addresses employer learning by the comparison of employees, alternative theoretical models in the literature address moral hazard problems arising from information asymmetries between employees and their firms about either employee productivity (Arya and Mittendorf, 2006a) or task productivity (Ickes and Samuelson, 1987; Arya and Mittendorf, 2004; Eguchi, 2005)

If the employee is better informed than the firm about task productivity and he exerts maximum effort, the firm is able to learn about task productivity. Since the firm cannot credibly commit to future compensation schemes, the employee fears that the firm will demand higher levels of performance at the same compensation level once it learns about true task productivity. As a result, the employee is reluctant to exert maximum effort to keep the firm from learning. This is the so-called ratchet effect (e.g. Weitzman, 1980, Freixas et al., 1985). Ickes and Samuelson (1987) prove in their theoretical model that job rotation is more beneficial for the firm than specialization if the firm is less informed about task productivity than the employee is.

With regard to the car production example, the employee can be better informed about the productivity of the new robotic arm the employee uses to install engines. If he rotates jobs, he will exert maximum effort because in the next period he will be assigned to another job. The reason is that the firm's adjustment of performance pay for the former job due to its learning about task productivity does not affect his future compensation on the next job.[26]

Similarly, Arya and Mittendorf (2004) assume in the case of job rotation that the employee reveals explicitly his former task productivity through reports in the second period. The firm can apply the reports for improving the next employee's assessment on this job.[27]

Unlike Ickes and Samuelson (1987), Hakenes and Katolnik (2014) show that elimination of information about past performance after job rotation creates incentives

[26] Concerning the ratchet effect and job rotation, Choi and Thum (2003) analyze the dynamics of corruption. Unlike Ickes and Samuelson (1987), they let the principals (i.e., the corrupt officials) rotate rather than the agents. To support this kind of rotation, they refer to the guidelines for the prevention of corruption by the German Federal Ministry of the Interior in 1998 that make job rotation obligatory for positions which are potentially prone to corruption. Interestingly, they find that job rotation of the principal is not always beneficial.

[27] Similarly, Carmichael and MacLeod (1993) analyze theoretically that multi-skilled employees are more willing to reveal information about labor-cost saving technical change. They state that job rotation leads to collection of those skills (employee learning). This is contrary to Arya and Mittendorf (2004) who do not consider issues of employee's eligibility for the next job: They assume that job rotation is possible regardless of employee's skills.

for the employee to exert effort because by doing so the employee wants to reveal information about his ability due to career concerns.

Eguchi (2005) shows that job rotation alleviates influence activities if performance measurement is noisy. Influence activities are employee's activities that, for instance, distract him from conducting his job or influence performance measurement by colluding with his supervisor (e.g., Milgrom, 1988; Tirole, 1986). Since Eguchi (2005) assumes that the value of influence activities increases with time, he shows that job rotation makes influence activities less attractive by reducing that time. As a result, the employee exerts more effort on his job. Through this incentive effect the firm is, again, able to learn about task productivity.

Concerning employee productivity, Arya and Mittendorf (2006a) predict in their theoretical model that employees opt voluntarily for job rotation if they are highly-skilled, i.e., have a high value of human capital because it emulates taking an attractive outside option that exists only for high-skilled employees. Consequently, this self-selection leads to employer learning about employee productivity.

Empirical evidence about the employer learning argument is rare. Exceptions are Ortega and Eriksson (2006) and Campion et al. (1994) who both find a negative relation of firm tenure with job rotation which, howerver, supports both employer and employee learning argument.

Moreover, Ortega and Eriksson (2006) find that the growth rate of firms' workforce and recruitment on the national level are positively related to the adoption of job rotation. They interpret this result as empirical evidence for the employer learning argument. Regarding the former variable, I expect that the employee learning argument can also explain the finding. My argument is that if the workforce grows, employees learn more easily about new colleagues through job rotation.

Concerning the latter variable, recruitment on the national level, they only estimate a significant coefficient if they observe salary-paid employees in large firms which makes their result less representative. To conclude, they only provide weak empirical evidence for the employer learning argument.

3.2.1.2 Employee motivation

The employee motivation argument refers to psychological motivation through elimination of boredom if employee's job is, for instance, monotonous (e.g., Walker and

Guest, 1952). Ference et al. (1977) state that job rotation can help to motivate plateaued employees who do not expect any career advancement. On the contrary, Campion et al. (1994) show empirically that job rotation is associated with promotions contradicting this statement. Eriksson and Ortega (2006) cannot find any empirical evidence for this argument.

3.2.1.3 Employee learning

The employee learning argument states that the employee acquires skills on different jobs within the same firm (Eriksson and Ortega, 2006). These skills can, for instance, lead to a better understanding of dependencies between jobs (Aoki, 1986) or are essential for managerial positions (Saari et al., 1988).

One rare theoretical model related to employee learning is a model by Ruckes and Rønde (2014). They analyze incentives to overcome employee's inertia to search for new projects for two periods of time. I interpret such searching effort as employee learning. In addition, they assume that job rotation denoted as restructuring induces the employee to search for new projects after the first period whereas it reduces searching effort for the first-period project. They conclude that job rotation is adopted if incentive pay to elicit employee learning is too costly.

Campion et al. (1994) document that job rotation has a positive impact on acquisition of administrative and business skills but not on technical skills. So, more managerial skills are learned through job rotation. Besides, they observe a positive coefficient on the rate of job rotations explaining the rate of promotions. Further, they find a negative coefficient on employee's firm tenure for explaining rate of rotation. These findings support the employee learning argument as preparation for career advancement.

Eriksson and Ortega (2006) also detect this relation in their data and relate it to the employee as well as the employer learning argument. Kusunoki and Numagami (1998), however, find no statistically significant impact of firm tenure on job rotation but observe a statistically significant influence of job rotation on promotions.

In addition, Eriksson and Ortega (2006) find a positive relation between training costs relative to the industry and adoption of job rotation supporting the employee learning argument. Other proxies they apply for employee learning such as firm size, employee heterogeneity, and average firm tenure, however, are hypothesized and found to have

the same signs for both the employer and employee learning arguments so that they cannot contribute to empirical evidence exclusive for one of these arguments.

3.2.2 Hypotheses

Ortega's (2001) theoretical model which I base my hypotheses on assumes two employees i who are assigned to two different jobs k for two periods of time t. The production function y is formulated as follows:

$$y_{k,t} = \underbrace{\eta_{ik} + \theta_k}_{\text{expected employee's job productivity}} + \underbrace{\varepsilon_{kt}}_{\text{exogenous shock}}$$

$$\text{where } i \in [A, B], k \in [1,2], \text{and } t \in [1,2].$$

η_{ik} represents employee *i*'s expected value of human capital specific to job *k* as, e.g., his ability (i.e., employee productivity) to conduct the tasks of the job *k*. θ_k denotes the expected value of job-specific nonhuman capital such as technology applied in the job. Thus, it reflects task productivity. ε_{kt} represents an exogenous shock to production.

Ortega (2001) assumes that neither the firm nor the employees know a priori the values of these production components and have only beliefs about them following normal distributions with expected values of 0 and variances σ_η^2 (uncertainty about employee's job-specific human capital), σ_θ^2 (uncertainty about job-specific nonhuman capital), and σ_ε^2 (uncertainty about an exogenous shock), respectively.

The firm assigns the two employees to the two jobs according to a specialization and job rotation policy. During the following two periods of time, the firm learns about the value of different employee-job assignments and decides after the second period who to assign to which job to maximize firm value expressed by the sum of the two job production functions.

According to the specialization policy, each employee is assigned to one of the two jobs for both periods of time. In this case, he infers the expected firm value of a specialization policy, Π_S,as

$$\Pi_S = \sqrt{\frac{2}{\pi}\left(\frac{\sigma_\eta^4}{\sigma_\varepsilon^2 + 2\sigma_\eta^2 + 2\sigma_\theta^2}\right)}.$$[28]

Π_S reveals that uncertainties about job-specific nonhuman capital and an exogenous shock decrease firm value whereas uncertainty about job-specific human capital increases firm value.

According to the job rotation policy, each employee is assigned to different jobs in period one and both employees swap jobs in period two. Then, Ortega (2001) calculates an expected value of job rotation policy, Π_R, as

$$\Pi_R = \sqrt{\frac{2}{\pi}\left(\frac{\sigma_\eta^4}{\sigma_\varepsilon^2 + \sigma_\eta^2}\right)}.$$

Again, uncertainty about an exogenous shock decreases firm value whereas uncertainty about job-specific human capital increases it.

Uncertainty about job-specific nonhuman capital does not have an effect on firm value because it is eliminated by simply comparing both employees' performances in the same job. Thus, the firm does not learn anything about the value of nonhuman capital.

To compare both policies, he analyzes the difference of the expected values of both policies denoted as Δ as follows:

$$\Delta = \Pi_R - \Pi_S = \sqrt{\frac{2}{\pi}}\left(\sqrt{\frac{\sigma_\eta^4}{\sigma_\varepsilon^2 + \sigma_\eta^2}} - \sqrt{\frac{\sigma_\eta^4}{\sigma_\varepsilon^2 + 2\sigma_\eta^2 + 2\sigma_\theta^2}}\right).$$

Through differentiation he finds out that the values of Δ are always positive regardless of any value of the three uncertainties. So, a rotation policy is economically superior over a specialization policy.

Moreover, he predicts that the more uncertain the firm is about job-specific human capital represented by σ_η^2, the more valuable the job rotation policy is.

Uncertainty about job-specific nonhuman capital (i.e., σ_θ^2) increases the expected value added by job rotation in comparison to specialization.

[28] Π_S is derived from the expected value of the maximized sum of the production values of both jobs in period two.

Uncertainty about an exogenous shock (i.e., σ_{ε}^{2}) decreases Δ.

Since I assume that firms maximize expected values of their production, I expect that firms adopt job rotation if a job rotation policy leads to a higher firm value than a specialization policy.

Consequently, I formulate my hypotheses as follows:

H1: If the firm is uncertain about job-specific human capital, it adopts job rotation.

H2: If the firm is uncertain about job-specific nonhuman capital, it adopts job rotation.

H3: If employee's job faces exogenous shocks, the firm adopts job rotation.

3.3 Sample description and specification of variables and models

3.3.1 Sample description

I use cross-national data from the Fourth and Fifth European Working Conditions Survey (EWCS)[29] that took place in 2005 (4th) and 2010 (5th) and was conducted by the European Foundation for the Improvement of Living and Working Conditions.[30] The combined sample contains residents of the European Union and other European countries who are older than 15 years, work in all industries of the private sector and live in 35 European countries.[31]

The surveys intended to gain information about European working conditions regarding organization of work, communication and management styles, work-life balance and compensation schemes.

The questionnaire-based interviews of the surveys were conducted at the homes of the respondents so that it is unlikely that answers were given strategically to influence employers (Ortega, 2009). The response rates were on average 44.2 percent (European Foundation for the Improvement of Living and Working Conditions, 2010) and 47 percent (European Foundation for the Improvement of Living and Working Conditions, 2005), respectively.

The original sample size amounts to 73,496 observations. I exclude state institutions, industries referring to armed forces or household activities because I assume that their incentive schemes are quite different from private, profit-oriented firms. I filter out self-employed and non-employed respondents to focus on employees in firms.

After filtering out observations with missing values, I obtain a sample of 26,957 observations (i.e., employees).

[29] Data is available on http://www.eurofound.europa.eu

[30] The Fourth and the antecedent EWCS are used in some studies such as Nienhüser and Matiaske (2006), Daniels et al. (2007), and Ortega (2009).

[31] Countries are the EU-27 countries in 2012 (Austria, Belgium, Bulgaria, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovenia, Slovakia, Spain, Sweden and United Kingdom), Norway, Croatia, Turkey, Switzerland, Albania, Former Yugoslav Republic of Macedonia, Kosovo, Montenegro.

Random route selection was applied so that a sample selection bias is unlikely. In addition, due to this approach it is unlikely that a respondent or firm is contained twice in the sample so that cluster effects for a respondent or firm are negligible.

3.3.2 Specification of variables

3.3.2.1 Proxy variable for adoption of job rotation

As proxy for adoption of job rotation I choose the dummy variable ROTATING_TASKS which is set to ‘1’ if task rotation between the employee and her colleagues occur. I also interpret task rotation as job rotation because a task can also be seen as a job. So, it is just an issue of the level of aggregation. Campion et al. (1994) find out in interviews with executives that the jobs are mostly within one function, e.g., from accounting to treasury within the finance department. Their finding supports that task rotation likely represents job rotation.

In addition, I expect that task rotation is the least costly version of job rotation. Reasons are that loss of job-specific human capital (Kwon, 2006) and trainings for new skills (Campion and McClelland, 1991) are less likely for task rotation because next jobs might be very similar with regard to skill requirements. Consequently, my analysis is not expected be influenced materially by costs of job rotation.

3.3.2.2 Proxy variable for uncertainty about job-specific human capital

I assume that the firm is uncertain about job-specific human capital in particular if the employee utilizes human capital which he has not acquired through processes provided by the firm such as trainings. To detect employees with such type of human capital, I pick the question referring to whether the interviewed employee is able to apply his own ideas in his work. Based on this question, I define a variable, OWN_IDEAS, which carries values from ‘0’ (‘almost never’) to ‘4’ (‘almost always’). Then, I assume that the higher the value of OWN_IDEAS is, the more likely the firm is uncertain about job-specific human capital.

3.3.2.3 Proxy variable for the uncertainty about job-specific nonhuman capital

As proxy variable for the uncertainty about job-specific nonhuman capital I include the dummy variable COMPLEX_TASKS whose value of ‘1’ indicates if the job contains complex tasks.

Ortega (2009) chooses the same variable to proxy for specific knowledge that denotes knowledge that is too costly to transfer to the firm (Jensen and Meckling, 1992).[32] He documents empirically a positive relation between job complexity and the provision of different performance pay schemes and the level of employee's discretion. His findings support model predictions by Prendergast (2002) and Raith (2008). The fact that Raith (2008) regards specific knowledge as private information about task productivity supports the choice of COMPLEX_TASKS to reflect uncertainty about job-specific human capital.

3.3.2.4 Proxy variable for noise

As proxy variable for noise (i.e., uncertainty about an exogenous shock), I include the four-step scaled variable NOISE which reflects the frequency of task interruptions caused by unforeseen tasks. Its values range from '0' ('never') to '3' ('very often').

I regard the unforeseen interruptions as exogenous shocks because the employee does not predict them and they decrease his job performance through interrupting his tasks. Hence, the higher the value of NOISE, the more likely the firm is uncertain about an exogenous shock.

3.3.2.5 Control variables

Since the sample is very heterogeneous, it is important to include several control variables which can be correlated with the dependent variable ROTATING_TASKS, and the explanatory variables of interest, COMPLEX_TASKS, OWN_IDEAS, and NOISE.[33]

To identify a dependency of a job on other jobs, I choose the dummy variable COLL_DEPEND which is set to '1' if the pace of the employee's work depends on colleagues' work. Noise can be caused by such dependency but I expect that an employee has influence on such noise. In this case, noise does not reflect an exogenous shock. Since I observe a positive correlation coefficient between NOISE and COLL_DEPEND, this expectation is supported. Consequently, inclusion of

[32] Ortega (2009) analyzes if answers about COMPLEX_TASKS are biased because respondent's perception of job complexity could vary with skills. He ascertains that this is rather unlikely because less experienced employees work on less complex tasks.

[33] Overall, I employ 79 control variables to mitigate omitted variables biases affecting variables of interest.

COLL_DEPEND reduces the likelihood that NOISE does not only measure exogenous, but also controllable shocks.

I also include dummy variables for gender (GENDER), the level of education (ISCED_X), age (AGE), and firm tenure (TENURE and its squared version, TENURE*TENURE).[34]

Occupational effects are taken into account by dummy variables, ISCO_X, according to the International Standard Classification of Occupations (ISCO) code.

I control for a managerial position by the binary variable SUBORDINATES that exhibits a value of '1' if the employee has at least one subordinate as well as by the dummy variable ISCO_1 (i.e., management position).

To control for the level of risk, earnings and regulations across industries, I add thirteen industry dummy variables according the NACE code (in French: Nomenclature Statistique des Activités Économiques dans la Communauté Européenne).

To address firm size, I include seven dummy variables, UNIT_SIZE_X, based on answers of the question referring to the size of the workplace or local premise of the establishment.[35]

Furthermore, I account for different levels of educational and economic states among countries by adding country dummy variables, COUNTRY_X, to the models. I control for time effects through the year dummy variable, YEAR2010, (value of '1' for year 2010).

3.3.3 Descriptive statistics

Descriptive statistics about all variables of the sample is shown in *Table 3.1*.

Consistent with Osterman (1994), task rotation is adopted in 49.4 percent of all observations. The mean of complex tasks is 57.6 percent. The likelihood that employees

[34] According to Eriksson and Ortega (2006), job rotation is correlated with TENURE. A squared version of AGE is not included because then variance inflation factors would be very high because of its high correlation with TENURE and TENURE*TENURE.

[35] This approach is consistent with Ortega (2009) as well as the official reports EWCS (2005) and EWCS (2010) which both regard those variables as firm size proxy variables. As already mentioned in Chapter two, these variables can only be seen as lower bound of the real firm size so that estimates of coefficients should be taken with caution. Also the fact that 2.7 percent of the employees in the sample have a workplace which counts only one person indicates that those variables do not likely refer to the entire firm size.

can apply their own ideas represented by OWN_IDEAS has a mean of 2.39 that is above the midpoint of its scale of 2.

NOISE with a mean value of 1.16 seems to be low on average because its mean is below the midpoint of its scale of 1.5. 15.9 percent of all employees have subordinates (SUBORDINATES) and 5.8 percent have a management position. 51.1 percent are dependent on their colleagues' pace of work (COLL_DEPEND).

55.0 percent of employees are male with an average age of 39.04 years who have been working in the firm for 8 years on average. The most (least) employees live in Belgium (6.4 percent) (Albania (9.5 percent)), work in the manufacturing sector (24.5 percent) (fishing sector (0.2 percent)), are service worker, shop and market sales worker (19.3 percent) (skilled agricultural and fishery workers (1.0 percent)) and completed upper secondary education (47.7 percent) (second stage of tertiary education (0.6 percent)).

Most of employees (32.6 percent) work in a workplace of a size between 10 and 49 employees whereas least of them (1.7 percent) in a workplace of the size of one employee. 59.5 percent of observations took place in 2010.

Before estimation, I estimate a Pearson correlation matrix of all independent variables to check for multicollinearity problems (exhibited in *Table 3.2*). For the variables of interest, I observe neither any correlation coefficients above critical levels of 0.8 (see for a thorough analysis about multicollinearity Mason and Perreault, 1991) nor variance inflation factors (vif) below the critical value of 10 (Kennedy, 2008). Therefore, I do not expect that my analyses suffer from multicollinearity problems.

Table 3.1: Descriptive statistics. Variables are defined as described in Table 3.5.

	Entire sample (N=26,957)	
Variables	**Mean**	**Standard deviation.**
ROTATING_TASKS	0.494	0.500
INDV_PPAY	0.151	0.358
PROFIT_SHARE	0.132	0.339
EQUITY_COMP	0.032	0.177
COMPLEX_TASKS	0.576	0.494
OWN_IDEAS	2.386	1.393
NOISE	1.241	0.949
COLL_DEPEND	0.511	0.500
ISCED_0_2	0.249	0.433
ISCED_3	0.456	0.498
ISCED_4	0.070	0.256
ISCED_5	0.215	0.411
ISCED_6	0.010	0.010
SUBORDINATES	0.159	0.366
GENDER	0.550	0.497
AGE	39.042	11.662
TENURE	8.002	8.6937
ISCO_1	0.058	0.233
ISCO_2	0.085	0.278
ISCO_3	0.135	0.342
ISCO_4	0.135	0.342
ISCO_5	0.177	0.382
ISCO_6	0.009	0.094
ISCO_7	0.170	0.376
ISCO_8	0.112	0.315
ISCO_9	0.119	0.324
UNIT_SIZE_1	0.017	0.130
UNIT_SIZE_2_4	0.153	0.360
UNIT_SIZE_5_9	0.189	0.391
UNIT_SIZE_10_49	0.326	0.469
UNIT_SIZE_50_99	0.102	0.303
UNIT_SIZE_100_249	0.094	0.292
UNIT_SIZE_250_499	0.048	0.213
UNIT_SIZE_500+	0.070	0.256
AGRICULT_HUNT_FOREST	0.023	0.150
FISHING	0.002	0.040
MINING_QUARRYING	0.006	0.080
MANUFACTURING	0.245	0.430
SUPPLY	0.014	0.119
CONSTRUCTION	0.093	0.290
WHOLESALE_RETAIL_TRADE	0.214	0.410
HOTELS_RESTAURANTS	0.066	0.248
TRANSPORT_STORAGE_COM	0.064	0.245
FINANCIALS	0.046	0.209
REAL_ESTATE_OTHERS	0.156	0.362
PUBLIC_ADMINISTRATION	0.009	0.092
EDUCATION	0.017	0.130
HEALTH_SOCIAL_WORK	0.046	0.210
YEAR2010	0.595	0.491

Table 3.2: Correlation matrix. Variables are defined as described in Table 3.5. Entire sample (N=26,957) is applied here. Asterisks denote statistical significance at the 0.01(***), 0.05(**) and 0.10(*)-level.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 ROTATING_TASK	1																	
2 INDV_PPAY	0.008	1																
3 PROFIT_SHARE	0.036***	0.100***	1															
4 EQUITY_COMP	0.020***	0.054***	0.284***	1														
5 COMPLEX_TASKS	0.089***	0.031***	0.121***	0.067***	1													
6 OWN_IDEAS	0.034***	-0.016***	0.101***	0.062***	0.209***	1												
7 NOISE	0.142***	-0.043***	0.098***	0.064***	0.216***	0.148***	1											
8 COLL_DEPEND	0.213***	0.056***	0.017***	0.013**	0.108***	-0.040***	0.124***	1										
9 SUBORDINATES	0.036***	-0.006	0.139***	0.099***	0.162***	0.215***	0.168***	0.084***	1									
10 GENDER	0.031***	0.070***	0.079***	0.054***	0.116***	0.067***	-0.010*	0.085***	0.097***	1								
11 AGE	-0.056***	-0.027***	0.029***	0.039***	0.037***	0.065***	-0.025***	-0.067***	0.093***	0.019***	1							
12 TENURE	-0.006	-0.018***	0.075***	0.087***	0.093***	0.078***	0.049***	-0.008*	0.130***	0.082***	0.527***	1						
13 TENURE*TENURE	-0.006	-0.018***	0.057***	0.073***	0.072***	0.061***	0.035***	-0.010*	0.099***	0.080***	0.465***	0.937***	1					
14 ISCED_3	0.024***	0.060***	-0.031***	-0.038***	-0.049***	-0.058***	-0.052***	0.002	-0.088***	0.001	-0.074***	-0.033***	-0.028***	1				
15 ISCED_4	0.011*	-0.010	-0.007	-0.006	0.028***	0.045***	0.024***	0.005	0.018***	-0.032***	0.004	-0.010	-0.006	-0.251***	1			
16 ISCED_5	-0.028***	-0.038***	0.152***	0.099***	0.171***	0.160***	0.142***	-0.001	0.169***	-0.033***	-0.012*	-0.026***	-0.032***	-0.479***	-0.144***	1		
17 ISCED_6	-0.004	-0.019***	0.062***	0.066***	0.060***	0.055***	0.042***	-0.009	0.074***	0.024***	0.005	-0.012**	-0.014**	-0.092***	-0.028***	-0.053***	1	
18 ISCO_1	-0.017***	-0.016**	0.015***	0.115***	0.111***	0.141***	0.126***	0.041***	0.371***	0.049***	0.064***	0.053***	0.038***	-0.076***	0.001	0.170***	0.050***	1

3.3.4 Specification of models

Since my dependent variable is binary, I choose a probit regression model, M1, as follows:

$$ROTATING\_TASKS = \Phi(\beta_0 + \beta_1 COMPLEX\_TASKS + \beta_2 OWN\_IDEAS + \beta_3 NOISE + \beta' controls + \varepsilon).$$

If the coefficient on OWN_IDEAS is positive and statistically significant for ROTATING_TASKS, H1 is confirmed.

If the coefficient on COMPLEX_TASKS is positive and statistically significant for ROTATING_TASKS, H2 is confirmed.

If the coefficient on NOISE is positive and statistically significant for ROTATING_TASKS, H3 is confirmed.

I calculate clustered robust standard errors for all variables by choosing year, country and industry dummy variables as cluster variables (see for the necessity of clustered robust standard errors Petersen, 2009). Besides, I calculate McFadden's likelihood ratio index (LRI) (McFadden, 1974) to measure goodness of fit.

3.4 Empirical results and their discussion

3.4.1 Empirical results

The results for M1 are depicted in *Table 3.3*. The coefficient on OWN_IDEAS is positive and statistically significant at the one percent level confirming H1. It reflects that the firm adopts job rotation if it is uncertain about job-specific human capital.

The coefficient on COMPLEX_TASKS is positive and statistically significant at the one percent level confirming H2. It reflects that the firm adopts job rotation if it is uncertain about job-specific nonhuman capital.

The coefficient on NOISE is positive and statistically significant at the one percent level confirming H3. It reflects that the firm adopts job rotation if the employee's job performance is likely influenced by an exogenous shock.

Some findings about the control variables are worth mentioning. SUBORDINATES is positively related to the adoption of job rotation (statistically significant at $p < 0.1$). This result can be explained by the employee learning argument that in particular employees of higher ranks who have subordinates rotate to advance their career (Saari et al., 1988). It can also support Müller's (2011) argument that managers should rotate to cure a possible confirmation bias in their decision making.

The negative coefficient on ISCO_1 (i.e., manager), however, contradicts these arguments. I suggest that the negative coefficient reflects the employer learning argument if employer learning about managers is less important than about rank and file. One reason for this argument can be that the firm is represented by managers who likely were in the same positions than the ISCO_1 managers. As a result, their uncertainty about job-specific human capital for those jobs is smaller than for jobs of the rank and file. Alternatively, the negative coefficient can also be explained by the employee motivation argument that managerial jobs are not boring and thus job rotation is, then, less necessary.

The positive relation of COLL_DEPEND with ROTATING_TASKS (statistically significant at $p < 0.01$) show that the firm adopts job rotation if the employee is dependent on other colleagues. If I interpret such dependency as job-specific nonhuman capital because it is part of job design and cannot be modified by the employee himself, it also supports the employer learning argument.

Table 3.3: Main models about job rotation. Variables are defined as described in Table 3.5. Asterisks at standard errors denote statistical significance at the 0.01(***), 0.05(**) and 0.10(*)-level.

	M1 (PROBIT)	**M2 (LPM)**
Sample	**Entire sample**	**Entire sample**
Variables	**ROTATING_TASKS**	**ROTATING_TASKS**
COMPLEX_TASKS	0.134***	0.048***
	(0.019)	(0.007)
OWN_IDEAS	0.030***	0.014***
	(0.007)	(0.003)
NOISE	0.145***	0.052***
	(0.010)	(0.004)
OWN_IDEAS*TENURE		-0.0004*
		(0.0003)
TENURE	0.000	0.001
	(0.003)	(0.001)
TENURE*TENURE	-0.000	0.000
	(0.000)	(0.000)
COLL_DEPEND	0.498***	0.183***
	(0.019)	(0.007)
SUBORDINATES	0.045*	0.017*
	(0.025)	(0.009)
GENDER	-0.007	-0.003
	(0.020)	(0.007)
AGE	-0.008***	-0.003***
	(0.001)	(0.000)
ISCED_3	-0.029	-0.010
	(0.025)	(0.009)
ISCED_4	-0.059	-0.022
	(0.042)	(0.015)
ISCED_5	-0.151***	-0.054***
	(0.032)	(0.011)
ISCED_6	-0.095	-0.036
	(0.085)	(0.032)
ISCO_1	-0.307***	-0.112***
	(0.047)	(0.017)
Year/industry/country/ size/occupation	YES	YES
Constant	-1.435***	0.037
	(0.164)	(0.054)
N	26,957	26,957
McFadden-LRI (PROBIT)/R^2 (LPM)	0.0979	0.1270

The negative coefficient on AGE (statistically significant at $p < 0.01$) could be explained by the employer learning argument that the firms knows more about older employees than about younger. Alternatively, the older the employee the less likely he needs to learn new things reflecting the employee learning argument. Champion et al. (2001) and Ortega and Eriksson (2006) also document these arguments with firm tenure. On the contrary, my firm tenure variables lack statistical significance.

3.4.2 Discussion about alternative theories about employer learning

My findings are also consistent with alternative theories about the employer learning argument. Ickes and Samuelson (1987) also predict that the firm adopts job rotation if it is uncertain about task productivity. The positive coefficient on COMPLEX_TASKS is consistent with that.

Eguchi (2005) shows that job rotation is adopted if performance measurement is noisy. The positive coefficient on NOISE is consistent with this prediction.

Arya and Mittendorf (2004) demonstrate that the employee reports truthfully about his private information about task productivity in the case of job rotation. The positive coefficient on COMPLEX_TASKS is consistent with that expectation.

Arya and Mittendorf's (2006a) model assumes that the employee can opt for job rotation voluntarily. Then, if the employee chooses job rotation, he signals high employee productivity. Hence, the positive coefficient on OWN_IDEAS which reflects uncertainty about employee productivity supports their prediction.

3.4.3 Discussion about alternative arguments of job rotation

3.4.3.1 Employee motivation argument

My findings are inconsistent with the employee motivation argument: If job rotation avoided boredom as driver for employee motivation, I would find negative coefficients on COMPLEX_TASKS, OWN_IDEAS, and NOISE because high values of each of these variables signal a low likelihood of boredom: Job complexity and applying his own ideas obviously require more intellectual activities. In addition, more noise triggers more versatile activities.

3.4.3.2 Employee learning argument

My results are also inconsistent with the employee learning argument of job rotation for several reasons: COMPLEX_TASKS as proxy variable for uncertainty of job-specific nonhuman capital does not refer to employee's human capital. Since such human capital is acquired by employee learning, COMPLEX_TASKS is not linked to employee learning.

OWN_IDEAS, however, can be related to employee learning in the sense that if the employee is not able to use his own ideas, he must learn from the firm how to conduct his job. As a result, if the employee learning argument had driven my results, the coefficients on OWN_IDEAS would have been negative rather than positive as I actually estimate.

Lastly, since an exogenous shock as represented by NOISE is supposed to be unique and does not repeat, it is rather unlikely that the firm wants the employee to learn about it.

3.5 Robustness analyses

3.5.1 Alternative model specifications

Since OWN_IDEAS is not a dummy variable, I estimate M1 with OWN_IDEAS*OWN_IDEAS, i.e., the squared version of OWN_IDEAS, or replace OWN_IDEAS with LN_OWN_IDEAS, the logarithm of (OWN_IDEAS+1). Then, I obtain the same qualitative results (not reported).

Since NOISE is also continuously scaled, I include LN_NOISE, i.e., the logarithm of (NOISE+1), instead of NOISE, or add its squared version, NOISE*NOISE, to M1. All those alternative specifications do not yield any other qualitative results as documented with M1 (not reported). Though, the marginal effect on NOISE*NOISE is negative and statistically significant at the one percent level. Since its coefficient is rather small (-0.021) compared to the one of NOISE (0.113), the net effect of any value of NOISE is always positively correlated to ROTATING_TASKS supporting H3.

3.5.2 Robustness analysis about interpretation of OWN_IDEAS

Ortega (2001) also predicts that the profitability of a job rotation policy over a specialization policy increases with the level of firm's uncertainty about job-specific human capital. According to Eriksson and Ortega (2006), uncertainty about human capital is lower, the longer the employee works in the firm (TENURE). Hence, I interact OWN_IDEAS with TENURE[36] and expect a negative coefficient reflecting that lower uncertainty about job-specific human capital is related to less likely adoption of job rotation. To estimate it, I apply the following linear probability model, M2:

$$ROTATING\_TASKS = \beta_0 + \beta_1 COMPLEX\_TASKS + \beta_2 OWN\_IDEAS + \beta_3 TENURE + \beta_4 OWN\_IDEAS * TENURE + \beta_5 NOISE + \beta' controls + \varepsilon$$

I choose a linear probability model (LPM) because then the coefficient on the interaction term can be interpreted directly and without further manipulation that is necessary in the case of probit models according to Ai and Norton (2003). In spite of the nonlinearity in the relation of OWN_IDEAS with ROTATING_TASKS, LPM is also acceptable in the case of a binary dependent variable (Wooldridge, 2013).

[36] Though firm tenure is not always equal to job tenure, but job tenure can never be greater than firm tenure, firm tenure is a proxy for the upper bound of job tenure. Due to this, following empirical results must be taken with caution.

Table 3.4: Robustness analyses. Variables are defined as described in Table 3.5. Asterisks at standard errors denote statistical significance at the 0.01(***), 0.05(**) and 0.10(*)-level.

Sample	**M6 (SURE)** **Entire sample**			
Variables	**ROTATING_ TASKS**	**INDV_PPAY**	**PROFIT_SHARE**	**EQUITY_COMP**
COMPLEX_TASKS	0.048***	0.019***	0.019***	0.006**
	(0.007)	(0.005)	(0.004)	(0.002)
OWN_IDEAS	0.011***	0.002	0.012***	0.002*
	(0.002)	(0.002)	(0.002)	(0.001)
NOISE	0.052***	-0.005**	0.010***	0.002**
	(0.003)	(0.002)	(0.002)	(0.001)
COLL_DEPEND	0.183***	0.021***	0.002	-0.000
	(0.006)	(0.004)	(0.004)	(0.002)
SUBORDINATES	0.017*	0.017***	0.040***	0.014***
	(0.009)	(0.007)	(0.006)	(0.003)
GENDER	-0.003	0.021***	0.045***	0.014***
	(0.007)	(0.005)	(0.004)	(0.002)
AGE	-0.003***	-0.001***	-0.001***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
TENURE	0.000	0.000	0.004***	0.002***
	(0.001)	(0.001)	(0.001)	(0.000)
TENURE*TENURE	-0.000	-0.000	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
ISCED_3	-0.010	0.016***	0.014***	0.006*
	(0.008)	(0.006)	(0.005)	(0.003)
ISCED_4	-0.022*	0.006	0.021**	0.012**
	(0.013)	(0.010)	(0.009)	(0.005)
ISCED_5	-0.055***	-0.003	0.056***	0.024***
	(0.010)	(0.008)	(0.007)	(0.004)
ISCED_6	-0.036	0.006	0.159***	0.098***
	(0.031)	(0.023)	(0.021)	(0.011)
ISCO_1	-0.112***	-0.018	0.140***	0.049***
	(0.016)	(0.012)	(0.011)	(0.006)
Year/industry/country/ size/occupation	YES	YES	YES	YES
Constant	0.045	0.000	0.001	0.017
	(0.045)	(0.037)	(0.033)	(0.018)
N	26,957			
R^2	0.1269	0.0742	0.1421	0.0679

As hypothesized, I observe a negative and statistically significant at the ten percent level coefficient on OWN_IDEAS*TENURE (depicted in *Table 3.3*). This finding documents a positive relation of the level of uncertainty about job-specific human capital and adoption of job rotation.

The fact that the coefficient on OWN_IDEAS remains positive and statistically significant at the one percent level and the coefficient on TENURE is not statistically significant support my assumption that OWN_IDEAS refers to firm's uncertainty about employee's job-specific human capital.

3.5.3 Additional analyses of COMPLEX_TASKS and NOISE

Now, I analyze relations of COMPLEX_TASKS and NOISE with different types of explicit incentives such as individual performance pay, a profit sharing plan, and equity compensation to rule out alternative interpretations and to support my interpretations about the two variables.

As individual-based performance pay proxy variable I choose a dummy variable, INDV_PPAY whose value is set to '1' if the question about the inclusion of a piece rate or productivity payments in the remuneration is answered positively. A profit sharing plan is represented by the dummy variable PROFIT_SHARE and equity compensation by the dummy variable EQUITY_COMP.[37]

INDV_PPAY is most prevalent in the sample with a share of 15.2 percent among all types of incentives including a profit sharing plan, PROFIT_SHARING, (10.9 percent) and equity compensation, EQUITY_COMP (2.4 percent).

I estimate the following seemingly unrelated regression (SURE) model, M3:[38]

$$ROTATING\_TASKS = \beta_0 + \beta_1 COMPLEX\_TASKS + \beta_2 OWN\_IDEAS + \beta_3 NOISE + \beta' controls + \varepsilon$$
$$INDV\_PPAY = \beta_0 + \beta_1 COMPLEX\_TASKS + \beta_2 OWN\_IDEAS + \beta_3 NOISE + \beta' controls + \varepsilon$$
$$PROFIT\_SHARE = \beta_0 + \beta_1 COMPLEX\_TASKS + \beta_2 OWN\_IDEAS + \beta_3 NOISE + \beta' controls + \varepsilon$$
$$EQUITY\_COMP = \beta_0 + \beta_1 COMPLEX\_TASKS + \beta_2 OWN\_IDEAS + \beta_3 NOISE + \beta' controls + \varepsilon$$

The SURE model takes explicitly into account that the firm decides about incentives and job rotation simultaneously that potentially leads to correlated disturbances (Greene, 2013).[39] Ortega (2009) also applies a SURE model to regress binary proxy variables for the provision of different incentives on job complexity. The Breusch-Pagan test for independent equations (Breusch and Pagan, 1980) is significant at the one percent level showing that disturbances are, in fact, correlated.

Raith (2008) predict that job complexity is positively related to all types of performance pay. Consistently, I observe a positive and statistically at the one percent level (for

[37] EWCS2005 contains a question which refers to 'Payments based in the overall performance of a group' (i.e., group-based bonus). I do not choose this variable because it is only available for 2005.
[38] The concept of a SURE model is introduced by Zellner (1962)
[39] Due to computational burdens (Greene, 2013), I cannot estimate a multivariate probit model for that analysis. It is not disadvantageous because Wooldridge (2013) states that a linear probability model such as the SURE model is acceptable in the case of a binary dependent variable.

INDV_PPAY and PROFIT_SHARE) and at the five percent level (for EQUITY_COMP) coefficient on COMPLEX_TASKS (depicted in *Table 3.4*).[40]

Another argument could be that COMPLEX_TASKS reflects noise (e.g. Kettenring et al., 2014; Mintzberg, 1973; Finkelstein and Boyd, 1998) because task complexity means more possibilities of exogenous shocks. If this were true, I would observe a negative coefficient on COMPLEX_TASKS for INDV_PPAY. Besides, I control in my equations with NOISE for noise, so that COMPLEX_TASKS should not capture noise.

In the case of NOISE, I observe a negative and statistically significant at the five percent level coefficient for INDV_PPAY that is consistent with standard moral hazard models about a negative relation of noise and performance pay (e.g., Gibbons, 2005; Prendergast, 1999; Milgrom and Roberts, 1992).

On the contrary, for PROFIT_SHARE and EQUITY_COMP the coefficients on NOISE are positive and statistically significant at the one percent level. Group-based performance pay schemes are provided in particular if the firm intends to induce cooperation among employees (e.g., Hwang et al., 2008; Siemsen et al., 2007; Drago and Turnbull, 1988; Wageman and Baker, 1997; Wageman, 1995; Hamilton et al., 2003). Since NOISE reflects how often the employee has to interrupt his task to take on an unpredicted task, it likely refers to situations when the unforeseen task is helping others that the firm also wants to incentivize through firm-based performance pay. As Drago and Turnbull (1988) show theoretically, individual-based performance pay does not incorporate helping behavior performance and thus helping requests by the employee's colleagues are noise to the employee's individual performance measurement. Then, one can argue that NOISE reflects uncertainty about job-specific nonhuman or human capital if one task in his job is to help others and thus is job-specific. Since that task is unpredicted, I assume that helping others is not a regular part of his job and thus distracts him as exogenous shock from job-specific performance. According to this argument, NOISE, in fact, measures noise to performance measurement.

[40] Ortega (2009) also adopts this view when he regresses different incentives on COMPLEX_TASKS applying a very similar sample of the EWCS. All his results are consistent with mine, except in the case of INDV_PPAY he observes an insignificant coefficient on COMPLEX_TASKS. One reason for this different finding could be that he does not include as many control variables as I do. In particular, he does not control for noise.

3.6 Conclusion

Consistent with Ortega (2001), my empirical study documents that a firm adopts job rotation if it is uncertain about job-specific employee's human capital or nonhuman capital, or employee's job performance is influenced by an exogenous shock.

In addition, I show that my findings are consistent with alternative theoretical models of the employer learning argument. Moreover, I show that the employee motivation and employee learning arguments of job rotation do not explain my results. All my findings are robust against model specification and variable interpretation concerns.

Suggestions for future research

My analysis, though, lacks to document whether or not adoption of job rotation leads to higher job performance (i.e., firm value) as Ortega (2001) shows. Thus, I can only suppose that my findings show a positive relation of job rotation to firm performance if the firm opts for a job rotation policy only if it is value-maximizing. Hence, it would be fruitful for future research to extend the analysis to performance data.

In addition, it would be advantageous to have panel data to track job assignments and job performance over time to reveal learning effects of job rotation for assignment decisions which are studied by Ortega (2001).

3.7 Appendix

Table 3.5: Definitions of variables.

Variable	Question in EWCS 2005 (EWSC 2010)	Definition
Variables of Interest		
COMPLEX_TASKS	q23e. Does your main paid job involve: complex tasks? (q49e. Generally, does your main paid job involve complex tasks?)	Dummy variable that is set to '1' if respondent's job involves complex tasks and to '0' otherwise.
EQUITY_COMP	ef6i. What does your remuneration include: Income from shares in the company your work for? (ef7i. Thinking about your earnings from your main job, what do they include - Income from shares in the company your work for?)	Dummy variable that is set to '1' if remuneration includes stock of the firm and to '0' otherwise
INDV_PPAY	ef6b. What does your remuneration include: Piece rate or productivity payments? (ef7b. Thinking about your earnings from your main job, what do they include - Piece rate or productivity payments?)	Dummy variable that is set to '1' if remuneration includes an individual bonus (e.g. piece rate or productivity payments) and to '0' otherwise
NOISE	q22a. How often do you have to interrupt a task you are doing in order to take on an unforeseen task? (q47. How often do you have to interrupt a task you are doing in order to take on an unforeseen task?)	Numeric variable that ranges from '0' ('never') to '3' ('very often'): approximation for work interruptions
LN_NOISE		= ln(NOISE+1)
OWN_IDEAS	q25j. Are you able to apply your own ideas in your work? (q51i. Select the response which best describes your work situation – You are able to apply your own ideas in	Numeric variable that ranges from '0' ('never' ('almost never')) to '4' ('always' ('almost always')

	your work)	
OWN_IDEAS_2		= OWN_IDEAS * OWN_IDEAS
LN_OWN_IDEAS		= ln(OWN_IDEAS+1)
PROFIT_SHARE	ef6g. What does your remuneration include: Payments based on the overall performance of the company where you work? (ef7g. Thinking about your earnings from your main job, what do they include - Payments based on the overall performance of the company where you work?)	Dummy variable that is set to '1' if remuneration includes payments based on company performance and to '0' otherwise
ROTATING_TASKS	q26a. Does your job involve rotating tasks between yourself and colleagues? (q53. Does your job involve rotating tasks between yourself and colleagues?)	Dummy variable that is set to '1' if respondent faces task rotation with colleagues and to '0' otherwise.
Control variables		
AGE	hh2b. Age-Respondent (hh2b. Age – Respondent)	Numeric, continuous variable for years of age
Country variables (COUNTRY_X)	Country where interview was conducted	34 dummy variables for 35 European countries
COLL_DEPEND	q21a. Is your pace of work dependent on the work done by colleagues? (q46a. On the whole, is your pace of work dependent, or not, on the work done by colleagues?)	Dummy variable that is set to '1' if respondent answers 'yes' and to '0' otherwise.
GENDER	hh2a. Sex – Respondent (hh2a. Sex – Respondent)	Dummy variable that is set to '1' for a male respondent and '0' for female
Education variables (ISCED_X)	ISCED classification: the highest level of education or training	4 dummy variables indicating level (X) of education with value of '1' and '0' otherwise: (X = 0..2) Below Upper secondary education (not included)

		(X = 3) Upper secondary education (X = 4) Post-secondary including pre-vocational education (X = 5) Tertiary education – first level (X = 6) Tertiary education – advanced level
Industry variables (NACE_X)	According to NACE industry classification	14 dummy variables for different industries according to NACE nomenclature: AGRICULT_HUNT_FOREST, FISHING, MINING_QUARRYING (not included), MANUFACTURING, SUPPLY, CONSTRUCTION, WHOLESALE_RETAIL_TRADE, HOTELS_RESTAURANTS, TRANSPORT_STORAGE_COM, FINANCIALS, REAL_ESTATE_OTHERS, PUBLIC_ADMINISTRATION, EDUCATION, HEALTH_SOCIAL_WORK
Occupation variables (ISCO_X)	ISCO Occupation classification	8 dummy variables for different occupations with X representing respective codes according to ISCO nomenclature: (X=1) Legislators, senior officials and managers (X=2) Professionals (X=3) Technicians and associate Professionals (X=4) Clerks (X=5) Service workers and shop and market sales workers (X=6) Skilled agricultural and fishery

		Workers (X=7) Craft and related trades workers (X=8) Plant and machine operators and assemblers (X=9)Elementary occupations (not included)
Size variables (UNIT_SIZE_X)	q6. How many people in total work in the local unit of the establishment where you work? (q11. How many people in total work at your workplace?)	7 dummy variables with the size X: (X = 1) 1 (not included) (X = 2_4) 2-4 (X = 5_9) 5-9 (X = 10_49) 10-49 (X = 50_99) 50-99 (X = 100_249) 100-249 (X = 250_499) 250-499 (X = 500+) 500 or more
SUBORDINATES	q7. How many people work under your supervision? (q17. How many people work under your supervision, for whom pay increases, bonuses or promotion depend directly on you?)	Dummy variable set to '1' if employee have at least one subordinate and to '0' otherwise
TENURE	q2d. How many years have you been in your company or organisation? (q12. How many years have you been in your company or organisation?)	Numeric, continuous variable for years of employment in current firm
YEAR2010		Dummy variable is set to '1' if interview took place in 2010 and to '0' if in 2005

Chapter 4:

Internal Governance of Firms

4.1. Introduction

Since ownership and control in publicly-held firms are separated, practitioners and scholars examine issues of corporate governance that address instruments and mechanisms such as monitoring of CEOs by boards of directors which align the CEOs' interest with shareholders' interest to maximize shareholder value (e.g., Shleifer and Vishny, 1997).

Since the CEOs are self-interested (e.g., Jensen, 1986; Morck et al., 1990; Shleifer and Vishny, 1989) and boards are generous towards CEOs (Bebchuk and Fried, 2004), Acharya et al. (2011) doubt that this kind of monitoring is effective. Alternatively, they suggest that a manager below the CEO denoted as young manager is a better monitor. The reason for it is that he can observe CEO's activities closely and possesses inside information to assess whether or not CEO's activities maximize shareholder value.

If the CEO is myopic, he does not care about preserving firm value after his dismissal and due to this is more willing to conduct value-destructive activities such as consumption of perks or getting excessive compensation. If the young manager identifies these activities and the CEO is dependent on cash flows the young manager generates, he is able to prevent such activities by exerting less effort to generate such cash flows. Then, the CEO is willing to commit to invest in the firm's capital stock to preserve firm value because it induces the young manager to exert effort to provide these cash flows. In this case, Acharya et al. (2011) assume that the young manager is induced to do so if he inherits the firm from the incumbent CEO in the future, technically by getting promoted to the CEO position. Therefore, he is interested that the CEO invests cash flows rather than privately consume them.[41] Acharya et al. (2011) call this mechanism internal governance.

Since in reality the CEO also contributes to firm's cash flows, Acharya et al. (2011) analyze situations in which cash flows are partially contributed by the CEO and

[41] Fama (1980) also discusses monitoring by CEO's subordinates. Contrary to Acharya et al. (2011), he argues that bad firm performance can influence adversely their outside options and due to this they are motivated to contribute to good firm performance by monitoring the CEO.

partially by the young manager (no other managers are involved here). Following their reasoning, they demonstrate theoretically that a myopic CEO maximizes firm's long-term investments (i.e., capital stock) if neither he nor the young manager dominantly contributes to firm's cash flows. This finding is reflected by a hump-shaped relation of firm's long-term investments and myopic CEO's contribution to firm's cash flows relative to the young manager's contribution.

In this Chapter, I document this hump-shaped relation by showing that capital expenditures as measure of firm's long-term investments are maximized if CEO's contribution to firm's cash flows is neither too small nor too large relative to his subordinated managers.

As proxy variable for the CEO's contribution to firm's cash flows I choose the number of the firm's reportable operating segments at the beginning of the observed firm-year. I argue that more operating segments lead to more cash flow diversification among all subordinated managers that causes more CEO's influence (i.e., contribution) on firm's aggregated cash flows generation. The reason for it is that the young manager who is induced by promotion incentives to conduct tasks of internal governance contributes less to firm's aggregated cash flows if the number of segments and consequently the level of cash flow diversification increase. Alternative arguments from the literature regarding CEO's ability and CEO entrenchment (e.g., Rose and Shepard, 1997) caused by more segments also support my choice of number of segments.

Moreover, Acharya et al. (2011) assume that a far-sighted CEO always undertakes long-term investments. In this case, CEO's cash flow contribution has no effect on CEO's investment behavior. Consistently, I document that the hump-shaped relation between firm's long-term investments and CEO's cash flow contribution disappears if the CEO is likely not myopic. I identify such far-sighted CEO if his compensation is more sensitive to firm's shareholder value than the median CEO's sensitivity in my sample.

For my empirical study, I use panel data about 73 S&P 500 firms that have at least one internal promotion between 2004 and 2011. My results are robust if I control for alternative corporate governance instruments such as institutional ownership, institutional ownership dispersion, CEO equity alignment, and all insider equity alignment.

My analysis contributes to a new strand of literature that deals with internal governance conducted by CEOs' subordinated managers. Regarding this field, empirical work is rare. Exceptions are Landier et al. (2012) and the working paper by Aggarwal et al. (2013). Contrary to Landier et al. (2012) who analyze senior managers' dependencies on their CEOs, I address Acharya's (2011) internal governance mechanism contingent on CEO's cash flow contribution.

Aggarwal et al. (2013) also addresses this model: They measure CEO's cash flow contribution as the number of CEO's corporate titles relative to all titles of the top-five executives who he also belongs to.

The remainder of the Chapter is organized as follows: In Chapter 4.2, I provide a short literature review about internal governance and derive my hypotheses from Acharya's (2011) model. Chapter 4.3 contains a sample description and all model and variable specifications. Chapter 4.4 presents the empirical results and discusses them. Chapter 4.5 provides some robustness analyses. Chapter 4.6 concludes.

4.2. Literature review and hypotheses

4.2.1 Literature review about internal governance

Landier et al. (2012) document that the more members of the top management team have been appointed by the incumbent CEO the worse firm performance (represented by Tobin's Q and return on assets) is. Their findings suggest that managers who have been appointed by the CEO are more aligned to their CEO's (self-) interest. Though, their empirical model does not suit Acharya's et al. (2011) model and cannot document their model predictions.

The working paper by Aggarwal et al (2013) provides empirical evidence about Acharya's (2011) model. As proxy for CEO's contribution to firm's cash flows they choose the number of corporate titles assigned to the CEO relative to the top-five executives who also include him and are reported in the database ExecuComp. Then, they find a hump-shaped relation of their measure of CEO's contribution and firm investments measured as capital expenditures. They also find such relation of CEO's contribution to firm performance measured as industry-adjusted Tobin's Q and industry-adjusted return on assets.

As an alternative way of analyzing CEO's contribution to firm's cash flows, Aggarwal et al. (2013) also test Bebchuk's et al. (2011) CEO pay slice that measures the percentage of CEO total compensation relative to top five executives' total compensation.[42] Then, they show a hump-shaped relation of CEO pay slice with firm investments and performance. This relation, however, lacks statistical significance after inclusion of their corporate title variable. Hence, they conclude that their measure is the better proxy for CEO's cash flow contribution. Nevertheless, their approach suffers from one endogeneity problem which they do not address[43]: Their measure of cash flow contribution is sensitive to the combination of different corporate titles because they have different impact on generating cash flows. The title 'president', for instance, refers to a corporate role with a higher impact on cash flow generation than the title 'member of the audit committee'. Though, all titles are equally-weighted so that ratios lack

[42] Bebchuk et al. (2011) find that CEO pay slice is negatively related to firm performance and regard agency problems as the reason for their results. They do not find a hump-shaped relation because they do not include a squared version of CEO pay slice into their models.

[43] In fact, they address that the number of corporate titles could be influenced by firm performance and analyze the impact of the financial crisis in 2008/2009 on their measure as exogenous shock.

comparability within firms over time. This cannot be captured by firm-fixed effects and thus results in potential endogeneity problems through an omitted variable bias.

4.2.2 Hypotheses

Acharya et al. (2011) assume a two-level hierarchy with a CEO at the top and a young manager who succeeds him in the next period as CEO. The firm is entirely employee-financed. At the beginning of the first period *t* the CEO commits to invest a certain fraction of cash flows he obtains from the young manager at the end of the period denoted as end-of period capital stock k_t. Subsequently, the young manager decides on how much effort he exerts to learn about the firm represented by s_t. Then, cash flows are generated the higher s_t and the higher CEO's learning effort s^{CEO} *was* in period *t-1* when he was the young manager. At the end of period *t*, investments are made and the CEO gets the residual of all generated cash flows that remain after investing some fraction of them in the capital stock. In the next period *t+1* the CEO leaves the firm and the young manager gets promoted to the CEO position.

Acharya et al. (2011) differentiate three cases for which they infer the optimal capital stock at the end of period *t*. First, in the first best case (FB), the CEO has a long-term horizon regarding the firm and the manager internalizes his learning effort meaning that he acknowledges that current learning also increases current cash flows, not only future cash flows when he is CEO.

Second, in the constrained efficient case (CE), they also assume a far-sighted CEO, but the young manager does not internalize his learning effort so that the CEO must incentivize him to exert learning effort by investing in end-of-period capital stock. Otherwise, the manager would wait with learning because he ignores current impact of his learning on cash flow generation. As Chapter 2 presents, Prendergast (1993) predicts this behavior by showing that the employee only profits from current training (i.e., learning) if he is provided with promotion incentives which promise a higher wage in the next job. The reason for it is that this is the only way the firm can credibly commit to compensate for such firm-specific human capital acquisition. In Acharya's et al. (2011) model, the higher wage is the additional cash flow he will be able to appropriate privately if he is the next CEO and utilizes the human capital he has acquired as young manager. So, Acharya's et al. (2011) assumption that the young manager does not internalize current learning effort is predicted theoretically and my

empirical findings in Chapter 2 concerning firm-specific human capital support this assumption.

Third, in the myopic CEO case (MC), the CEO is myopic and the manager does not internalize his current learning effort. Then, the CEO is only interested in the cash flows he can misappropriate at the end of the first period and does not care about firm value after leaving the firm. Since the manager is only interested in the capital stock he will inherit in the next period as CEO, he is only willing to exert effort if the CEO invests in that capital stock. Hence, that mechanism induces the CEO to invest and not to misappropriate cash flows.

Subsequently, Acharya et al. (2011) introduce the parameter δ that represents CEO's contribution to firm's cash flow relative to the young manager's contribution. They describe such CEO's contribution as fraction of tasks the CEO undertakes to generate cash flows relative to the fraction of the young manager's tasks. Accordingly, δ=0 denotes a situation in which all cash flow generation is decentralized and not influenced by the CEO.

Contrary, in the case of δ=1, all cash flow generation is centralized and determined by the CEO himself. Analytically, they predict the following relation of CEO's cash flow contribution δ and the steady state capital stock k^{MC} at the end of the first period:

$$k^{MC} = \left[\gamma * (1-\delta)\delta^{b-1} \frac{\theta^b}{(1+r)^{b-1}} \right]^{\frac{1}{1-\gamma b}}$$

where r is the discount rate, b with $b > 1$ is a parameter for the cash flow production function contingent on the learning effort, γ is a constant which determines the return on the capital stock for one period with $1-\gamma b > 0$, and θdenotes the productivity of the business environment.

Acharya et al. (2011) reflect this relation in their proposition: In the case of a myopic CEO, firm value represented by the long-term investment in the end-of-period capital stock is maximized if CEO's contribution to firm's cash flows is neither very small nor very large relative to the young manager's contribution.

This finding can be explained economically: If δ=0, i.e., the young manager contributes to all cash flows in the current period, he is not motivated to exert learning effort and

generate cash flows because he will never profit from his learning effort. This is caused by Acharya's et al. (2011) assumption for the constrained efficient case and myopic CEO case: The young manager does not internalize his learning effort for current cash flow generation. Then, he can only profit from this firm-specific human capital acquisition if he is the CEO and generates higher cash flows by utilizing such human capital. Since in the case of δ=0 his cash flow contribution as CEO will also be zero as his current CEO also experiences, he knows that human capital he acquires now will not influence future cash flows. As a result, he will never be compensated for exerting learning effort in the current period and hence he is not willing to incur any learning effort costs. Since the current CEO anticipates it, he has no incentive to invest in end-of-period capital stock. Consequently, the capital stock is minimized.

The other extreme case is that the CEO contributes all cash flows (i.e., δ=1) now. In this case, he does not depend on any learning effort by his young manager and does not need to motivate him to learn by investing in end-of-period capital stock. As a result, end-of-capital stock is also minimized.

Between these two extreme CEO's cash flow contributions both the CEO and the young manager can profit from young manager's learning effort: The CEO now by receiving higher cash flows he can partially appropriate privately and the young manager in the next period as CEO because the current CEO must invest in end-of-period capital stock to motivate the young manager today.

With regard to this finding, I formulate my first hypothesis:

> ***H1: The relation of firm's long-term investments and CEO's contribution to firm's cash flows is hump-shaped.***

Further, Acharya et al. (2011) compare k^{MC} with the capital stock in the first best case denoted as k^{FB} in the following ratio:

$$\frac{k^{MC}}{k^{FB}} = \left[\frac{r(1-\delta)\delta^{b-1}}{(b-1)(\delta+(1-\delta)(1+r))^{b-1}} \right]^{\frac{1}{1-\gamma b}},$$

According to that ratio, they also state in their proposition that in the case of a far-sighted CEO it is optimal if he alone contributes to all firm's cash flows to maximize firm value (i.e., capital stock) because then the ratio reaches its bottom. Besides, a far-sighted CEO always invests in the firm's capital stock so that the young manager is

motivated to exert maximum effort regardless of the CEO's cash flow contribution. Hence, the internal governance mechanism conducted by the young manager is not necessary.

If I compare the relation between firm's long-term investments and CEO's cash flow contribution for a more likely myopic CEO and less likely myopic CEO, I expect that I find such relation more likely for the former CEO.

Consequently, I formulate my second hypotheses as follows: [44]

> ***H2: A hump-shaped relation of firm's long-term investments and CEO's contribution to firm's cash flows is more pronounced if the CEO is more likely myopic than far-sighted.***

[44] Aggarwal et al. (2013) analyze similar hypotheses.

4.3 Sample description, specification of variables and models

4.3.1 Sample description

My sample contains panel data for 73 firms listed in the S&P 500 index in May 2012 which have at least one CEO change between January 1, 2004 and December 31, 2010 and the new CEO was promoted from within (i.e., internal promotion). The panel data addresses up to four years per firm from 2006 to 2010 excluding the promotion year and the years after promotion.

I analyze only firms with internal promotions to comply with Acharya's et al. (2011) model assumption that the young manager gets promoted for certain. I assume that in my selected firms the young managers know very early that they will succeed rendering internal governance effective for all periods of time before the actual turnover.[45] I retrieve the number of business segments and some exercise prices of stock options from firms' annual reports. Accounting data, compensation data, promotion data, and data such as CEO age, the existence of a COO, a president, COO-president, CEO-president, CEO-chairman, COO director and president director is retrieved from either the database S&P Capital IQ or a database of the Institute for Finance, Banking and Insurance of the Karlsruhe Institute of Technology based mostly on data provided by firms' annual reports and S&P Capital IQ. Eventually, I count 140 to 159 firm-years with 67-73 firms contingent on the model specification.[46]

4.3.2 Specification of variables

4.3.2.1 Proxy variable for firm's long-term investments

As proxy variable for firm's long-term investments I choose capital expenditures scaled by lagged total assets denoted as CAPEX. Aggarwal et al. (2014) also selects the same definition of capital expenditures for firm investments.

Even though Acharya et al. (2011) indicate to research and development expenses as measure of long-term investments, I do not choose research and development expenses because it would reduce my sample to 53 firm-years because a lot of firms in the service sector as Wal-Mart Stores do not report such expenses. Besides, I expect that some CEO's misappropriation such as conducting pet projects can be concealed as those

[45] I address the possibility of a selection bias when I discuss my control variables later in this Chapter.
[46] Data for all variables is not available for some years, so that the number of firm-years does not reach the theoretically possible number of 124*6 = 744.

expenses. In this case, it is a noisy measure of firm's long-term investments. As a better measure I would prefer R&D expense capitalization that follows more verifiable accounting standards and is scrutinized by auditors. Since I have no data about it, I only choose CAPEX.[47]

4.3.2.2 Proxy variable for CEO's contribution to firm's cash flows

As proxy variable for the CEO's contribution to firm's cash flows I choose the number of firm's reportable operating segments at the beginning of the observed firm-year which is represented by the variable NUM_SEG.

To illustrate my argument for this choice, I assume a firm in which each CEO's subordinated manager leads one operating segment, so that I denote him as segment manager.[48] So, each segment manager generates cash flows in the segment he is assigned to. Hence, he represents only one source of cash flows for the aggregated cash flow stream the CEO receives. The young manager in the sense of Acharya et al. (2011) is likely one of these managers. This assumption is supported by studies about internal promotions (see for surveys on these studies Kesner and Sebora, 1994; Giambatista et al., 2005).[49]

Now, I consider two situations. First, if there is only one segment, the segment manager is the young manager. Then, the young manager is responsible for providing the firm's entire aggregated cash flows. Second, if there are two segments, only one of the two segment managers is the young manager.[50] Then, the young manager only partially contributes to firm's aggregated cash flows. The other fraction of cash flows is provided by a segment manager who will not be promoted to the CEO position and hence does not care about firm's long-term value. Hence, I assume him as more myopic than the young manager so that his level of effort to generate cash flows is not influenced by CEO's long-term investments contrary to that Acharya et al. (2011) assumes for the young manager. Due to this, I interpret his cash flow contribution as part of CEO's cash flow contribution.

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[47] Aggarwal et al. (2013) also analyze firm performance measured as Tobin's Q and return on assets. Since I focus on firm investments to have more likely proxy for Acharya's et al. (2011) capital stock, I do not analyze firm performance.

[48] Later, I relax this assumption by analyzing the special case of a Chief Operating Officer as manager.

[49] Cichello et al. (2009), for instance, analyze divisional managers as CEO successors.

[50] I assume that the young manager has been already appointed to make the promotion decision not endogenous on segment manager's behavior. This is consistent with Acharya et al. (2011) who assume promotion chance as exogenous. If the firm, for instance, has a COO who is regarded as heir apparent by literature (Cannella and Shen, 2001; Bennet and Miles, 2006) this assumption is very realistic.

Adopting this argument, if I compare both cases, I draw the following conclusion: The young manager's contribution to firm's cash flows relative to CEO's cash flow contribution is higher in the first case (100 percent) than in the second case (1 - fraction of the other segment manager's cash flows on firm's aggregated cash flows). Consequently, the number of operating segments provides diversification in the cash flows from the CEO's perspective that makes the CEO less dependent on the young manager's cash flow generation.

Since Chief Operating Officers (COOs) or non-CEO presidents are often regarded as firms' heirs apparent (Cannella and Shen, 2001; Bennet and Miles, 2006), I also interpret them as young managers. Then, one can argue that aforementioned cash flow diversification argument does not hold because these young managers provide the entire firm's aggregated cash flows. The reason for it is that they represent an additional managerial layer between all segment managers and the CEO (Bennet and Miles, 2006). In this case, I argue that the diversification argument also holds because I assume the more segments the firm has, the more costly it is for, say, a COO to influence all segment managers to make them react on CEO's long-term investments as the COO reacts. The reason for it is that the segment manager who is not the young manager and hence is myopic as I outline in my illustration about two segment managers has no incentive to adopt the COO's long-term horizon and due to this must be induced costly by the COO. An example that illustrates that alignment of all segment managers to COO's long-term interest can be costly, is that I assume that the COO cannot commit to retain some segment managers after getting promoted to the CEO position. In this case, the segment manager will not adopt the COO's long-term horizon. If it gets too costly for this COO, he will not influence all segment managers. As a consequence, he controls only a fraction of firm's cash flows resulting in a smaller cash flow contribution relative to the CEO whose cash flow contribution comes from cash flows generated by the segment managers who are not influenced by the COO.

Another argument to support my proxy variable choice is based on literature that argues that the more segments the firm has the more complex the firm is and hence the more able the CEO must be (Rose and Shepard, 1997). To make it an appropriate proxy for CEO's cash flow contribution, CEO's ability must be better relative to the young manager. Hoang and Ruckes (2014), for instance, assume in their theoretical model explaining socialism in the case of firm's capital allocation that CEOs are better

informed about their segments than their segment managers. Since I assume that CEOs have determined corporate segment structure by their past investments more likely than their young managers, it is likely that these CEOs possess an information advantage about their firms' operations. Consistently, Shleifer and Vishny (1989) argue that CEOs undertake CEO-specific investments such as firm diversification to entrench themselves. The reason for it is that CEO-specific investments lead to an information advantage that prevents shareholders from replacing them if their activities turn out not to be shareholder value-maximizing.

Due to these arguments, I choose the number of operating segments as proxy variable for the CEO's contribution to firm's cash flows denoted as NUM_SEG. So, I interpret a small number of business segments as a situation in which the CEO's contribution to firm's cash flows relative the young manager's contribution is small while a large number of business segments indicates a large CEO's contribution to firm's cash flows relative to the young manager's contribution.

Another advantage of this proxy variable is that the definition of reportable operating segments must follow certain objective rules according to the accounting standard FAS 131. According to the management approach, reportable operating segments should reflect the internal reporting structure. Each segment should consist of operations that are homogenous in their products, customers, or production technologies and generates revenues (i.e., cash flows with external customers) (Alves, 2007). Therefore, it is very likely that each segment has its own segment manager who contributes to firm's cash flows from operations with external customers.[51] One operating segment has to be reported if it contributes materially to the firm's financial success (e.g., Coenenberg, 2012). To be material, it should meet two of the following three criteria (Alves, 2007): First, its contribution to firm's revenue exceeds 10 percent of all revenues. Second, its contribution to firm's net profit amounts to more than 10 percent of all profits. Third, its total assets contribute to at least 10 percent to firm's total assets. Though, the firm may report operating segments that do not meet these criteria if the management assumes that the information is useful and material for shareholder's decisions (Alves, 2007).

Nevertheless, some degree of materiality is always required so that the number of reportable operating segments likely reflects comparable levels of cash flow

[51] For my diversification argument, at least two managers must exist who contribute cash flows independently from each other.

diversification across firms. Besides, I control for firm-individual preferences for segment definitions by applying a firm-fixed effects regression model. This mitigates the likelihood of an omitted variable bias that is caused by not controlling precisely for the size of each segment.[52]

In addition, I observe that only 26.1 percent of all firm-years in the sample include changes in the number of operating segments. This finding supports that the number of operating segments conveys material information about the structure of the firm's cash flow sources rather than reflecting arbitrary accounting changes that would not reflect changes in cash flow diversification. In my sample, operating segments are, for instance, subsidiaries that are sold or spun off if they disappear as reportable operating segments over time. One example is the pharmaceutical firm Bristol-Myers Squibb Company which spun off its nutrition subsidiary called Mead Johnson in 2009 and consequently reduces his number of reportable operating segments from two to one.

4.3.2.3 Control variables

I include some control variables that are potentially correlated with CAPEX or NUM_SEG.[53]

To control for the existence of a Chief Operating Officer (COO) who can influence effectiveness of internal governance on CAPEX, I include a dummy variable NO_COO whose value is set to '1' if there is no COO in the firm. I argue that a COO has more influence on all segments' cash flows than a single segment manager as I outline in the previous chapter. Since COOs are often CEO successors and hence often regarded as heirs apparent (Cannella and Shen, 2001; Bennet and Miles, 2006), they represent likely the young manager.

To account for a CEO who is also president that could mean less influence of a young manager on cash flow generation according to the corporate title accumulation argument (e.g., Aggarwal et al., 2013), I add a dummy variable, CEO_PRES. To control that no president exists in the firm, I include the dummy variable NO_PRES whose value is set to '1' if the firm does not have a president.

Since older CEOs are more likely myopic, I include a dummy variable CEO_58 measuring if the CEO is older than the sample's median CEO age of 58 years.

[52] Rose and Shepard (1997) also apply number of operating segments to measure firm diversification.
[53] The definitions of all variables are shown in *Table 4.5* in the appendix. All variables are measured either at the firm's end-of or beginning-of-fiscal year date.

I include dummy variables, COO_DIRECTOR or NONCEO_PRESIDENT_DIRECTOR to account for the existence of a COO or non-CEO president who is a member of the board of directors, respectively. In this case, these managers can conduct internal governance directly by participating in investment decisions.

Since young and mature firms likely have different governance structures and visibility for external monitors, I include the logarithm of firm age represented by LN_FIRM_AGE (e.g., Bebchuk et al., 2011; Landier et al., 2012).

Since former firm performance can have an influence on future investments, I include lagged Tobin's Q (i.e., Tobin's Q at the end of the previous fiscal year), TOBINS_Q_LAGGED.[54]

In addition, I add lagged capital expenditures (i.e., capital expenditures at the end of the previous fiscal the year relative to total asset two fiscal years before), CAPEX_LAGGED, into the model because former capital expenditures can influence the number of operating segments if the firm, for instance, acquires a company that becomes a segment.

Besides, one can argue that my sample suffers from a selection bias that is represented by an omitted variable that reflects firm's propensity for internal promotions that potentially correlates with NUM_SEG. This argument follows Naveen (2006) who shows empirically that firm complexity is positively related to internal CEO successions that he attributes to a, then, higher value of an internal successor's firm-specific human capital.

In this case, inclusion of TOBINS_Q_LAGGED and CAPEX_LAGGED alleviate such selection bias because they likely capture firm's propensity for internal promotions (see for a survey on this issue Kesner and Sebora, 1994)

Following corporate governance literature (e.g., Bebchuk et al., 2011; Baghat and Bolton, 2008; Landier et al., 2012), I include a dummy variable, CEO_CHAIRMAN, representing if the CEO is also chairman of the board of directors. Moreover, I add a variable, LEVERAGE, reflecting firm's ratio of total debt to total assets, and the logarithm of revenue, LN_REV, and its squared version, LN_REV*LN_REV, as proxy

[54] Aggarwal et al. (2013) also includes Tobin's Q to address a correlation with their measure of cash flow contribution.

variables for firm size (e.g., Kale et al., 2009). To account for different annual effects, I include fiscal year dummies, YEAR_X.[55]

As additional control variable, I add institutional ownership, INSTIT_OWNERSHIP, at the beginning of the observed fiscal year as control variable for external governance (e.g., Aggarwal et al., 2013). Since diversification of the institutional ownership structure can entail free-riding problems that render external governance ineffective (Demsetz and Lehn, 1985), I also calculate the Herfindahl index over all institutional holdings denoted as INSTIT_DIVERSIFICATION reaching its maximum if ownership structure is highly diversified.

Following Kale et al. (2009), I include CEO alignment, CEO_ALIGNMENT, and insider alignment, INSIDERS_ALIGNMENT, at the end of the preceding fiscal year (see also Aggarwal, 2013; Bebchuk et al., 2009; Kale et al., 2009; Bebchuk et al., 2011).[56] Note that INSIDERS_ALIGMENT also includes CEO alignment if it exists. I observe that insiders can be firms' executives, founders, or directors.

I calculate both variables according to Kale et al. (2009) and Murphy (1999) as follows, for example, in the case of CEO_ALIGNMENT:

$$\text{CEO\_ALIGNMENT} = \frac{(\text{Number of shares} + \text{delta of options} * \text{number of options})}{\text{total number of shares outstanding}} * 100$$

Accordingly, a value of 1 denote that CEO's compensation represented by the present value of his shares and option he holds in the firm rises by $1 if shareholder value increases by $100. INSIDERS_ALIGNMENT is a proxy variable for incentives other than promotions incentives for internal governance where CEO_ALIGNMENT is an incentive to impose a long horizon on CEO's investment decisions (Kale et al., 2009).

4.3.3 Descriptive statistics

Descriptive statistics about all variables is shown in *Table 4.1*.[57]

[55] Since end-of-fiscal year dates vary across firms, I also conduct my analysis with quarter dummy variables as robustness analysis. I prefer fiscal year dummies, because due to my small sample size some quarter dummies would identify directly the firm. For each fiscal year dummy, I always observe more than one firm.

[56] I calculate the option value according to Murphy (1999) with 5-year average volatility of stock returns. I exclude four firm-years with alignment values which are implausibly over 100 percent of firm's market capitalization. I obtain free-risk interest rates for 5-year constant maturity treasury bonds from the Board of Governors of the Federal Reserve System (www.federalreserve.gov).

[57] Some variables have 161 observations but most samples in the following estimations only contain 140-159 observations because of missing values of included variables.

Table 4.1 Descriptive statistics. Variables are defined as described in Table 4.6.

Variables	Observations	Mean	Standard deviation	Min	Max
CAPEX	161	0.072	0.086	0.003	0.591
Capital expenditures (in millions of $)	161	1,505.599	3,136.984	19,843	9.2
CAPEX_LAGGED	161	0.068	0.087	0.001	0.591
NUM_SEG	161	3.516	1.997	1	9
NUM_SEG*NUM_SEG	161	16.323	17.783	1	81
Total assets (in millions of $)	161	27,526.08	39,971.23	899.251	212,949
Total assets at the end of the previous fiscal year (in millions of $)	161	25,173.85	35,480.62	671.79	161,165
Revenues (in millions of $)	161	22,212.94	49,503.87	600.828	377,023
Number of employees	161	65,538.11	227,740.4	596	2,100,000
Market capitalization (in millions of $)	161	29,868.14	46,346.16	1,440.495	203,204
Ceo age	161	57.721	4.558	44	68
CEO_58	161	0.478	0.501	0	1
Firm age	161	94.155	58.555	8	224
LN_FIRM_AGE	161	4.140	0.944	0.693	5.384
CEO_ALIGNMENT	143	6.487	10.098	0.0003	48.774
INSIDERS_ALIGNMENT	144	15.646	21.769	0.061	87.909
NO_COO	161	0.571	0.496	0	1
NO_PRES	161	0.211	0.409	0	1
NONCEO_PRESIDENT_DIRECTOR	161	0.174	0.380	0	1
COO_DIRECTOR	161	0.193	0.396	0	1
CEO_PRES	160	0.419	0.495	0	1
CEO_CHAIRMAN	160	0.725	0.448	0	1
INSTIT_OWNERSHIP	161	0.473	0.132	0.048	0.886
INSTIT_DIVERSIFICATION	161	0.932	0.051	0.587	0.978
LN_REV	161	9.004	1.343	6.398	12.840
LN_REV*LN_REV	161	82.870	25.057	40.938	164.867
LEVERAGE	161	0.238	0.157	0	0.702
TOBINS_Q_LAGGED	161	2.282	1.531	0.956	12.012
2-year lagged volatility of stock returns (in percent)	159	25.290	9.792	10.784	60.141
LN_VOLA_LAGGED (2-year average)	159	0.223	0.076	0.102	0.471
Fiscal year 2010	161	0.006	0.079	0	1
Fiscal year 2009	161	0.230	0.422	0	1
Fiscal year 2008	161	0.124	0.331	0	1
Fiscal year 2007	161	0.335	0.474	0	1
Fiscal year 2006	161	0.304	0.462	0	1

The firms report on average over all firm-years revenues of $22,212.94 million, total assets of $27,526.08 million and 65,538 employees.[58] Their capital expenditures amount to $1,505.599 million on average.

CEOs are on average 57.72 years old and 47.8 percent of all CEO are older than 58 years while firms themselves are on average 94.16 years old.

Firms have on average 3.52 reportable operating segments ranging from 1 to 9.

On the contrary, 41.8 percent of all firm-years include firms with CEOs who are presidents. 57.1 percent of all firm-years do not exhibit a COO, whereas 21.1 percent do not include any president.

19.3 percent of all firm-years refer to firms which have COOs who are members of the board of directors. 17.4 percent of all firm-years have non-CEO presidents on their boards.

72.5 percent of all firm-years show firms with CEOs who are also chairman of the board of directors showing that external governance is likely weak in most of my sample firms.

CEO alignment is $6.49 per $100 shareholder value increase whereas insiders' alignment amounts to $15.64 per $100 shareholder value increase. Institutional investors hold 47.3 percent of all equity while institutional ownership diversification is high indicated by a value of 0.93 close to 1.

Before estimation, I estimate a Pearson correlation matrix of all independent variables to check for multicollinearity problems (exhibited in *Table 4.2*). The correlation coefficients do not reach critical levels above 0.8 (see for a thorough analysis about multicollinearity Mason and Perreault, 1991). Moreover, variance inflation factors (vfi) are below 10 for the all variables of interest (except if squared versions are included) (Kennedy, 2008). Therefore, I conclude that my analysis does not suffer from multicollinearity problems.

[58] All means and standard deviations are calculated for all firm-years.

Table 4.2: Correlation matrix. Variables are defined as described in Table 4.6. Sample of 140 firm-years (M1 (4)) is applied here. Asterisks denote statistical significance at the 0.01(***), 0.05(**) and 0.10(*)-level.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 CAPEX	1														
2 NUM_SEG	-0.084	1													
3 NUM_SEG*NUM_SEG	-0.038	0.959	1												
4 CAPEX_LAGGED	0.924	-0.093	-0.045	1											
5 CEO_58	-0.107	0.146*	0.137*	-0.73	1										
6 NO_COO	0.096	-0.110	-0.098	0.106	-0.126	1									
7 NO_PRES	-0.097	0.042	0.064	-0.062	0.114	0.079	1								
8 COO_DIRECTOR	-0.010	-0.071	-0.068	-0.002	0.069	-0.564***	-0.060	1							
9 NONCEO_PRES_DIRECTOR	0.063	-0.045	-0.059	0.043	-0.013	-0.331***	-0.237	0.649***	1						
10 CEO_PRES	0.111	-0.097	-0.110	0.119	-0.072	0.448***	-0.441	-0.278***	-0.391***	1					
11 CEO_CHAIRMAN	-0.051	0.167	0.113	-0.084	0.117	-0.282***	0.286***	0.196**	0.284***	-0.579***	1				
12 INSTIT_OWNERSHIP	-0.005	-0.013	0.035	0.008	-0.097	-0.039	-0.053	0.230**	0.115	-0.079	0.051	1			
13 INSTIT_DIVERSIFICATION	-0.096	0.171**	0114	-0.076	-0.018	0.133*	0.164	-0.272***	-0.216***	0.043	0.097	-0.341***	1		
14 CEO_ALIGNMENT	-0.067	-0.109	-0.048	-0.049	-0.233***	0.198**	-0.049	-0.133	-0.121	0.056	-0.200**	0.010	-0.033	1	
15 INSIDERS_ALIGNMENT	0.015	-0.120	-0.037	0.015	-0.158*	0.192**	-0.098	-0.137	-0.127	0.101	-0.261***	-0.039	-0.060	0.951***	1
16 LN_REV	-0.219***	0.378***	0.345***	-0.194**	0.110	0.010	0.261***	-0124	-0.019	-0.190**	0.258***	-0.087	0.294***	-0.293***	-0.359***
17 LN_REV*LN_REV	-0.191**	0.358***	0.329***	-0.167**	0.103	0.021	0.271***	-0.129	-0.026	-0.186**	0.240***	-0.096	0.293***	-0.279***	-0.342***
18 LEVERAGE	-0.038	0.286***	0.226***	-0.035	0.018	0.023	-0.029	-0.061	0.052	0.050	0.145*	-0.133*	0.025	-0.218***	-0.265***
19 TOBINS_Q_LAGGED	-0.004	-0.239***	-0.232***	-0.045	-0.022	-0.153*	0.082	0.094	-0.101	-0.106	-0.148*	0.061	-0.175**	0.311***	0.351***
20 LN_FIRM_AGE	-0.147*	0.175	0.175**	-0.147*	0.104	0.093	0.130	-0.197**	-0.084	-0.065	0.229**	-0.234***	0.327***	-0.147*	-0.242***

Table 4.2 cond't

	16	17	18	19	20
1 CAPEX					
2 SEGMENT_NUMBER					
3 SEGMENT_NUMBER*					
4 CAPEX_LAGGED					
5 CEO_58					
6 NO_COO					
7 NO_PRES					
8 COO_DIRECTOR					
9 NONCEO_PRES_DIRECTOR					
10 CEO_PRES					
11 CEO_CHAIRMAN					
12 INSTIT_OWNERSHIP					
13 INSTIT_DIVERSIFICATION					
14 CEO_ALIGNMENT					
15 INSIDERS_ALIGNMENT					
16 LN_REV	1				
17 LN_REV*LN_REV	0.996***	1			
18 LEVERAGE	0.016	0.001	1		
19 TOBINS_Q_LAGGED	-0.370***	-0.341***	-0.334***	1	
20 LN_FIRM_AGE	-0.422***	0.411***	0.060	-0.308***	1

4.3.4 Specification of models

4.3.4.1 Hypothesis 1

To test H1, I estimate the following firm-fixed effects linear regression model, M1:

$$CAPEX_{it} = \beta_0 + \beta_1 NUM\_SEG_{it-1} * NUM\_SEG_{it-1} + \beta_2 NUM\_SEG_{it-1} + \beta' controls_{it} + \beta' lagged\_controls_{it-1} + year\_dummies_t + firm\_fixed\_effects_i + \varepsilon_{it}$$

If NUM_SEG[59] exhibits a positive and statistically significant coefficient and NUM_SEG*NUM_SEG a negative and statistically significant coefficient, H1 is confirmed reflecting that the relation of firm's long-term investments and CEO's contribution to firm's cash flows is hump-shaped. I calculate clustered robust standard errors for all variables by choosing a firm identifier variable as cluster variable (see for the necessity of clustered robust standard errors Petersen, 2009). A Hausman (1978) specification test indicates that a fixed effects regression model is more preferable than a random effects model. I control for firm-fixed effects to mitigate endogeneity concerns about NUM_SEG that some firm-fixed effects could capture number of segments: The firm, for instance, could have some time-invariant preferences in their annual reports for defining operating segments or the level of transparency w.r.t. job titles that are factored out by the firm-fixed approach.

4.3.4.2 Hypothesis 2

To test H2, I argue that a CEO whose compensation is highly sensitive to shareholder value is more aligned with shareholder's interest and thus is more far-sighted than a CEO with less sensitivity. Consequently, I split my sample including all valid alignment variables (sample size = 140) in two subsamples, representing high CEO alignment and low CEO alignment, respectively. As cutoff value I choose the median of CEO_ALIGNMENT (i.e., \$1.261 per \$100 shareholder value increase).[60] Then, I also apply M1 for each subsample, then called M2 (1) (CEO alignment < median CEO alignment) and M2 (2) (CEO alignment >= median CEO alignment). If I observe a statistically significant hump-shaped relation for the subsample of low CEO alignment (M2 (1)) whereas no statistically significant relation for the high CEO alignment group (M2 (2)), H2 is confirmed that a hump-shaped relation of firm's long-term investments and CEO's contribution to firm's cash flows is more pronounced if the CEO is more likely myopic than far-sighted.

[59] In the text, I do not use the subscripts of the variables.
[60] Aggarwal et al. (2013) choose as cutoff value five percent to differentiate between the two CEO types.

4.4 Empirical results and their discussion

4.4.1 Empirical results

4.4.1.1 Hypothesis 1

The results for M1 are depicted in *Table 4.3*. M1 (1) excludes the squared versions of NUM_SEG to show that there is no statistically significant linear relation of the number of segments and capital expenditures.

In M1 (2), I include the squared version of NUM_SEG but exclude CEO_ALIGNMENT and INSIDER_ALIGNMENT to have slightly larger sample size (159) and more firms (73). In M1 (3), I include CEO_ALIGNMENT, and in M1 (4), CEO_ALIGNMENT and INSIDER_ALIGNMENT.

In all specifications with NUM_SEG*NUM_SEG, I observe a positive coefficient on NUM_SEG and a negative one on NUM_SEG*NUM_SEG. In M1 (3) and M1 (4), all corresponding coefficients are statistically significant at the five percent level whereas in M1 (2) the coefficient on NUM_SEG is statistically significant at the ten percent level and NUM_SEG*NUM_SEG also at the five percent level. All findings confirm H1 that the relation of firm's long-term investments and CEO's contribution to firm's cash flows is hump-shaped.

4.4.1.2 Hypothesis 2

The results for M2 for both subsamples are shown in *Table 4.4*.

For the subsample of low CEO alignment in M2 (1) (i.e., more likely myopic CEOs), I observe again the hump-shaped relation of firm's long-term investments and CEO's contribution to firm's cash flows reflected by the positive coefficient on NUM_SEG (significant at $p < 0.10$) and negative one on NUM_SEG*NUM_SEG (significant at $p < 0.10$).

For the subsample of high CEO alignment in M2 (2) (i.e., more likely far-sighted CEOs), I observe no statistically significant coefficients on NUM_SEG and NUM_SEG*NUM_SEG. Hence, I cannot document a hump-shaped relation of firm's long-term investments and CEO's contribution to firm's cash flows.[61]

[61] Aggarwal et al. (2013) also apply this approach and concludes that insignificance in the one group and significance in the other as indication that the effect is more pronounced in the latter group.

Table 4.3: Main models for Hypothesis 1. Variables are defined as described in Table 4.6. Standard errors are clustered robust with a firm identifier as cluster variable and reported in parentheses. Asterisks denote statistical significance at the 0.01(***), 0.05(**) and 0.10(*)-level.

	M1 (1)	**M1 (2)**	**M1 (3)**	**M1 (4)**
Sample	**Entire sample**	**Entire sample**	**Entire sample**	**Entire sample**
Variables	**CAPEX**	**CAPEX**	**CAPEX**	**CAPEX**
NUM_SEG	0.001	0.015*	0.019**	0.019**
	(0.003)	(0.008)	(0.009)	(0.009)
NUM_SEG*NUM_SEG	-	-0.002*	-0.002**	-0.002**
		(0.001)	(0.001)	(0.001)
CAPEX_LAGGED	-0.071	-0.082	-0.000	-0.096
	(0.065)	(0.070)	(0.066)	(0.067)
CEO_58	-0.004	-0.005	-0.010	-0.010
	(0.005)	(0.006)	(0.008)	(0.009)
NO_COO	0.002	0.001	-0.007	-0.004
	(0.007)	(0.007)	(0.008)	(0.008)
NO_PRES	-0012	-0.010	-0.015	-0.016
	(0.011)	(0.011)	(0.013)	(0.013)
COO_DIRECTOR	-0.008	-0.009	-0.013	-0.011
	(0.010)	(0.010)	(0.013)	(0.013)
NONCEO_PRES_DIRECTOR	-0.002	0.001	-0.006	-0.008
	(0.012)	(0.012)	(0.016)	(0.016)
CEO_PRES	-0.007	-0.007	-0.008	-0.011
	(0.009)	(0.009)	(0.011)	(0.012)
CEO_CHAIRMAN	-0.003	-0.005	-0.013	-0.013
	(0.008)	(0.008)	(0.010)	(0.014)
INSTIT_OWNERSHIP	-0.059	-0.057	-0.101**	-0.106**
	(0.052)	(0.051)	(0.044)	(0.047)
INSTIT_DIVERSIFICATION	0.442	0.442	0.401	0.383
	(0.336)	(0.336)	(0.376)	(0.371)
CEO_ALIGNMENT	-	-	-0.004	-0.001
			(0.001)	(0.001)
INSIDERS_ALIGNMENT	-	-	-	0.000
				(0.001)
LN_REV	-0.232	-0.235	-0.356	-0.354
	(0.257)	(0.258)	(0.207)	(0.302)
LN_REV*LN_REV	0.012	0.012	0.019	0.019
	(0.014)	(0.014)	(0.016)	(0.016)
LEVERAGE	0.034	0.039	0.061	0.039
	(0.043)	(0.044)	(0.049)	(0.056)
TOBINS_Q_LAGGED	0.008***	0.008***	0.007	0.006
	(0.002)	(0.002)	(0.012)	(0.012)
LN_FIRM_AGE	0.159*	0.157*	0.393*	0.400*
	(0.089)	(0.089)	(0.229)	(0.234)
Time dummy variables	Fiscal years	Fiscal years	Fiscal years	Fiscal years
Firm-fixed effects	YES	YES	YES	YES
Constant	0.095	0.083	-0.290	-0.299
	(0.815)	(0.817)	(0.977)	(0.918)
#Firm-years	159	159	141	140
#Firms	73	73	62	62
R^2 within	0.2314	0.2385	0.2861	0.2902
R^2 between	0.0126	0.0175	0.0456	0.0452
R^2 overall	0.0159	0.0200	0.0415	0.0393

Table 4.4: Main models for Hypothesis 2. Variables are defined as described in Table 4.6. Standard errors are clustered robust with a firm identifier as cluster variable and reported in parentheses. Asterisks denote statistical significance at the 0.01(***), 0.05(**) and 0.10(*)-level.

	M2 (1)	**M2 (2)**
Sample	**Low CEO alignment**	**High CEO alignment**
Variables	**CAPEX**	**CAPEX**
NUM_SEG	0.021*	-0.017
	(0.012)	(0.087)
NUM_SEG*NUM_SEG	-0.004*	0.004
	(0.002)	(0.007)
CAPEX_LAGGED	-0.147	-0.327
	(0.134)	(0.269)
CEO_58	0.008	0.183
	(0.011)	(0.049)
NO_COO	0.017	0.230
	(0.020)	(0.024)
NO_PRES	-0.030	-0.040
	(0.037)	(0.038)
COO_DIRECTOR	-0.014	0.019
	(0.029)	(0.025)
NONCEO_PRES_DIRECTOR	0.014	-0.040
	(0.020)	(0.032)
CEO_PRES	-0.105	-0.052**
	(0.075)	(0.022)
CEO_CHAIRMAN	0.008	-0.016
	(0.020)	(0.037)
INSTIT_OWNERSHIP	0.001	-0.294**
	(0.085)	(0.107)
INSTIT_DIVERSIFICATION	-0.659	0.359
	(0.803)	(0.513)
CEO_ALIGNMENT	0.084	-0.005**
	(0.134)	(0.002)
INSIDERS_ALIGNMENT	0.004	0.002*
	(0.005)	(0.001)
LN_REV	1.052	-0.447*
	(0.786)	(0.229)
LN_REV*LN_REV	-0.051	0.020*
	(0.039)	(0.011)
LEVERAGE	0.020	-0.077
	(0.088)	(0.127)
TOBINS_Q_LAGGED	0.031	-0.033
	(0.028)	(0.024)
LN_FIRM_AGE	-0.083	0.790
	(0.202)	(0.483)
Time dummy variables	Fiscal years	Fiscal years
Firm-fixed effects	YES	YES
Constant	-4.364	-0.925
	(3.203)	(0.967)
#Firm-years	70	70
#Firms	34	34
R^2 within	0.6345	0.6580
R^2 between	0.0603	0.1103
R^2 overall	0.1358	0.1358

These findings confirm H2 that a hump-shaped relation of firm's long-term investments and CEO's contribution to firm's cash flows is more pronounced if the CEO is more likely myopic than far-sighted.

4.4.2 Comparison of empirical results with model predictions

To plot my findings from M1 (4) regarding the internal governance mechanism, I calculate the relation of firm's long-term investments and CEO's contribution to firm's cash flows as follows:

$$CAPEX_{M1(4)} = -0{,}00192 * NUM\_SEG * NUM\_SEG + 0{,}01906 * NUM\_SEG ,$$

where NUM_SEG ranges from 1 to 9 segments as my descriptive statistics show. To make the plot start at CAPEX=0 for NUM_SEG=1, I transform it as follows:

$$CAPEX_{M1(4)} = \frac{-0{,}00192 * NUM\_SEG * NUM\_SEG + 0{,}01906 * NUM\_SEG}{CAPEX_{M1(4)@NUM\_SEG=1}}$$
$$= \frac{-0{,}00192 * NUM\_SEG * NUM\_SEG + 0{,}01906 * NUM\_SEG}{0.01714} ,$$

where $CAPEX_{M1(4)@NUM\_SEG=1} = -0{,}00192*1*1 + 0{,}01906*1 = 0{,}01714.$

The plot is depicted in *Figure 4.1*. The plot shows the hump-shaped relation of firm's long-term investments and CEO's contribution to firm's cash flows.

Similarly, I plot the hump-shaped relation for the subsample of likely myopic CEOs from M2 (1) in *Figure 4.1* according to the following function:[62]

$$CAPEX_{M2(1)} = \frac{-0{,}00399 * NUM\_SEG * NUM\_SEG + 0{,}02091 * NUM\_SEG}{CAPEX_{M2(1)@NUM\_SEG=1}}$$
$$= \frac{-0{,}00861 * NUM\_SEG * NUM\_SEG + 0{,}03912 * NUM\_SEG}{0.01692}$$

As a benchmark, I also analyze the theoretical capital stock the CEO invests at the end of the first period, i.e., k^{MC}, according to Acharya's et al. (2011) prediction with the parameters $b = 1.4286$, $\theta = 1$, $\gamma = 0.2$, and $r = 0.05$ which they also choose in their paper (Acharya et al., 2011, p. 710) as follows:

[62] Note that the subsample applied in M2 (1) only counts 7 operational segments so that segments 8 and 9 are not supported by empirical data.

$$k^{MC} = \left[\gamma * (1-\delta)\delta^{b-1} \frac{\theta^b}{(1+r)^{b-1}} \right]^{\frac{1}{1-\gamma b}}$$

$$\Rightarrow CAPEX_{Acharya\ et\ al.(2011)} = \left[0.2 * (1 - \frac{NUM\_SEG}{NUM\_SEG_{\max}})(\frac{NUM\_SEG}{NUM\_SEG_{\max}})^{1.4286-1} \frac{1^{1.4286}}{(1+0.05)^{1.4286-1}} \right]^{\frac{1}{1-0.2*1.4286}},$$

where $\delta = \frac{NUM\_SEG}{NUM\_SEG_{\max}}$ denotes myopic CEO's contribution to firm's cash flows

with $NUM\_SEG_{\max} = 9$ to comply with Acharya's et al. (2011) interval for δ .

Since I intend to compare the plot of my empirical findings with those model predictions, I also transform $CAPEX_{Acharya\ et\ al.(2011)}$ to get $CAPEX_{Acharya\ et\ al.(2011)} = 0$ at NUM_SEG=1:

$$CAPEX_{Acharya\ et\ al.(2011)} = \frac{\left[0.2 * (1 - \frac{NUM\_SEG}{NUM\_SEG_{\max}})(\frac{NUM\_SEG}{NUM\_SEG_{\max}})^{1.4286-1} \frac{1^{1.4286}}{(1+0.05)^{1.4286-1}} \right]^{\frac{1}{1-0.2*1.4286}}}{CAPEX_{Acharya\ et\ al.(2011)@\ NUM\_SEG=1}}$$

$$= \frac{\left[0.2 * (1 - \frac{NUM\_SEG}{9})(\frac{NUM\_SEG}{9})^{0.4286} \frac{1}{(1+0.05)^{0.4286}} \right]^{\frac{1}{1-0.2857}}}{0.02315},$$

where

$$CAPEX_{Acharya\ et\ al.(2011)@NUM\_SEG=1} = \left[0.2 * (1 - \frac{1}{9})(\frac{1}{9})^{1.4286-1} \frac{1^{1.4286}}{(1+0.05)^{1.4286-1}} \right]^{\frac{1}{1-0.2*1.4286}} = 0.02315$$

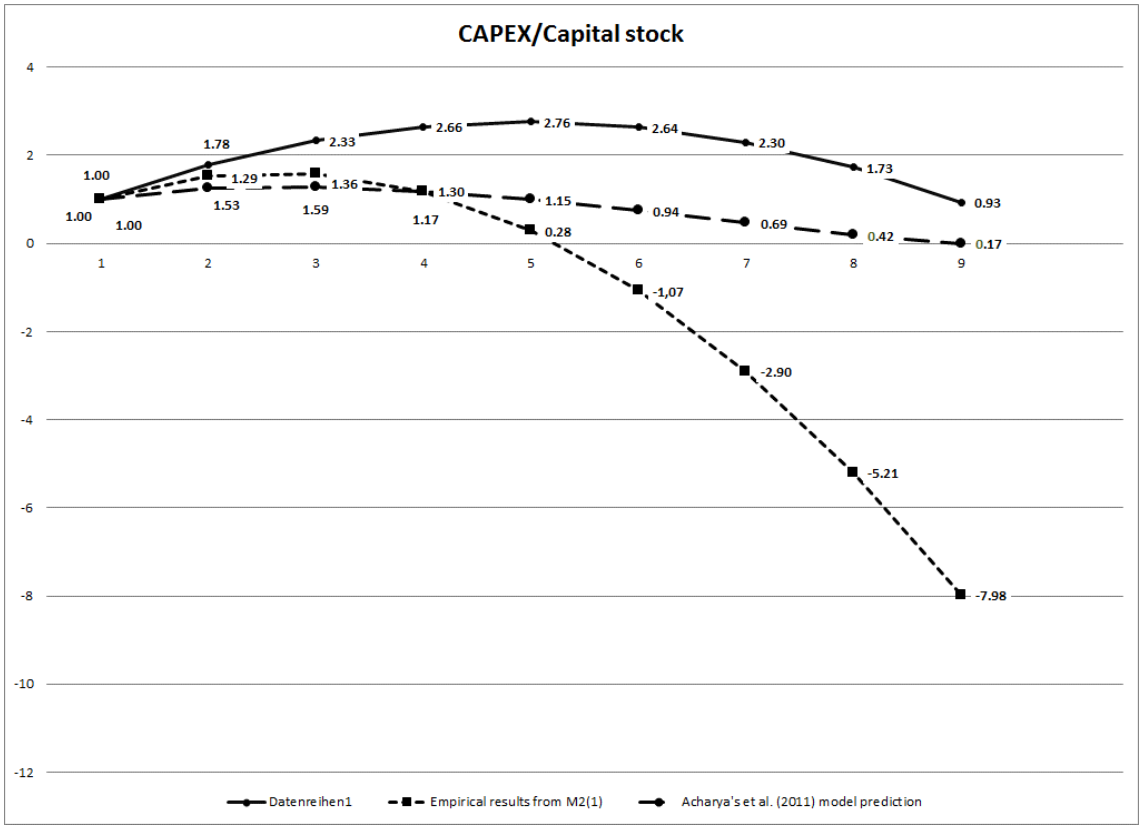
Then, I also plot $CAPEX_{Acharya\ et\ al.(2011)}$ in *Figure 4.1*.

All three plots show the hump-shaped relation between firm's long-term investments and CEO's contribution to firm's cash flows.

The results from M1(4) and M2 (1) have a correlation coefficient of 0.4586 that shows that controlling for the horizon of the CEO influences my findings, but does not change the underlying hump-shape.[63]

[63] Interestingly, the correlation coefficient of the results from M2 (1) and the theoretical model with a value of 0.9803 is very high. In addition, both curves have a peak at a number of segments of 3. Since the curve of the theoretical model depends on parameter choice, I take this finding with caution. Nevertheless, it could indicate that controlling for CEO's horizon is profitable.

Figure 4.1: CAPEX/Capital stock.



4.5 Robustness Analyses

4.5.1 Variable specifications concerns

Since I observe that very few annual reports lack data about the management team concerning NO_COO, NO_PRES, COO_DIRECTOR, PRESIDENT_DIRECTOR, CEO_PRES, and CEO_CHAIRMAN, these control variables can be biased by an omitted variable that measures firms propensity to report that data. I do not regard it as a problem for my main models, because such propensity should be filtered out due to the applied firm-fixed effects model. Nevertheless, as robustness analysis, I provide an estimation of M1 (4) denoted as M3 without these variables. Then, my results remain qualitatively unchanged (depicted in *Table 4.5*).

Another variable specification concern can be that FISCAL_YEAR_X is biased by an omitted variable measuring that some firms' fiscal years do not end at December, 31. To address this concern, I define quarter-year dummy variables based on quarters of all calendar years and estimate M1 (4) denoted as M4 with these year-quarter dummies. Then, I yield the same qualitative results as with the original model M1 (4) (shown in *Table 4.5*). These findings show that some endogeneity concerns about my control variables caused by possible omitted variable biases do not change my results.

4.5.2 Financial diversification

The number of operational segments conveys information about cash flow diversification form the CEO's perspective. It can also be seen from the investors' perspective. Then, one can argue that such diversification can, for instance, decrease the credit default risk of firm's bonds. This can lead to better financial strength to undertake more investments.

Hence, the number of segments is partially positively related to CAPEX, because it reflects financial strength rather than CEO's cash flow contribution. Since I control for TOBINS_Q_LAGGED and CAPEX_LAGGED, I suggest that my analysis should be robust against such interpretation.

Nevertheless, to rule out more likely such interpretation, I include in M1 (4) the logarithm of the 2-year average volatility of firm's stock returns at the end of the preceding fiscal year (Kale et al., 2009) denoted as LN_VOLA_LAGGED to account for diversification effects that increase financial strength.

Then, my results remain qualitatively unchanged (depicted in *Table 4.5*). This finding indicates that the number of reportable operating segments does not likely refer to financial strength as an alternative interpretation.

Table 4.5: Robustness analyses. Variables are defined as described in Table 4.6. Standard errors are clustered robust with a firm identifier as cluster variable and reported in parentheses. Asterisks denote statistical significance at the 0.01(***), 0.05(**) and 0.10(*)-level.

	M3	**M4**	**M5**
Sample	**Base sample**	**Base sample**	**Base sample**
Variables	**CAPEX**	**CAPEX**	**CAPEX**
NUM_SEG	0.014*	0.018*	0.022*
	(0.007)	(0.009)	(0.012)
NUM_SEG*NUM_SEG	-0.002**	-0.002*	-0.002**
	(0.001)	(0.001)	(0.001)
CAPEX_LAGGED	-0.097	-0.079	-0.038
	(0.071)	(0.069)	(0.093)
CEO_58	-0.006	-0.010	-0.005
	(0.006)	(0.009)	(0.008)
NO_COO	-	-0.001	-0.003
		(0.009)	(0.008)
NO_PRES	-	-0.014	-0.020
		(0.014)	(0.015)
COO_DIRECTOR	-	-0.007	-0.013
		(0.014)	(0.013)
NONCEO_PRES_DIRECTOR	-	-0.008	0.013
		(0.017)	(0.017)
CEO_PRES	-	-0.013	-0.012
		(0.014)	(0.013)
CEO_CHAIRMAN	-	-0.015	0.010
		(0.011)	(0.009)
INSTIT_OWNERSHIP	-0.082	-0.093*	-0.112**
	(0.034)	(0.050)	(0.049)
INSTIT_DIVERSIFICATION	0.393	0.426	0.366
	(0.378)	(0.388)	(0.363)
CEO_ALIGNMENT	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
INSIDERS_ALIGNMENT	0.000	0.000	0.004
	(0.001)	(0.001)	(0.001)
LN_VOLA_LAGGED	-	-	-0.190
			(0.183)
LN_REV	-0.328	-0.349	-0.362
	(0.289)	(0.303)	(0.292)
LN_REV*LN_REV	0.017	0.018	0.019
	(0.015)	(0.016)	(0.016)
LEVERAGE	0.354	-0.004	0.023
	(0.057)	(0.077)	(0.058)
TOBINS_Q_LAGGED	0.004	0.007	0.006
	(0.012)	(0.014)	(0.012)
LN_FIRM_AGE	0.201	0.334	0.375*
	(0.159)	(0.234)	(0.220)
Time dummy variables	Fiscal years	Quarters of calendar years	Fiscal years
Firm-fixed effects	YES	YES	YES
Constant	0.403	-0.073	-0.072
	(0.874)	(0.896)	(0.814)
#Firm-years	142	140	140
#Firms	62	62	62
R^2 within	0.2591	0.3005	0.3095
R^2 between	0.0443	0.0404	0.0431
R^2 overall	0.0320	0.0328	0.0354

4.6 Conclusion

Acharya et al. (2011) show in their theoretical model that a manager below the CEO rank who will be promoted to the CEO position in the next period is only induced to generate cash flows if his CEO does not misappropriate firm assets and undertakes long-term investments instead.

Consistently, I document that the relation of firm's long-term investments and CEO's contribution to firm's cash flows is hump-shaped. In addition, I find that this relation is more pronounced if the sensitivity of CEO's compensation to shareholder value is not too high and thus he is likely myopic.

Suggestions for future research

My analysis provides some implications for future research. First, my sample size is small. It should be extended with more firms and even with firms which do not experience internal promotions. Second, following Rose and Shepard (1997), the Herfindahl index for operating segments based on their revenues or profits should be applied to measure CEO's cash flow contribution because this measure is likely more related to my cash flow diversification arguments. Third, as an alternative measure for firm's long-term investments I suggest research and development expense capitalization because it follows more verifiable accounting standards and is scrutinized by auditors than R&D expenses in the income statement. This measure is, therefore, less likely biased by pet projects disguised as research projects.

Acharya's et al. (2011) idea that promotion incentives motivate a manager below the CEO rank to conduct tasks of internal governance has some managerial implications. According to their theory, all that shareholders must do is to choose the right heir apparent at the right time.

To begin with the right heir apparent, since the relation of CEO's and heir apparent's cash flow contribution must be balanced to maximize firm value, shareholders should search for an heir apparent with such a balanced contribution. For my sample, I conduct further analysis about the realization of promotions. Most of them are COOs or non-CEO president (66.67 percent) whereas only 7.7 percent of promoted managers are Chief Financial Officers (CFOs) that is consistent with literature (e.g., Kesner and Sebora, 1994; Giambatista et al., 2005). In this context, it would be interesting to extend Acharya's et al. (2011) model to Chief Financial Officers who might contribute cash

flows from financing activities that compete with operating cash flows. Maybe, a CFO contributes more to cash flows relative to the CEO, if he has specific knowledge about financial contracts. In addition, I find that the relation of CEO's contribution to firm's cash flows measured by NUM_SEG and the COO's or non-CEO president's promotion chance is also hump-shaped. This finding indicates that those managers are supposed to conduct tasks of internal governance. Since only few management literature (Zhang, 2006) refer to such tasks and even COOs themselves do not mention them (Bennet and Miles, 2006), it would be fruitful for future research to explore this idea empirically.

Since Acharya et al. (2011) assume that the young manager's promotion is certain and not endogenous, their model cannot explain this finding. So, it is left to future research to extend their model with an endogenous promotion chance, maybe by modeling competing young managers.[64]

About the right timing of selecting an heir apparent, I expect the following trade-off: If shareholders choose him too early, it is a signal to the CEO that his dismissal approaches and thus make him myopic in his investment behavior. If they select him too late, the CEO could misappropriate too many firm assets before. Consequently, it would be interesting for future research to determine the optimal timing for selecting the heir apparent.

To take it to a broader view, Acharya's et al. (2011) model and my empirical approach are applicable to other types of CEO-young manager alike relationships such as division managers and their deputies, or deans and their professors.

[64] In their conclusion, Acharya et al. (2011) also suggest further analysis in the case several potential CEO candidates exist.

4.7 Appendix

Table 4.6: Definitions of variables.

Variable	Definition
CAPEX	Capital expenditures in year t / total assets in year t-1
NUM_SEG	Number of reportable operating segments
CAPEX_LAGGED	capital expenditures in fiscal year t-1 / total assets in year t-2
CEO_58	Dummy variable set to ‘1’ if the CEO is older than 58 years
NO_COO	Dummy variable set to ‘1’ if the firm does not report a COO
NO_PRES	Dummy variable set to ‘1’ if the firm does not report a president
COO_DIRECTOR	Dummy variable set to ‘1’ if the firm reports a COO who is director
NONCEO_PRES_DIRECTOR	Dummy variable set to ‘1’ if the firm reports a non-CEO president who is director
CEO_PRES	Dummy variable set to ‘1’ if the firm reports a CEO who is president
CEO_CHAIRMAN	Dummy variable set to ‘1’ if the firm reports a CEO who is chairman of the board of directors
INSTIT_OWNERSHIP	Number of holdings held by institutional investors in year t-1 / stocks outstanding in year t-1
INSTIT_DIVERSIFICATION	Herfindahl index of holdings held by institutional investors in year t-1
CEO_ALIGNMENT	CEO alignment in year t-1
INSIDERS_ALIGNMENT	Insiders’ alignment (also including CEO alignment) in year t-1
LN_VOLA_LAGGED	Logarithm of 2-year volatility of stock returns in year t-1 in percent
LN_REV	Logarithm of revenues
LEVERAGE	Total debt / total assets
TOBINS_Q_LAGGED	Tobin’s Q in year t-1 = (market capitalization in year t-1 + total assets in year t-1 – book value of equity in year t-1-deferred taxes in year t-1)/total assets in year t-1
LN_FIRM_AGE	Logarithm of firm age

Chapter 5:

Conclusion

The dissertation contributes empirical findings to three research questions motivated by problems that firms and employees encounter during the lifecycle of human capital.

Research question RQ1

Chapter 2 addresses the research question RQ1 how firms motivate their employees to acquire firm-specific and general human capital. I document empirically that promotion incentives are positively related to nonverifiable firm-specific human capital acquisition whereas I find no relation of individual performance pay and such acquisition. On the contrary, I show that individual performance pay is positively related to general human capital acquisition whereas I find no relation of promotion incentives with such acquisition.

I suggest that future research tracks employees over time in a panel data set to reveal their investment dynamics in human capital and control for employee- and firm-fixed effects. One additional interesting finding of the dissertation is that the positive relation of individual performance pay and job-specific human capital acquisition. This finding motivates further research to explore why in this case an individual performance pay contract seems to be feasible.

Research question RQ2

Chapter 3 addresses the research question how firms learn about employees' human capital. I find empirically that firm's uncertainty about employees' job-specific human capital is positively related to adoption of job rotation. Further, I document that the firm also adopts job rotation if it is uncertain about job-specific nonhuman capital or if employees' job performance is influenced by an exogenous shock.

Since the study lacks employees' performance data, I suggest that future research analyzes the combined effect of the adoption of job rotation and firms' uncertainty about employees' job-specific human capital on job performance.

Research question RQ3

Chapter 4 addresses the research question how firms alleviate moral hazard problems caused by CEO's discretion due to their high value of human capital. I contribute to the

recent strand of literature about internal governance by documenting empirically in selected S&P 500 firms that the relation of firm's long-term investments and CEO's contribution to firm's cash flows is hump-shaped as predicted theoretically by Acharya's et al. (2011). In addition, I find that this hump-shaped relation is more pronounced if the CEO is likely myopic.

I suggest that the study of the dissertation is the starting point for several research projects. First, since subordinated managers usually compete against each other for the CEO job (Bognanno, 2001), it would be interesting to incorporate such tournaments in Acharya's et al. (2011) model as Acharya et al. (2011) also suggests in their conclusion. Second, future research should explore theoretically when internal governance should be triggered by a succession plan defined by shareholders because there is the trade-off that succession plans make incumbent CEOs myopic whereas heirs apparent discipline them. Third, I suggest that empirical research should examine if the selection of different types of executives as heirs apparent provide different outcomes that are not captured by Acharya et al. (2011). For example, if a CFO is considered as CEO successor, it is interesting how his contribution to firm's cash flows by designing financial contracts influence CEO's investment behavior. Last, the idea of internal governance should be examined empirically for all ranks in firms.

To conclude, a firm cannot simply acquire or evaluate human capital as it can do with nonhuman capital because the firm never possesses human capital because it is tied to employees who are free to leave the firm (e.g., Hart and Moore, 1994). Besides, it is often nonverifiable. As I outline in the dissertation, these characteristics of human capital entail moral hazard or evaluation problems which the firm can solve by using certain incentive and job designs. Since human beings are complex, I expect that in reality these designs also become complex. Due to this complexity, I expect that research on human capital will always be challenging and interesting.

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Jan-Oliver Strych

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gemäß § 6 Abs. 1 Ziff. 4 der Promotionsordnung des Karlsruher Instituts für Technologie für die Fakultät für Wirtschaftswissenschaften

1. Bei der eingereichten Dissertation zu dem Thema „Human Capital: Incentive and Job Design“ handelt es sich um meine eigenständig erbrachte Leistung.

2. Ich habe nur die angegebenen Quellen und Hilfsmittel benutzt und mich keiner unzulässigen Hilfe Dritter bedient. Insbesondere habe ich wörtlich oder sinngemäß aus anderen Werken übernommene Inhalte als solche kenntlich gemacht.

3. Die Arbeit oder Teile davon habe ich *bislang nicht* an einer Hochschule des In- oder Auslands als Bestandteil einer Prüfungs- oder Qualifikationsleistung vorgelegt.

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Karlsruhe, den 09.12.2014