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Master Thesis

Determinants and effects of employee stock option plans: Evidence from Germany

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Abstract

In this paper, the determinants of the provision of broad-based employee stock option plans and its effects on labor performance, are investigated using a new panel dataset consisting of a large number of German publicly listed firms during 2004-2008. By conducting several logistic regression models, ESOP provision is found to be determined by various firm characteristics. I observe that the use of ESOPs is associated with larger firm size, high R&D expense and high growth opportunities, while it is negatively related to book leverage. Regarding the effects of ESOP provision on labor performance, measured by employee turnover and employee productivity, the results are somewhat mixed. The results suggest that the provision of broad-based stock option plans does not reduce employee turnover. On the other hand, the empirical evidence supports the hypothesis that ESOP providing firms have superior performance in terms of employee productivity. This finding is robust when adding control variables for firm size, profitability and growth opportunities to the model.

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1. Introduction

1.1 Employee stock ownership

Granting stocks and stock options to executives as a form of compensation is a well-known phenomenon. In the last couple of decades however, and especially from the late 1990s onward, there has been a sharp increase in the number of companies that, besides granting stock options to executives, use broad-based employee stock option plans (ESOPs). Research indicates that option grants to employees have become an important part of firm's compensation policies (e.g. Mehran and Tracy, 2001; Murphy, 1999). However, in the United States, the number of ESOPs started to decline in the early 2000s after a dramatic increase the years before. The decline in the number of plans is mostly caused "by termination of small, dubiously legitimate plans that were set up to take advantage of then-recent S corporation ESOP tax law" (NCEO, 2017). Since 2009 the number of ESOPs has stayed somewhat the same, but the number of participants is still steadily increasing (NCEO, 2017). This indicates the persistent popularity of ESOPs.

An employee stock option is a non-tradable stock option, granted to an employee, which gives the employee the opportunity to buy or sell shares of the company he works for, at a fixed price per share and for a prespecified period of time. An employee stock option typically cannot be exercised immediately; it has a vesting period. Stock options cannot be exercised all at once, but only in parts and over time. They typically expire after five to ten years. A stock option is called vested when it can be exercised. With employee stock option plans, companies not only compensate executives or "key" employees with stock options; they use them for a broader set of employees. The original rationale behind this is that it allows companies to link a specific proportion of employee compensation to the performance of employees. In this way, employees are incentivized to enhance their performance, in order to increase their own reward. On the other hand, research has indicated that these incentive effects barely exist and are outweighed by free-riding problems (e.g. Lazear, 2004; Oyer, 2004). In the literature, employee stock options have therefore been referred to as "incentives that have no incentive effects" (Oyer, 2004). Still, there must be some benefits of ESOP that offset the large degree of risk for employees associated with this form of compensation. However, there is still no firm consensus in the literature why companies use these broad-based stock option plans. That is one of the main reasons why employee stock option plans have continued to be a popular subject of research in last decades. Also in recent years, new

research is conducted to examine the implications of ESOPs, but there are still some questions to which no unequivocal answer is available.

With regards to the literature on ESOPs, two main research questions can be distinguished: what determines the use of employee stock option plans and what are the effects of its provision on organizational performance. Most of the findings on these two questions are based on evidence that is generated using US data. In this thesis, I will cover both questions using German data. The literature identifies different categories of organizational performance measures. For the present work, I am interested in only one of them; i.e. labor performance. This taken together results in the following research question:

"What are the determinants of the provision of employee stock option plans and what are the effects of employee stock option plans on labor performance?"

To investigate the research question, I make use of new panel data for a large proportion of German publicly listed companies during 2004-2008. This thesis contributes to the existing literature, since the unique panel dataset allows me to test the universality of results obtained from previous studies that are mostly originated in the US and use US data.

1.2 Methodology and most important findings

To compose the panel dataset, I gather information on the provision of employee stock option plans from the annual reports of the selected German companies. Firm-level data is collected from WorldScope and Asset4. I examine both the determinants for and effects of employee stock option plans, hence my empirical analysis is twofold. In the first part, which investigates the determinants of ESOP provision, I use logistic regression models, with the provision of ESOP as the dependent variable. The second part of my analysis links to the relationship between ESOPs and labor performance, which is operationalized by both employee turnover and employee productivity. I employ various linear regression models with these two variables as dependent variables and the provision of employee stock option plans as the key explanatory variable.

When conducting the logistic regression models, I find strong statistical support for a positive relationship between the provision of ESOPs and firm size. Furthermore, my results indicate that firms with high levels of R&D are more likely to provide employee stock options. Additional support for this is given by the result that new economy firms are more likely to use an ESOP;

those firms are characterized by high R&D intensity. I also find evidence, although a little weaker, that the likelihood of using an ESOP is low for firms with high book leverage and is higher when a firm has a large value for Tobin's Q. My results indicate that firm risk, liquidity and financing constraints are no determinants of ESOP provision.

With regards to the effects of ESOP provision on labor performance, my findings are somewhat mixed. Results in this research suggest that there is no negative relationship between ESOP provision and employee turnover. This implies that ESOP providing firms do not have lower employee turnover rates than non-providing firms. On the other hand, I do find empirical evidence for a positive relationship between the use of broad-based ESOPs and employee productivity. Firms that make use of broad-based employee stock option plans are thus characterized by superior employee productivity.

1.3 Structure

The remainder of this thesis is structured as follows. Section 2 gives an overview of the relevant literature on employee stock ownership and stock option plans. Furthermore, it provides the hypotheses development, based on previously discussed studies. In section 3, I will clarify the sample selection methods and the dataset that is used. Section 4 gives an extensive explanation on the applied estimation methods. It starts with a comprehensive description of the measurement of all variables used in regression analysis. Furthermore, it illustrates which regression models are used to test the formulated hypotheses on both the determinants of employee stock option plans and the relation between ESOPs and specific measures of firm performance. The results of these empirical analyses are presented in section 5. Section 6 summarizes this study and discusses limitations together with some of the directions for further research.

2. Literature review

In this chapter, different aspects of employee ownership and ESOPs will be explained. After an introduction on the benefits and costs of ESOPs, this chapter provides a comprehensive discussion of relevant literature on ESOPs. The current literature on ESOPs can be divided into two groups: research that focusses on the determinants for the adoption of employee stock options and research that focusses on the effect of employee stock options on firm performance.

2.1 Benefits of employee stock ownership and employee stock option plans

Sesil et al. (2001) state that there is no dominant explanation for the adoption of employee stock ownership plans. There are different rationales for employee stock ownership and several motives why companies use employee stock option plans. First, the main benefits of employee stock options are discussed. Subsequently, a brief overview of alternative motives for using ESOPs is given.

2.1.1 Main benefits of ESOPs

The relevant literature distinguishes three main explanations why firms use employee stock ownership and ESOPs. First, in the US, ESOPs are taxed at a lower rate than regular forms of compensation such as salaries, which can give a firm tax advantages. The findings of the relevant literature are mixed on this point. Scholes and Wolfson (1990) find that tax benefits of employee ownership are limited. Beatty (1995) however does find evidence that employee ownership induce tax benefits to firms. Consistent with that, Graham et al. (2004) suggest that employee stock options are important non-debt tax shields. They find that for S&P firms, the marginal tax rate is drastically lowered by stock option deductions.

Second, Hall et al. (2003) consider favorable accounting treatment as a benefit of ESOPs. Wages have to be reported as a compensation expense, while stock option grants do not have to be reported in that way. Firms that pursue short-term stock price increase can use ESOPs to boost their stock price because employee stock option grants can have influence on how investors value the firm (e.g. Aboody et al., 2004; Bell et al., 2002). However, Oyer et al. (2005) find, consistent with Oyer and Schaeffer (2003), that favorable accounting treatment is not a standalone reason why firms adopt ESOPs, because it is inconsistent with variation in adoption of option plans in the model they calibrate.

Third, Kruse et al. (2004), amongst others, emphasize that employee stock ownership can help reduce governance problems that are related to the agency theory. The agency theory, as designed by Jensen and Meckling (1976), addresses corporate governance problems that can arise due to differences in interests between employees (agents) and shareholders (principles). These differences can induce agency costs. With employee stock ownership, agency costs can be reduces by aligning the interests of employees and shareholders more closely (Pendleton, 2001). By giving stock options to employees namely, a firm links compensation for employees to firm performance. In this way, employees are given an incentive that motivates them to act in the interest of the firm and to increase firm value, which maximizes their own compensation. Both Core et al. (2001) and Kedia and Mozumdar (2002) suggest that providing these kinds of incentives to employees, can play a role in a company's decision to adopt ESOPs.[1] Oyer (2004) and Oyer et al. (2005) however, find no evidence for an incentive-based explanation for the use of ESOPs. They suggest that risk premia associated with option grants are much larger than the cost to employees of the resulting increases in effort, which makes stock options a very inefficient instrument to give incentives to employees. They also state that employees, unlike executives, are only motivated by these kinds of incentives under a very limited set of circumstances. Employees must be able to take actions that have large value implications for the firm and taking these actions should be possible at very small costs for the employees (Oyer et al. 2005). Typically, these criteria are not met since an individual employee often cannot make a big impact on the value of the firm. Putting in extra effort only has a trivial value on stock holdings.

Furthermore, Lazear (2004) and Oyer (2004) suggest that the incentive effects of ESOPs are weakened or even outweighed by free-rider problems. These problems arise "due to the weak link between an individual's performance and financial payoff as the workgroup grows larger" (Kruse et al., 2004). Free-riding employees thus benefit from the ESOPs without putting in extra effort, while other employees increase their effort to improve the value of the firm. Poutsma et al. (2006) and Ding et al. (2001) also find evidence for free-rider problems related to ESOPs. They report that free-rider problems tend to be most serious in very large firms, where many employees take part in a stock option plan, and where they all hold a very small amount of stocks. In very large

[1] Both Core et al. (2010) and Kedia and Mozumdar (2002) use a very broad definition of employee. In their research, every employee other than the five highest-paid executive officers is considered as non-executive and thus as an employee.

firms, the impact an individual employee can make on the stock price is therewith very small. Despite of these findings, research indicates that ESOPs are more dominant in larger firms (Pendleton et al. 2001).

As pointed out above, research suggests that employee stock options provide weak incentives themselves. Empirical evidence indicates however, that broad-based ESOPs, despite of these weak incentive effects, are still used very often (Oyer, 2004). Oyer et al. (2005) therefore consider two other reasons why firms use employee stock options. One of those reasons is sorting employees. The idea behind this is that with stock option grants, a firm can reduce compensation costs when it attracts employees that are optimistic about future firm performance. This only applies when employees differ in their beliefs about the firms' prospects. Consistent with Core et al. (2001), Oyer et al. (2005) find that stock options are an efficient instrument to reduce compensation costs if employees are sufficiently optimistic about the firm's prospects. Thereby, the model they calibrate, indicates optimistic employees are somewhat more productive. Sorting motives could therefore be a contributing factor to decisions to grant employee stock options.

Another benefit of using ESOPs, Oyer et al. (2005) consider, is that it can contribute to retention of employees. When a firm is able to retain its employees for a longer period of time, the turnover rate decreases and the corresponding turnover costs can be reduced. Employee turnover is defined as the "departure of an employee from the formally defined organization" (March and Simon, 1958)[2]. The turnover rate is a measurement of how often an employee has to be replaced within a certain period of time. Since stock option grants typically have a vesting period and in some cases expire when an employee leaves the firm, they can make it very costly for employees to leave, since it is a form of deferred compensation. With stock options, a firm can also link compensation to labor market conditions and "index the value of an employees deferred compensation to their outside opportunities" (Oyer et al., 2005), which makes it more effective than deferred cash payments. Oyer et al. (2005) find, consistent with Oyer (2004), that there is a positive relation between the adoption of firm-wide stock option plans and the firm's turnover costs and employee risk tolerance. This means that when the cost of replacing an employee or employee risk tolerance is high, firms are more likely to adopt ESOPs. Carter and Lynch (2004) also find evidence that

[2] Turnover can both be voluntary and involuntary. Voluntary turnover is initiated by an employee himself, involuntary turnover is controlled by the company.

repricing of "underwater" stock options - i.e. when stock price drops below exercise price of the stock option – reduces employee turnover. This shows the importance of retention as a motive for adopting ESOPs. Ittner et al. (2003) endorse these findings, but state that retention objectives only have significant impact on "new hire grants". In contrast to those findings, Hall and Murphy (2003) argue that employee ownership and employee stock options are an inefficient way of retaining and attracting employees.

2.1.2 Other benefits of ESOPs

Beside the benefits of ESOPs mentioned in paragraph 2.2.1, there can be some other contributing factors in explaining why firms use broad-based stock option plans. In this paragraph some of those factors will be highlighted.

Research located largely within the human resource management field identifies possible benefits of ESOPs, with participation of employees as an important factor. Pendleton (2001) only finds little evidence for improvement of employee participation due to the use of employee stock options. Nevertheless, Poutsma (2001) suggests that ESOPs are used to enhance commitment and improve employee attitude. Besides, employees are given a role in corporate governance due to their voting rights as shareholders, which enhances industrial democracy. Some research argues that improved participation leads to enhanced commitment, employee attitude and industrial democracy, which can contribute to improving firm performance. Faleye et al. (2006) however argue that participation in corporate governance leads to inefficiency

Firms can also use employee stock ownership as an instrument to prevent hostile takeovers. When a firm has granted stock options to employees, it reserves stock for future issue. This reserved stock can be issued when thread of a hostile takeover occurs. Chaplinsky and Niehaus (1994) argue that ESOPs are quite an effective way of defense.

Employee stock ownership can also have some advantages for employees themselves. Perotin and Robinson (2002) state that employee ownership in some cases can create wealth with employees. There is only very little evidence on this and little literature on why employees participate in ESOPs.

2.2 Costs of employee stock ownership and stock options

The most important cost of employee stock ownership is that it exposes employees to a high level of risk. First of all, employees do not have the possibility to sell their stock options and cannot hedge their risk with short-selling. Peetz et al. (1988) also suggest that employee ownership shifts back risk on employees that was allocated to shareholders. According to Lazear (2004), variable compensation, such as employee stock options, transfers risk from capital to labor. Thereby, with ESOPs, employees invest both their capital and labor in the same firm. This means that employees become very dependent on the firm they work for. Besides, firm performance and stock price are definitely not only determined by the efforts of employees; internal and external factors, such as managerial decisions and possible demand shocks, play a big role. Perotin and Robinson (2002) therefore emphasize that employees are sometimes exposed to their manager's moral hazard.

On the other hand, research suggests that employee stock ownership can induce costs for regular, non-employee shareholders. First, when employee stock options are used as hostile takeover defense, the resultant outcome is quite often not favorable for shareholders (Ding et al., 2001). Second, Faleye et al. (2006) suggest that employee's "voice in corporate governance" can harm shareholder value maximization. They find that shareholder value is significantly depressed when employees have a role in corporate governance due to employee stock ownership. Employees tend to be concerned about current and future cash flows only, which is not always in the best interest of regular shareholders.

Another disadvantage of ESOPs is the free-rider problem as described in paragraph 2.1. Employees with stock option grants that want to maximize their payoff, can benefit from the extra efforts of other employees. This weakens or even outweighs the incentive effects that firms may try to achieve with ESOPs.

2.3 Effect of employee stock options on performance

As indicated in paragraph 2.1, there are a lot of reasons why it could be beneficial for firms to use stock ownership. Underlying meaning for most of these reasons is improving the performance of the firm. There is a substantial body of literature concerning the effects of broad-based ESOPs on firm performance. Theoretical starting point of most of the research is the agency problem as described in paragraph 2.1. Firm performance can be improved by increasing employee productivity or by lowering monitoring costs. In both ways, agency costs are reduced.

2.3.1 Employee productivity

Economic literature predicts that incentives such as stock option grants enhance employee productivity, since the interests of employees are aligned with those of the firm. There is mixed evidence on the positive effects of ESOPs on employee productivity. Nevertheless, most studies find at least no negative effects of employee stock ownership on employee productivity and firm performance (e.g. Blasi et al., 1996; Kruse et al., 2004; Sesil et al., 2001; Frye, 2004). In addition, Beatty (1995) finds some evidence for a link between incentive compensation and employee productivity. Hochberg and Lindsey (2010) suggest that there is a positive link between broad-based employee stock option grants and firm performance as well, especially in smaller firms, and find a causal relationship between the provision of ESOPs and firm performance. Sesil et al. (2002) endorse this, by stating that firm-wide stock option plans are positively correlated with employee productivity. Their research indicates that stock option plans are associated with greater value added per employee, which they use as a measurement of employee productivity. On the other hand, they cannot determine the mechanism associated with their findings. Their results do not indicate whether employees are motivated directly by stock option grants or not. They thereby state, other than Hochberg and Lindsey (2010), that there is no evidence for positive causal effects of stock option plans on employee productivity; e.g. it might be possible that the most productive firms choose to adopt ESOPs. In contrast, by following approximately the same methodology as Sesil et al. (2002), Jones et al. (2010) consistently find no evidence for a link between ESOPs and firm productivity. This is supported by Blasi et al. (1996), who find little evidence for employee productivity improvements as a result of employee stock ownership. They argue that there is no automatic relationship between employee ownership and firm performance. Consistent with that, Sesil et al. (2001) emphasize that employee stock options do not automatically improve firm performance when introduced and that ESOPs alone do not improve firm productivity. This corresponds to the research as discussed in paragraph 2.1.1. To achieve improvements in firm productivity and firm performance, ESOPs should be accompanied by increased employee participation in decision-making (Kruse et al., 2004; Pendleton, 2001).

Furthermore, reducing the employee turnover rate and corresponding turnover costs can help to improve firm performance. In the literature, the most common assumption is that turnover rate is negatively related to firm performance. Hancock et al. (2013) endorse this assumption by

conducting a meta-analysis of employee turnover as a predictor of firm performance. Consistent with that, Kedia and Mozumdar (2002) find that a low turnover rate is associated with positive abnormal returns. Also Oyer and Schaeffer (2005) identify retaining employees and thus a low turnover rate as a source of firm performance improvement.

2.3.2 Monitoring costs

Economic theory suggests that mutual monitoring among employees can also reduce agency costs, and can help to overcome free-rider problems. ESOPs potentially induce mutual monitoring. Kruse et al. (2004) advocate a three-pronged combination of factors that are key to increase firm performance: the incentives that are given to employees must be sufficiently meaningful, those employees should be able to act on the given incentives via participative mechanisms available in the firm and there must be a corporate culture that diminishes free rider problems. Employee stock options can help to create such a culture, in which consensually monitoring by employees and information sharing with the company are very important. Sesil et al. (2001) suggest that ESOPs can have positive effects on firm performance especially when monitoring costs are high. Hochberg and Lindsey (2010) find that the positive effect of employee stock options on firm performance is concentrated solely in firms that have broad-based stock option plan. According to those authors, this finding supports the argument that ESOPs may induce monitoring among employees. Lastly, Kandel et al. (1992) find that through mutual monitoring and peer pressure, employees that have stock options can improve firm performance.

2.4 Characteristics of ESOP firms

There is a substantial body of literature that sorts out the determinants[3] of employee stock ownership and employee stock option plans. Most research uses cross-sectional data to predict presence of these plans. In this paragraph some of the most important determinants will be discussed.

First, there are some systematic economic determinants for the provision of ESOPs. Core and Guay (2001) find that stock option grants are used more intensively when a firm needs to meet capital requirements and/or faces cash constraints. With equity grants, cash payouts can be deferred, so stock options give firms the possibility to ‘economize cash’ (Yermack, 1995). They therefore

[3] i.e. characteristics of firms that use ESOPs.

argument that firms will rely more on employee stock grants when taking on more debt is constrained as they substitute cash pay for equity grants. In addition, Oyer et al. (2005) have argued that their findings - i.e. that employee sorting drives employee stock option grants - might be partly driven by cash constraints. Those constraints might thus be driving option grants, since the cash constraint hypothesis and the sorting hypothesis have the same implications. Kedia and Mozumdar (2002) also suggest that employee stock options are used to relax financing constraints. They state that this is only the case when stock option grants do not require a cash outlay by the firm. Other research examines the effect of a firm's liquidity on the provision of ESOPs. Although Ding et al (2001) hypothesize that when liquidity of firm is low, it uses greater stock option compensation, they cannot find empirical evidence to support this hypothesis.

Yermack (1995), Ding et al. (2001) and Uchida (2006) furthermore suggest that the provision of ESOPs is negatively related to a firm's leverage. Because ESOPs align the interest of employees with those of shareholders, it is likely that a firm "will pursue overly-risky investment projects that transfer wealth from debt holders to equity holders" (Ding et al., 2001 p. 569). This causes debt holders to demand higher risk premiums for supplying capital when a firm provides an employee stock option plan. Such costs, resulting from these kind of conflicts of interest, are called agency costs of debt. Past research indicates that pay-performance sensitivity is therefore lowered when leverage increases, to avoid or reduce those agency costs of debt.

Furthermore, there are some firm-specific determinants of the provision of employee stock options. Ittner et al. (2003) find that employee stock options are used more intensively in "new economy firms".[4] These firms are characterized by high levels of R&D and high growth opportunities and growth rates which are in the literature typically proxied by the market-to-book ratio, Tobin's Q and R&D/Sales. Frye (2004) and Sesil et al. (2005) also suggest that there is empirical evidence for a positive relation between growth opportunities, proxied by Tobin's Q, and the use of employee stock options. Consistent with Ittner et al. (2003) and Frye (2004), Lazear (2004) states in his research that especially new technology firms use employee stock options. There are some theoretical explanations for these findings. In firms with high growth opportunities, the impact of incentives that are given with stock option grants is hypothesized to be larger.

[4] Ittner et al. (2003) define new economy firms as "organizations competing in the computer, software, internet, telecommunications, or networking fields".

Furthermore, information asymmetries tend to be greater when growth opportunities are high, since managers have much more information than shareholders. Complexities resulting from that can be partly resolved by ESOPs. Besides, some authors suggest that there is a positive relation between the intensity of stock options use for executives and the provision of employee stock options. Core and Guay (2001) find that when using stock options is an effective way of monitoring the top executives, a firm will use non-executive options more intensively.

In the literature, there is mixed evidence on the relation of employee stock options to firm size. Kruse (1996) argues, as well as Kedia and Mozumdar (2002), that employee stock ownership is more often present in small firms. Smaller firms often suffer les from free-rider problems and thus can benefit more from the incentive effects that employee stock options might give. On the other hand, as suggested by Core et al. (2001) and Sesil et al. (2001), monitoring costs are higher in large firms since it is more difficult to monitor performance of employees. They therefore predict that larger firms should make greater use of employee stock option grants, which supports the monitoring cost reduction hypothesis as explained in paragraph 2.3. Ding et al. (2001) actually find evidence that the use of ESOPs is positively related to firm size. Concluding, the relation between firm size and the provision of ESOPs is ambiguous and still subject to research.

According to Spalt (2013), another determinant of the provision of ESOPs is high firm risk. Agency theory predicts that firm risk and the provision of ESOPs are negatively related. However, the model Spalt uses, predicts a positive relationship between idiosyncratic volatility, which is used as a proxy for firm risk, and stock option grants. He thus finds that firms with more volatile stock returns grant more stock options to employees. This is contradictory to most standard models, like the retention model used by Oyer et al. (2005), which find results that are in line with agency theory and thus predict that risky firms grant less stock options to employees; employees cannot diversify their risk and therefore risk premia to accept equity compensation are higher. Spalt claims that his findings can be explained by so-called gambling preferences of employees. Employees tend to overvalue stock options relative to the Black-Scholes benchmark and prefer lottery-like payoffs.

Lastly, Oyer (2004) and Kedia and Mozumdar (2001) find that stock option compensation is higher when turnover of employees is costly and therefore retaining employees is very important for the

firm. Those findings are consistent with Oyer and Schaeffer (2005), and support the hypothesis that retaining employees is a key objective for using employee stock options.

2.5 Hypotheses development

In this master thesis, the research question as described in section 1.1 will be investigated:

"What are the determinants of the provision of employee stock option plans and what are the effects of employee stock option plans on labor performance?"

This chapter has thus far covered the relevant academic literature on the determinants of employee stock option plans and the effects of employee stock option plans on firm performance. Thereby, some of the most common measures for firm performance are discussed. Most of the research covered in the literature review, is conducted in the US. This thesis contributes to the existing literature, by further investigating both the determinants of ESOPs and the effect of ESOPs on firm performance, using data from German publicly traded companies.

First, this thesis will investigate the determinants of employee stock option plans. As already pointed out in the literature review, there are both systematic economic and firm-specific determinants of the provision of ESOPs. In this thesis, I will examine some of the major determinants that emerged from past research. The following hypotheses are formulated, following the literature as discussed in paragraph 2.4:

H1a: The provision of employee stock options is positively related to firm size.[5]

H1b: The provision of employee stock options is negatively related to a firm's leverage.[6]

H1c: The provision of employee stock options is negatively related to liquidity.[7]

H1d: The provision of employee stock options is positively related to a firm's growth opportunities.[8]

H1e: The provision of employee stock options is positively related to firm risk.[9]

[5] Following Core et al. (2001) and Sesil et al. (2001)
[6] Following Core et al. (2001) and Yermack (1995)
[7] Following Ding et al. (2001)
[8] Following Sesil et al. (2005), Frye (2004) and Ding et al. (2001)
[9] Following Spalt (2013)

H1f: The provision of employee stock options has a positive relation to financing constraints.[10]

H1g: Employee stock options are used more intensively in new technology firms with high R&D expense.[11]

A summary of the hypotheses regarding the determinants of the provision of employee stock option plans is given in Table 1 (see appendix).

Second, there is a growing body of literature that addresses the potential consequences employee turnover can have on, among other things, productivity and firm performance. Hausknecht & Trevor (2011, p. 360) state that "collective turnover can lead to undesirable outcomes because it entails the loss of firm specific human and social capital, disrupts operations and collective function, saddles remaining members with newcomer socialization and training, and increases recruitment and selection costs." Hancock et al. (2013) therefore predict that there is a negative relationship between employee turnover and firm performance and their results support this prediction. Hence, in order to improve firm performance, a company might try to retain their employees and thereby reduce employee turnover as much as possible. In this thesis, I will examine whether broad-based employee stock option plans are an effective instrument for employee retention. Therefore, the following hypothesis is proposed:

H2a: Employee turnover is negatively related to the provision of employee stock options.

H2b: Employee turnover is positively related to the provision of employee stock options.

In previous literature, it is assumed that ESOPs are positively related to employee retention (Oyer and Schaeffer, 2005). This implies that employee stock option plans can reduce employee turnover and, following Hancock et al. (2013), consequently improve firm performance and enhance employee productivity. That is why I also expect there to be a negative relationship between ESOPs and employee turnover.

In addition to the suggested consequences of employee turnover on productivity, research also indicates that stock option grants themselves might positively affect employee productivity.

[10] Following Kedia & Mozumdar (2002) and Oyer & Schaeffer (2005)
[11] Following Lazear (2004) and Ittner et al. (2003)

Agency theory predicts that when the interests of employees are aligned with those of the firm, employee productivity can be improved. Although research indicates that the incentive effects of stock option grants are very weak (see e.g. Oyer, 2004; Lazear, 2004), it also shows that broad-based stock option plans are positively correlated with employee productivity (Sesil et al., 2002). I therefore hypothesize that:

> *H3a:* The provision of employee stock options is positively related to employee productivity
>
> *H3b:* The provision of employee stock options is negatively related to employee productivity

Most studies on productivity do not examine the mechanism by which employee stock options affect employee productivity. This because the causal relation between employee stock options plans on the one hand, and employee productivity on the other hand, is difficult to establish. With the hypotheses formulated above, I will for the remainder of this thesis focus on the correlation between ESOPs and productivity. In the next section the data and methodologies that are used to test the hypotheses formulated in this section, will be described.

3. Data

3.1 Sample selection and data sources

In this thesis, I make use of a unique panel dataset with annual data including German publicly traded firms for the years 2004-2008. Panel data have both a cross sectional and a time series component and is therefore multi-dimensional. The existing literature on employee stock option plans is mostly originated in the United States. European firms have slightly different styles of corporate governance than US firms, hence the use of German data allows testing of the universality of the hypotheses and results that are proposed in previous research of US firms. Initial starting point of the dataset are companies listed on the Frankfurt Stock Exchange, including companies listed on the Deutscher Aktien Index (DAX) and Mid-Cap DAX (MDAX), which are the biggest listed companies in Germany. After matching these firms by name with a database at the German Federal Employment Agency, 180 listed companies are left. The panel represents the matched companies for which annual reports were available in English for the years 2004-2013. This comes down to a set of 100 listed companies.

I collect information regarding the provision of ESOPs by drawing on the German company's annual reports for the fiscal years 2004-2008. There is a lot of variation in incentive-based compensation plans, how these plans work and how firms call their plans. Besides, the information about employee stock option plans provided in annual reports is sometimes very limited. I used the following set of criteria to eliminate possible measurement problems that arise from those differences. First, there must be a plan or program within the company that partially compensates participating employees with stock options or in which they have the opportunity to purchase an amount of stock options as part of their compensation. Other types of employee compensation plan or employee incentive plans such as profit-sharing plans, bonus plans for employees without stock (option) rewards, pension benefit plans and stock appreciation rights are not considered as ESOP. Second, the stock option program must be broad-based/firm-wide. This means that the program must be designed for all employees or at least be accessible to all employees. If only members of the board of management and/or other executives are eligible, the program is not considered as ESOP. Third, there must have been stock options awarded to or purchased by employees during the year as reported. This implies that the presence of (exercisable) options outstanding from previous years or shareholders' approval to adopt an ESOP or to award stock options in previous

years is not sufficient to be considered as ESOP. Altogether, these criteria ensure that only broad-based employee stock option plans are qualified as ESOP. The provision of employee stock option plans is processed in the dataset using different information levels (values 1-3). If the company does not provide an ESOP, the value is set to 0. Furthermore, if a firm reports the number of stock options issued under the stock option plan and/or the number of employees participating in the plan, these numbers are included in the dataset. Summary statistics on those variables and on the dummy for the provision of ESOPs are included in Table 5.

Furthermore, this study makes an analysis of fundamental firm characteristics to examine the determinants of employee stock options plans and the relation between ESOPs and firm performance. Firms that provide ESOPs are expected to have some distinctive features that are different from firms that do not provide such plans. To investigate this, I collect annual accounting data from the Worldscope database by using Datastream for all 100 companies in the dataset. Annual data on the compensation of executives is gathered from Assets4 by using Datastream. Firms are deleted from the sample when the necessary data are not available from the above mentioned data sources. This implies that companies without data for, at least, total assets, shareholder's equity and the number of employees are excluded. This eventually results in a strongly balanced panel dataset with 466 firm-year observations for 95 unique companies. The data are strongly balanced because there are no firms that move in or out of the sample during the period of observations; almost every firm remains in the dataset for the entire length of the observation period. This is mostly due to the fact that I make use of a pre-specified list of companies. Only a couple of companies have lacking firm-year observations.

The gathered data items are used to construct different ratios and other variablesthat which are essential for regression analysis. The summary statistics on those explanatory variables for the complete sample are provided in Panel A of Table 3. Regarding variables gathered from Worldscope or computed with Worldscope items, the data coverage is quite good, with only a couple of values missing for most variables. Only data on R&D expense as well as the ratios computed with this item have significantly less observations. Regarding Asset4 items, the data coverage is a lot worse. This is because Asset4 keeps track of Environmental, Social and Governance (ESG) data for only 94 German companies, of which many are not in the dataset that is used in this study.

Subsequently, the dataset is split up in various ways. First, the dummy variable for the provision of employee stock option plans is used to construct two subsamples; one with ESOP provision (dummy variable has value 1) and one without ESOP provision (dummy variable has value 0). Summary statistics for those subsamples are provided in Panel B and C of Table 3. The means of both subsamples are compared, which is shown in Panel D of Table 3. This comparison demonstrates that firms that provide ESOPs have greater values for total assets, the number of employees, market value of equity and R&D expense. This corresponds to the prediction that larger firms are more likely to provide employees with stock options. It is also in line with the hypothesized positive relation between R&D expense and provision of ESOPs.

The dataset is also split up in different industry sectors using the firm's Standard Industry Classification (SIC) codes, gathered from Worldscope. This gives an overview of the distribution of the selected sample over different sectors and it allows me to investigate dissimilarities between sectors. These are the following sectors: Resources (SIC code <2000), Manufacturing (SIC code 2000-3999), Transportation and Public utility (SIC code 4000-4999), Wholesale and Retail (SIC code 5000-5999), Finance (SIC code 6000-6799), Services (SIC code 7000-8999) and Public Administration (SIC code 9100-9729). The distribution of observations per sector is shown in Panel A of Table 2. In addition, the number of ESOPs provided per sector is presented in Panel B of Table 2.

Table 3: Descriptive Statistics

This table provides descriptive statistics of variables used in regression analysis. Panel A shows the summary statistics for the total sample. Panel B shows the summary statistics for companies that provide stock options to employees. Panel C shows the summary statistics for companies that do not provide stock options to employees. Panel D reports the differences in means between the two subsamples and reports the t-test statistic

Panel A: Total Sample

	N	Mean	Min	Median	Max	Stdev
Assets (mill)	466	57239	39	2592	2193953	205434
ln(Assets)	466	8.30	3.66	7.86	14.60	2.24
Current ratio	410	1.73	0.17	1.49	13.05	1.04
Book lev	466	4.92	0.10	1.85	70.42	9.62
MtB ratio	450	2.40	0.29	1.71	28.08	2.85
Tobins Q	464	1.15	0.00	0.84	10.02	1.11
ROA	468	0.05	-0.46	0.05	0.79	0.09
R&D Exp (mill)	312	404.01	0.33	53.65	5658	952.27
R&D_S ratio	312	0.07	0	0.03	1.36	0.17
Employees	466	47222	59	10169	536350	90888
ln(Emp)	466	9.33	4.08	9.23	13.19	1.85
Δ Emp	465	1145	-88800	244	156135	11298
Sales/Emp	465	0.05	-0.68	0.03	0.90	0.16
Int. expense (mill)	466	386.96	0.00	31.64	9363.00	1162.43
Int. cov.	460	27.16	-690.45	5.53	4441.50	232.21
Stock vol.	447	0.36	0.08	0.30	1.73	0.19

Panel B: Companies that provide employee stock options

	N	Mean	Min	Median	Max	Stdev
Assets (mill)	187	109506	39	6464	2193953	302406
ln(Assets)	187	8.84	3.66	8.77	14.60	2.67
Current ratio	158	1.84	0.55	1.45	13.05	1.40
Book lev	187	5.30	0.10	1.75	70.42	10.31
MtB ratio	186	2.34	0.41	1.66	18.28	2.09
Tobins Q	186	1.17	0.01	0.85	5.48	1.16
ROA	187	0.05	-0.46	0.05	0.79	0.11
R&D Exp (mill)	131	571.56	1.00	55.20	5155	1101.74
R&D_S ratio	131	0.11	0	0.03	1.36	0.25
Employees	187	61589	59	18679	475000	96258
ln(Emp)	187	9.54	4.08	9.84	13.07	2.11
Δ Emp	186	663	-88800	189	34600	9557
Sales/Emp	186	0.03	-0.65	0.03	0.51	0.13
Int. expense (mill)	186	621	0	44	7916	1393
Int. cov.	182	14.92	-690.45	5.90	635.14	114.41
Stock vol.	182	0.36	0.13	0.30	1.73	0.20

Panel C: Companies that do not provide employee stock options

	N	Mean	Min	Median	Max	Stdev
Assets (mill)	279	22207	93	1827	619182	79606
ln(Assets)	279	7.94	4.54	7.51	13.34	1.81
Current ratio	252	1.65	0.17	1.51	4.70	0.72
Book lev	279	4.66	0.20	1.95	64.26	9.14
MtB ratio	264	2.45	0.29	1.75	28.08	3.29
Tobins Q	278	1.13	0.00	0.84	10.02	1.08
ROA	281	0.06	-0.43	0.05	0.55	0.08
R&D Exp (mill)	181	282.74	0.33	48.60	5658	809.25
R&D_S ratio	181	0.04	0	0.02	0.27	0.05
Employees	279	37593	242	9458	536350	85941
ln(Emp)	279	9.19	5.49	9.15	13.19	1.63
Δ Emp	279	1466	-88003	253	156135	12330
Sales/Emp	279	0.05	-0.68	0.04	0.90	0.17
Int. expense (mill)	280	231	0	30	9363	951
Int. cov.	278	35.18	-223.10	5.40	4441.50	283.96
Stock vol.	265	0.36	0.08	0.31	1.17	0.18

Panel D: Differences in means

	d_esop=0	d_esop=1	Diff. mean	Std. error	T-statistic	P (|T| > |t|)	H0: diff=0
Assets	22206.61	109506	-87299.1***	22621.830	-3.859	0.000	Rejected
ln(Assets)	7.94	8.84	-0.897***	0.223	-4.014	0.000	Rejected
Current ratio	1.65	1.84	-0.195	0.121	-1.615	0.054	Not rejected
Book leverage	4.66	5.30	-0.643	0.931	-0.690	0.245	Not rejected
MtB ratio	2.45	2.34	0.104	0.254	0.410	0.659	Not rejected
Tobins Q	1.13	1.17	-0.0412	0.107	-0.385	0.350	Not rejected
ROA	0.06	0.05	0.0108	0.009	1.176	0.880	Not rejected
R&D Exp	282.74	571.56	-288.8**	113.508	-2.545	0.006	Rejected
R&D_S ratio	0.04	0.11	-0.0745***	0.022	-3.396	0.000	Rejected
Employees	37592.57	61589	-23996.7***	8719.029	-2.752	0.003	Rejected
ln(Emp)	9.19	9.54	-0.351*	0.183	-1.919	0.028	Rejected
Δ Emp	1465.90	663	0.0199	0.014	1.386	0.917	Not rejected
Sales/Emp	0.05	0.03	-41.39	52.456	-0.789	0.215	Not rejected
Int. expense	231.47	621	-389.6***	116.894	-3.333	0.000	Rejected
Int. cov.	35.18	14.92	20.26	19.025	1.065	0.856	Not rejected
Stock vol.	0.36	0.36	0.00265	0.019	0.142	0.556	Not rejected

Two sample t-test on differences in means, equal variances assumed. H0: difference = 0

* p<0.10, ** p<0.05, *** p<0.01

4. Methodology

As mentioned before, there is an extensive body of research on the determinants of employee stock option plans and their effects on firm performance. In the next sections, which will successively cover the measurement of variables and the logistic linear regression models that are used in this thesis, I will refer to these earlier studies, since I mainly follow the approaches adopted in this work.

4.1 Variable measurement

The empirical analysis of this research is split up into two parts; one part covering hypotheses 1a-1g, the other part investigating hypotheses 2 and 3. The provision of employee stock option plans is central to both parts of the analysis. I use a dummy variable for the provision of ESOPs, with value 1 if firm i in year t has an employee stock option plan and value 0 if it does not (consistent with Uchida (2006)). Except that the ESOP dummy serves as a dependent or independent variable, it is also used to divide the entire sample into two subsamples of providing and non-providing firms.

4.1.1 Determinants of ESOP provision: variables

For the first part of the analysis, I use the ESOP dummy as the response variable. The explanatory variables are firm characteristics that might determine ESOP provision, all linked to one of the proposed hypotheses (1a-h). Hence, I need firm-level measures of those independent variables. The accounting data that serve as variables or that are used to calculate some of the variables are collected as described in section 3. The different measures are as follows.

Consistent with Core et al. (2001), Sesil et al. (2001) and Ding et al. (2001) I expect a positive relation between firm size and the provision of ESOPs. This positive relation would support the monitoring cost reduction hypothesis, which states that the use of ESOPs increases with firm size, since it is more difficult to monitor performance of employees when the firm is large. Following the previously mentioned authors, I use the natural logarithm of total assets (ln(assets)) and the logarithm of the number of employees (ln(employees)) as proxies for firm size. Both proxies capture different aspects of firm size.

The relationship between the provision of ESOPs and leverage is hypothesized to be negative. When a firm is highly leveraged, equity holders prefer to lower incentive based compensation to avoid agency costs of debt (Yermack, 1995). I follow Yermack (1995), using book leverage as a proxy for a firm's leverage. This measurement is calculated as the firm's total liabilities divided by its book value of equity. As well as leverage, liquidity is predicted to be negatively related to the provision of ESOPs. Following Ding et al. (2001), I use a firm's current ratio as a proxy for liquidity. The current ratio is calculated by dividing a firm's current assets by its current liabilities. The lower the current ratio of a firm, the less capable a firm is of complying with its obligations; in other words the more illiquid a firm is.

In contrast to earlier research, Spalt (2013) predicts a positive relation between firm risk and the provision of stock options to employees. While most research suggests that high firm risk causes employees to ask a higher risk premium for incentive based compensation, and therefore predict a negative relation between firm risk and the provision of ESOPs, Spalt finds the opposite. I follow Spalt (2013) in his prediction and proxy firm risk with annual stock volatility (following past research such as Yermack (1995)). I calculate this variable by taking the standard deviation from daily changes in stock price, multiplied by the square root of the average number of trading days in a typical year, which is 252. The more volatile a company's stock returns are, the riskier a firm is.

The hypothesized positive relation between ESOP provision and growth opportunities of a firm is investigated using two different proxies for growth opportunities: the market-to-book ratio (MtB ratio) and Tobin's Q. As previously mentioned, incentives from stock options are assumed to be larger for firms with large growth opportunities. Furthermore, problems concerning information asymmetries, which are larger when growth potential is high, can be resolved with ESOPs. Following Uchida (2006), the MtB ratio is calculated as the market value of equity scaled by its book value of equity. I follow Frye (2004) calculating Tobin's Q as the market value of equity divided by total assets. Furthermore, I hypothesize a positive relation between the provision of employee stock option plans and a firm's expenses on R&D. Following Kedia & Mozumdar (2002), I use the R&D/Sales ratio to proxy for a firm's R&D expense.

Related to this, I use a dummy for new economy firms to test whether these kind of firms are more likely to provide stock options to employees. This dummy has value 1 if it has one of the following

SIC codes: 3570–3579, 3661, 3674, 5045, 5961, or 7370–7379 (Oyer & Schaeffer 2005). Ittner et al. (2003) find that these firms use employee stock options more intensively than others. With the dummy for new economy firms, I try to find additional evidence for hypotheses 1d and 1h, because these firms are characterized by high levels of R&D and high growth opportunities.

I also use a variable that helps to examine the relationship between the provision of ESOPs and financing constraints. Core et al. (2001) and Kedia & Mozumdar (2002) suggest that companies with severe cash constraints are more likely to substitute cash pay to employees by equity compensation. Consistent with Kedia & Mozumdar (2002), I proxy for financing constraints with a measure of interest coverage. It is defined as the firm's earnings before interest and tax, scaled its interest expense. The more severe the financing constraints a firm faces, the lower the interest coverage ratio. Therefore, I predict that interest coverage is negatively related to the provision of employee stock options.

4.1.2 Labor performance effects of ESOP provision: variables

In the second part of my analysis, the ESOP dummy is used as an explanatory variable, to examine the relationship between the provision of employee stock option plans and labor performance. I use two measures of labor performance, namely employee turnover (based on Oyer & Schaeffer, 2005) and employee productivity (based on e.g. Hochberg & Lindsey, 2010; Kruse et al., 2004; Pendleton, 2001).

Employee turnover is normally defined as the number of employees that are leaving the company in year t, standardized by the total number of employees in year t-1. Because data on employee turnover is not available from Asset4 for most of the companies in the sample, I use the percentage change in the number employees as an alternative measure of employee turnover. It is computed as follows:

$$\Delta\, Emp\ (\%) = \frac{\#\, Employees_t - \#\, Employees_{t-1}}{\#\, Employee_{t-1}}$$

This ratio, with a lower bound of -1 and no upper bound, does not capture the exact number of employees that are retained by the company, since it does not take the number of new employees attracted by the company into account. A positive value could therefore mean that only the number of new employees is greater than the number of employees that left. For a negative value, the

opposite applies. Nevertheless, the percentage change in the number of employees is still informative and can give an indication whether employee stock option plans help to retain employees. I expect, consistent with Oyer & Schaeffer (2005), that ESOPs are used because of retention objectives, and thus ESOP provision is negatively related to employee turnover. This implies that the percentage change in employees should be positively related to ESOP provision. Underlying thought is that the more positive the percentage change is, the more likely a low turnover is and vice versa.

There has been a lot of research on the effects of employee stock option plans on firm performance. For this thesis I am specifically interested in one category of performance measures: labor productivity. Economic theory predicts that stock option grants enhance employee productivity. Rationale behind this is that employees are incentivized to improve their productivity, since this can improve the overall firm performance, which in turn is linked to their compensation. For the present work, I follow Sesil et al. (2002) and Kruse et al. (2004) by using the natural logarithm of sales per employee as a proxy for employee productivity. Sales per employee is defined as total sales of firm i in year t divided by the total number of employees of firm i in year t.

In the second part of analysis, some of the previously described variables are used as control variables in the regression models. Tobin's Q is used to control for growth opportunities, ln(assets) is used to control for firm size. Besides, I control for a firm's profitability operationalized by return on assets (ROA), which is calculated as net income divided by total assets.

A correlation matrix on the different variables used in regression analysis is presented in Table 4. As shown the correlation between total assets and the number of employees is quite high and is even higher for the natural logarithms of those two variables. Furthermore, the correlation between the market-to-book ratio and Tobin's Q is notable. Lastly the correlation between the number of employees and R&D expense is remarkably high.

Table 4: Correlation Matrix

This table shows the correlation coefficients between the different variables used in the regressions. Note that the correlation between total assets and the number of employees is quite high, as well as the correlation between the natural logarithms of these variables. Furthermore the correlation between Tobin's Q and the market-to-book ratio is quite high too, as well as the correlation between total assets and R&D Expense.

	D_Esop	Assets	ln(assets)	Cur.ratio	MtB	R&D exp	R&D/S	Intcov
D_Esop	1.00							
Assets	0.27	1.00						
ln(assets)	0.19	0.76	1.00					
Cur.ratio	0.11	-0.27	-0.42	1.00				
MtB	0.00	-0.07	-0.04	-0.04	1.00			
R&D exp	0.16	0.67	0.56	-0.15	-0.03	1.00		
R&D/S	0.20	-0.12	-0.33	0.47	0.06	0.00	1.00	
Intcov	-0.06	-0.04	-0.08	0.04	0.07	-0.01	-0.10	1.00
Volatility	0.01	-0.05	-0.11	0.01	-0.05	-0.03	0.10	0.06
# Empl.	0.22	0.80	0.70	-0.27	-0.11	0.85	-0.11	-0.04
ln(emp)	0.05	0.60	0.90	-0.45	-0.13	0.56	-0.43	-0.10
ΔEmp %	-0.04	-0.10	-0.05	0.00	-0.07	-0.06	-0.05	0.03
Sales/emp	0.21	0.49	0.50	-0.15	0.08	0.10	-0.21	0.08
Booklev	-0.10	0.34	0.32	-0.22	0.18	0.03	-0.11	-0.04
TobinsQ	0.01	-0.24	-0.26	0.23	0.69	-0.07	0.16	0.12
ROA	-0.09	-0.06	0.11	0.21	0.32	-0.01	-0.37	0.14

	Volatility	# Emp	ln(emp)	ΔEmp %	Sales/emp	Booklev	TobinsQ	ROA
Volatility	1.00							
# Emp	-0.05	1.00						
ln(emp)	-0.11	0.73	1.00					
ΔEmp %	0.08	-0.05	0.01	1.00				
Sales/emp	0.03	0.12	0.21	-0.06	1.00			
Booklev	0.06	0.05	0.05	-0.06	0.42	1.00		
TobinsQ	-0.12	-0.21	-0.26	0.07	-0.08	-0.19	1.00	
ROA	-0.14	-0.05	0.14	0.11	0.09	-0.05	0.30	1.00

4.2 Determinants of ESOP provision: Logistic regression analysis

To investigate the determinants of employee stock option provision, I estimate several logistic regression models (logit models), using the dummy for provision of employee stock option plans (ESOP dummy) as the dependent variable. Logit models are regression models where the dependent variable is not continuous, as in linear regression models, but categorical, e.g. dichotomous variables which can have either the value 0 or 1. The difference between both models and the reason why logistic regression is appropriate for this research can best be explained by looking at the regression equations of both models. The simple linear regression equation with only one regressor looks as follows:

$$\mathrm{E}(Y_{it}|X_{it}) = \alpha_i + \beta X_{it} + u_{it} \quad (1)$$

With Y_{it} as the dependent variable, a constant α_i , β the coefficient for dependent variable X_{it}, and residuals u_{it}. Since the dependent variable is dichotomous, I am interested in the probability that

Y=1, which can be investigated with a linear probability model. This can be derived from equation (1) by inserting $\mathrm{E}(Y_{it}|X_{it}) = \Pr(Y_{it} = 1|X_{it})$ and looks as follows:

$$\Pr(Y_{it} = 1|X_{it}) = \beta X_{it} + \alpha_i \quad (2)$$

There are some considerable problems regarding this model when testing a dichotomous dependent variable. The linear regression model assumes that the residuals of the regression are normally distributed, which is often violated. Furthermore, the predicted probability can take a value outside the interval between 0 and 1. The model also assumes a linear relationship between probability $\Pr(Y_{it})$ and the regressors. This assumption is violated, since the relationship between $\Pr(Y_{it})$ is S-shaped. The linear regression model is thus inefficient.

The logistic regression model copes with these problems since it assumes a linear relationship between the log of the odds and the explanatory variables. A logarithmic transformation of probability is used to get the logistic regression equation that eventually looks the following (with either one or more regressors):

$$Logit(p) = Log\left[\frac{p}{(1-p)}\right] = \alpha_i + \beta X_{it} \quad (3)$$

$$Log\left[\frac{p}{(1-p)}\right] = \beta_1 + \beta_2 X_{2it} + \ldots + \beta_K X_{Kit} + \alpha_i \quad (4)$$

With the probability that a firm provides an ESOP as the outcome variable, a constant α_i , β the coefficient for independent variable X_{it}. The value of this function is maximized using maximum likelihood. Maximum likelihood is used when the solution of a model cannot be calculated directly. It is an iterative process, which means that the solution is found by repeatedly improving a tentative solution, until the change in the likelihood function of a new improvement is negligible.

The output of the logistic regression model is always between 0 and 1. However, the interpretation of the coefficients in logistic regression models is different from linear regression models; i.e. more difficult. If in a linear regression model $\beta = 0.15$ this means that a one-unit increase in X is associated with a 15 percent point increase in the dependent variable Y. If in a logistic regression model $\beta = 0.15$ it means that a one-unit increase in X is associated with a 0.15 increase in the log odds that the dependent variable $Y = 1$. Since this is not very intuitive, it can be useful to use odds

ratios. Odds are, like probability, a measure of likelihood for an effect to occur. The odds ratio can be derived through exponentiation of equation 3:

$$Odds(Y_{it} = 1 | X_{it}) = e^{\beta X_{it} + \alpha_i + u_{it}}$$

With an odds ratio of 2, for example, a one-unit increase in X doubles the odds that $Y = 1$.

This looks more intuitive, but the interpretation is still not straightforward. It is therefore possible to convert the odds back to probability using the following functions:

$$Odds = \Pr/(1 - \Pr) \quad (5)$$

$$\Pr = Odds/(1 + Odds) \quad (6)$$

The estimated logit models, with different firm characteristics serving as regressors, help to investigate the hypotheses proposed in section 2.5. These firm characteristics are expected to affect the provision of ESOPs; in other words, these are expected to be the determinants of the provision of employee stock option plans. The characteristics involved are (proxies as described in section 4.1 in parentheses): Size (ln(Assets)), leverage (book leverage) number of employees, firm risk (annual volatility of stock returns), liquidity (current ratio), growth opportunities (market-to-book ratio and Tobin's Q), financing constraints (interest coverage), and R&D expense (R&D/Sales). This leads to the regression equations as shown in Table 6. The coefficients, expressed by β, indicate the relation between the provision of ESOP and firm characteristics.

To start with, I employ univariate logit regression models (equation (1), Panel A of Table 6) to separately test the formulated hypotheses, which all connect one of the possible determinants to the provision of employee stock options. This implies that only one of the firm characteristics is used as a regressor in each estimation equation. The univariate tests give a separate coefficient for each regressor. If β>0, there is a positive relation between the tested firm characteristic and the ESOP dummy, β<0 suggests a negative relation between the characteristic and the dependent variable. The univariate regression equations look as follows:

$$Log\left[\frac{p}{(1-p)}\right] = \beta_1 ln(Assets)_{1it} + \varepsilon_{it} \; ; Log\left[\frac{p}{(1-p)}\right] = \beta_2 Bookleverage_{2it} + \varepsilon_{it} \text{ etc.} \quad (7)$$

Thereafter, I use multivariate analysis to further support the univariate results; i.e. by testing the proposed hypotheses altogether. In the first multivariate regression model, most of the explanatory

variables that are used for univariate analysis are added to one model (equation (1), Panel B of Table 6). R&D expense and current ratio are left out of this first model. Because STATA ignores every observation with missing values, it would run the multivariate regression with a smaller sample when R&D expense and current ratio are added, since these variables have a lot less observations than the other explanatory variables. The first multivariate regression equation looks as follows:

$$Log\left[\frac{p}{(1-p)}\right] = \beta_1 ln(Assets)_{1it} + \beta_2 ln(Employees)_{2it} + \beta_3 Book\ leverage_{3it} + \beta_4 Volatility_{4it} + \beta_5 TobinsQ_{5it} + \beta_6 MtB\ ratio_{6it} + +\beta_7 Int\ cov_{7it} + \varepsilon_{it} \quad (8)$$

I extend this model in different ways (equations in parentheses can be found in Table 6 Panel B). In the next model R&D and current ratio expense are added (2). I also extend the first two multivariate models with a year dummy to control for time effects (3 and 4). Thereafter, I add the dummy for new economy firms to estimate whether ESOPs are provided more in this type of firms (5 and 6). Interpretation of logistic regression results are difficult to interpret because they are reported in log odds. As previously mentioned, odds ratios are more intuitive and easy computed by exponentiation of both sides of the logistic regression equation. Odds ratios will therefore also be reported in the results. The regression equations of all logistic regression models are reported in Table 6.

To examine the determinants of ESOP accurately, I use a fixed-effect model. There are some considerable differences between this model and a random-effect model. First and most important, fixed-effect models control for the effects of time-invariant variables with time-invariant effects. It is therefore not possible to estimate time-invariant effects with a fixed-effect model. Random-effects models on the other hand assume that there is no correlation between the explanatory variables and the error term, which allows for time-invariant variables to serve as regressors. Third, fixed-effect models have smaller standard errors than random-effects models and are therefore assumed to be somewhat more powerful. In this thesis, I examine whether certain firm characteristics influence the probability that a firm provides employee stock options. Both firm characteristics and the ESOP dummy show variation over time. This indicates a preference for the fixed-effect model.

Table 6: Fixed-effect logistic regression models

This table shows the estimation equations for the logistic regression analysis on the determinants of the provision of ESOPs. All models use fixed effects estimations. Panel A shows the univariate models, which test hypotheses 1a-1h separately. Panel B presents the multivariate regression models. In model 1, hypotheses 1a-1g are examined jointly, by adding various regressors to one logit model. In model 2, R&D expense and current ratio are added. Those variables are left out of model 1, since they have significantly less observations than the other explanatory variables. In model 3 and 4, a year dummy is added to control for time effects. In model 5 and 6, a dummy variable is added, with value 1 if firm i is categorized as a new economy firm and value 0 otherwise.

The estimated coefficient for each explanatory variable is denoted by β, estimated using maximum likelihood. The probability that a firm provides an ESOP is denoted by p. The dependent variable in the equations is the natural log of odds. The outcome variable is the ESOP dummy, with value 1 if firm i provides an employee stock option plan in year t, and 0 if it does not.

Panel A: Univariate models

$$Log\left[{}^{p}/_{1-p}\right] = \beta_1 \ln(assets)_{1it} + \epsilon_{it} \quad ; \quad Log\left[{}^{p}/_{1-p}\right] = \beta_{2it} Booklverage_{2it} + \epsilon_{it} \quad \text{etc.} \tag{1}$$

Panel B: Multivariate models

$$Log\,[p\,/\,(1-p)] = \beta_1 ln(Assets)_{1it} + \beta_2 ln(Employees)_{2it} + \beta_3 Book\ leverage_{3it} + \beta_4 Volatility_{4it} + \beta_5 TobinsQ_{5it} + \beta_6 MtB\ ratio_{6it} + \beta_7 Int\ cov_{7it} + \epsilon_{it} \tag{1}$$

$$Log\,[p\,/\,(1-p)] = \beta_1 ln(Assets)_{1it} + \beta_2 ln(Employees)_{2it} + \beta_3 Book\ leverage_{3it} + \beta_4 Volatility_{4it} + \beta_5 TobinsQ_{5it} + \beta_6 MtB\ ratio_{6it} + \beta_7 Cur\ ratio_{7it} + \beta_8 Int\ cov_{8it} + \beta_9 R\&D/Sales_{9it} + \epsilon_{it} \tag{2}$$

$$Log\,[p\,/\,(1-p)] = \beta_1 ln(Assets)_{1it} + \beta_2 ln(Employees)_{2it} + \beta_3 Book\ leverage_{3it} + \beta_4 Volatility_{4it} + \beta_5 TobinsQ_{5it} + \beta_6 MtB\ ratio_{6it} + \beta_7 Int\ cov_{7it} + \beta_t Year_t + \epsilon_{it} \tag{3}$$

$$Log\,[p\,/\,(1-p)] = \beta_1 ln(Assets)_{1it} + \beta_2 ln(Employees)_{2it} + \beta_3 Book\ leverage_{3it} + \beta_4 Volatility_{4it} + \beta_5 TobinsQ_{5it} + \beta_6 MtB\ ratio_{6it} + \beta_7 Cur\ ratio_{7it} + \beta_8 Int\ cov_{8it} + \beta_9 R\&D/Sales_{it} + \beta_t Year_t + \epsilon_{it} \tag{4}$$

$$Log\,[p\,/\,(1-p)] = \beta_1 ln(Assets)_{1it} + \beta_2 ln(Employees)_{2it} + \beta_3 Book\ leverage_{3it} + \beta_4 Volatility_{4it} + \beta_5 TobinsQ_{5it} + \beta_6 MtB\ ratio_{6it} + \beta_7 Cur\ ratio_{7it} + \beta_8 Int\ cov_{8it} + \beta_9 R\&D/Sales_{9it} + \beta_t Year_t + D(NewEconomy)_i + \epsilon_{it} \tag{5}$$

$$Log\,[p\,/\,(1-p)] = \beta_1 ln(Assets)_{1it} + \beta_2 ln(Employees)_{2it} + \beta_3 Book\ leverage_{3it} + \beta_4 Volatility_{4it} + \beta_5 TobinsQ_{5it} + \beta_6 MtB\ ratio_{6it} + \beta_7 Cur\ ratio_{7it} + \beta_8 Int\ cov_{8it} + \beta_9 R\&D/Sales_{9it} + \beta_t Year_t + D(NewEconomy)_i + \epsilon_{it} \tag{6}$$

4.3 Labor performance effects of ESOP provision: Regression analysis

After I have assessed the determinants of employee stock option plans, I proceed with the second part of analysis which focusses on the effects of ESOPs on labor performance. To examine whether the provision of employee stock option plans affects employee turnover and employee productivity, I employ multiple panel regression models with the ESOP dummy as an independent variable. The dependent variables are the percentage change in the number of employees (Δ Employees (%)) and sales per employee (sales/employee).

With the first model, I try to find evidence for hypotheses 2 and investigate the relation between the provision of ESOPs and employee turnover. To do so, I fist run a univariate regression model with the percentage change in the number of employees, which serves as a proxy for employee turnover, as the dependent variable and the ESOP dummy as an explanatory variable. The simple univariate regression equation has the following form:

$$y_{it} = \alpha + \beta_1 X_{1it} + \epsilon_{it} \tag{9}$$

Where, y_{it} is the indicator for labor performance, β_1 is the coefficient of the predictor variable X_{1it} and with intercept α and error termε_{it}. The estimated univariate regression equation is presented in Panel A of table 7.

Thereafter, I use a multivariate regression approach. Consistent with previous studies (e.g. Hochberg & Lindsey, 2010), I use different control variables to construct multivariate regression models. By adding control variables, the actual relationship between employee turnover and ESOP provision can be isolated from the effects of control variables. First, I add the logarithm of total assets to the multivariate regression model to control for firm size. Second, control for profitability and growth opportunities, measured by return on assets (ROA) and Tobin's Q respectively. Third, I use year dummies to control for time effects. Thereafter, I employ sub-sample regressions, to estimate the relationship between employee turnover and ESOP provision per industry sector separately. In order to ensure that the estimated coefficients are not biased by time-invariant variables with time-invariant effects, I use fixed-effects for both univariate and multivariate regressions.

The second model I construct corresponds to hypothesis 3 and investigates the effect of ESOP provision on employee productivity. Again, I first employ a univariate regression model with this time employee productivity as the dependent variable and the ESOP dummy as explanatory variable. The simple univariate regression equation has the same form as equation (9) and is presented in Panel B of Table 8. After running this univariate regression, I employ various multivariate regression models. Following Sesil et al. (2002), Sesil et al. (2007) and Jones et al. (2010), I use an augmented Cobb-Douglas production function as the baseline specification. The Cobb-Douglas production function is widely used as a measure of the relationship capital and labor input, on the one hand, and production output on the other. The linear regression model that is used in this thesis is derived from the basic form of the Cobb-Douglas production function, which looks as follows:

$$Y(L,K) = AL^{\beta 1}K^{\beta 2} \qquad (10)$$

With Y as total production, L as labor input, K capital input and β_1 & β_2 constants. The standard Cobb-Douglas function can be converted into a linear model by taking the natural logarithm of both sides of the equation. This standard function looks as follows:

$$\ln(Y)_{it} = A + \beta_1 \ln(L)_{it} + \beta_2 \ln(K)_{it} + \epsilon_{it} \quad (11)$$

To examine the impact of employee stock options on productivity, I estimate a Cobb-Douglas function with fixed-effects, augmented by a dummy variable capturing the productivity effect of the provision of ESOPs:

$$y_{it} = \ln\left(\frac{sales_{it}}{employees_{it}}\right) = \alpha_i + \beta_1 \ln(L)_{it} + \beta_2 \ln(K)_{it} + \beta_3 D_{ESOP\,it} + \beta_4 D_{Industry} + \epsilon_{it} \quad (12)$$

In this equation, y_{it} denotes the productivity indicator, which is the natural logarithm of sales per employee (ln(sales/employees)). The two control variables are denoted by $\ln(K)_{it}$ and $\ln(L)_{it}$, which are the natural logarithm of total assets and the natural logarithm of the number of employees. The two dummy variables that are used, are the dummy for ESOP provision, which is the key explanatory variable, and industry dummies, denoted by D_ESOP_{it} and $D\_Industry$ respectively. β_1 - β_4 are the estimated coefficients for each variable, which are the main point of interest. Those are estimated using Ordinary Least Squares (OLS) with fixed effects, which has the assumption of strict exogeneity, i.e., that regressors and error terms are uncorrelated. The firm specific fixed effects are denoted by α_i. By including these, I eliminate time-invariant characteristics. ϵ_{it} Is the error term.

Like in the employee turnover model, I add different control variables to the employee productivity model. To control for profitability, I add ROA. To control for a firm's growth opportunities, I use Tobin's Q. Again, year dummies are used to control for time effects. Sub-sample regressions are used to estimate the relationship between employee turnover and ESOP provision per industry sector separately. An overview of the various regression equations that are used can be found in table 7.

Table 7: Linear fixed-effect regression models

This table shows the estimation equations for the linear regression analysis on the relationship between labor performance and ESOP provision. All models are fixed-effect models. The coefficients, expressed by β, are measured using OLS estimates. Equation (1) of both Panel A and B are univariate regressions, with the ESOP dummy as explanatory variable. Panel A furthermore reports the multivariate regression equations for the relationship between employee turnover and ESOP provision. Panel B reports the multivariate regression equations for the relationship between employee productivity and ESOP provision. The following control variables are added to both models (equation 2 of Panel A and B): ln(assets), ROA and Tobin's Q are added as control variables. Because the employee productivity model is an augmented Cobb-Douglas function, ln(employees) is also used as a control variable. Year dummies are added to control for time effects (equations 3 Panel A and 4 Panel B). Subsequently, I employ sub-sample regressions to estimate the relationship between the dependent variables and ESOP provision for different sectors separately (equations 4 Panel A and 5 Panel B)

Panel A: Employee turnover

$$\Delta\ Emp\ (\%) = \alpha + \beta_1 D(ESOP)_{it} + \epsilon_{it} \quad (1)$$

$$\Delta\ Emp\ (\%) = \alpha + \beta_1 D(ESOP)_{it} + \beta_2 \ln(Assets)_{it} + \beta_3 ROA_{it} + \beta_4 TobinsQ_{it} + \epsilon_{it} \quad (2)$$

$$\Delta\ Emp\ (\%) = \alpha + \beta_1 D(ESOP)_{it} + \beta_2 \ln(Assets)_{it} + \beta_3 ROA_{it} + \beta_4 TobinsQ_{it} + \beta_t Year_t + \boldsymbol{\epsilon_{it}} \quad (3)$$

$$\Delta\ Emp\ (\%) = \alpha + \beta_1 D(ESOP)_{it} + \beta_2 \ln(Assets)_{it} + \beta_3 ROA_{it} + \beta_4 TobinsQ_{it} + \beta_t Year_t + \beta_5 D_{Industry} + \boldsymbol{\epsilon_{it}} \quad (4)$$

Panel B: Employee productivity

$$\ln\left(\frac{sales}{employees}\right) = \alpha + \beta_1 D(ESOP)_{it} + \epsilon_{it} \quad (1)$$

$$\ln\left(\frac{sales}{employees}\right) = \alpha + \beta_1 D(ESOP)_{it} + \beta_2 \ln(Assets)_{it} + \beta_3 \ln(employees)_{it} + \varepsilon_{it} \quad (2)$$

$$\ln\left(\frac{sales}{employees}\right) = \alpha + \beta_1 D(ESOP)_{it} + \beta_2 \ln(Assets)_{it} + \beta_3 \ln(employees)_{it} + \beta_4 ROA_{it} + \beta_5 TobinsQ_{it} + \epsilon_{it} \quad (3)$$

$$\ln\left(\frac{sales}{employees}\right) = \alpha + \beta_1 D(ESOP)_{it} + \boldsymbol{\beta_2} \ln(Assets)_{\boldsymbol{it}} + \beta_3 \ln(employees)_{it} + \beta_4 ROA_{it} + \beta_5 TobinsQ_{it} + \beta_t Year_t + \epsilon_{it} \quad (4)$$

$$\ln\left(\frac{sales}{employees}\right) = \alpha + \beta_1 D(ESOP)_{it} + \boldsymbol{\beta_2} \ln(Assets)_{\boldsymbol{it}} + \beta_3 \ln(employees)_{it} + \beta_4 ROA_{it} + \beta_5 TobinsQ_{it} + \beta_t Year_t + \beta_5 D_{industry} + \epsilon_{it} \quad (5)$$

As a robustness check, I allow for lags in the productivity effects of employee stock option plans. There are several underlying reasons for this. First, research has indicated that stock options might have lagged effects on productivity (e.g. Morikawa 2011). Previous studies suggest that it is highly unlikely that granted employee stock options plans instantly affect employee productivity. It may take some time before there is a noticeable effect. Second, using lags solve some problems with regards to endogeneity. For the robustness checks, I assume that it will take at least 1 year before an ESOP has its effect on employee productivity. I again run the models of Table 7 Panel B, but this time, the one-year lagged value of the natural logarithm of sales per employee is used as the dependent variable. All other variables are off course held equal. The effects of ESOP provision on employee productivity are considered to be robust, if the estimations of the regressions with lagged productivity have the same implications as the original regression models.

The regression models that are used, are helpful to prove the relationship between the presence of an ESOP and labor performance. However, it is hard to establish causality between the dependent variables on the one hand and key explanatory variable on the other due to endogeneity. A possible

endogeneity bias is for instance that a firm provides an ESOP "by anticipating an increased growth rate of their productivity" (Morikawa 2011, p. 13). Besides, it may be the case that there are omitted variables that affect the investigated relationship; e.g. firm specific characteristics, such as firm size and labor force, might drive the differences in employee productivity. Using these characteristics as control variables can solve part of the endogeneity problem. However, this does not rule out all possible estimation errors.

In summary, the endogeneity problems are addressed in different ways. To start with, I use fixed-effect estimators to capture unobserved heterogeneity that is constant over time. In addition, I use control variables to assess the effects of ESOP provision more carefully. Lastly, I allow for lags in the productivity effects of ESOPs.

5. Results

This section presents the results of the empirical analysis as applied in this thesis. The results are interpreted and discussed in the context of the research question and proposed hypotheses. The same order as section 4 will be followed, hence I will first discuss the results from logistic regression models on the determinants of ESOP provision and subsequently the results from linear regression models on the effects of ESOPs on labor performance.

5.1 Determinants of ESOP provision: Logistic regression results

To test hypotheses 1a-1g separately, univariate logistic regression models on the determinants of ESOP provision are employed. Regression results for the entire sample are presented in table 8. In the univariate logit models, the ESOP dummy, which takes value 1 if firm i provides an ESOP in year t and value 0 otherwise, serves as the outcome variable. The dependent variable is the log of the odds that this ESOP dummy has the value 1. Firm characteristics are used as explanatory variables. The univariate regressions do not use equal number of observations, since data for some of the characteristics were not available for some of the companies in the sample. Fixed-effect estimators are used to control for time-invariant effects.

Table 8 reports the estimated coefficients for the univariate logistic regression models. Specifications of these models are given in Table 6 Panel A. The hypothesized effects of the explanatory variables are shown in the second column of Table 8. For most of the coefficients, the estimated sign corresponds to the expected effect. However, the coefficients for the market-to-book are ratio, stock volatility and current ratio have the opposite sign. These first two coefficients are statistically insignificant, as well as the coefficient for Tobin's Q. The relationship between the ESOP dummy and the current ratio however, is statistically significant at the 0.10 level. The provision of an ESOP is thus partly determined by a firm's liquidity, although in a different way than expected. The relationship between the ESOP dummy and ln(assets) (+), book leverage (-) and RD/sales (+) respectively, is statistically significant at the 1 percent level, while the relationship between the ESOP dummy and ln(employees) (+) is statistically significant at the 5 percent level. This indicates that there is strong evidence that firm size, leverage and R&D expenditures are determinants of the provision of employee stock option plans.

As previously explained, interpretation of the coefficients estimated with a logistic regression model is complicated, since these do not represent marginal effects. Odds ratios are therefore presented at the bottom of the table. Although odds ratios are more intuitive, they still give some interpretational difficulties. If odds ratio > 1, it means that the relationship between the odds of ESOP provision and the explanatory variable is negative; if odds ratio < 1 this relationship is positive. In terms of probability, a positive relationship indicates an increase in the probability that a firm provides an employee stock option plan, while a negative relationship indicates the opposite. When a firm has high R&D expenditures, the odds that it has an ESOP are higher. When a firm is highly leveraged, the odds that it provides stock options to employees is lower. The intuition behind the values of the odds ratios is as follows. Consider for example the odds ratio of ln(assets), which has a value of 1.200. This implies that a one-unit increase (in dollars) in total assets is associated with a 1.200 increase of the odds that a firm has an ESOP.

The univariate logit models already give some evidence that the provision of ESOPs is determined by firm size, leverage, liquidity and R&D expense. To find supporting evidence, several multivariate logit models are employed. In these models, I regress the dummy for ESOP on the explanatory variables simultaneously to find the relative contribution to the probability of ESOP provision for each one of them. As well as for the univariate logit models, the outcome variable for the multivariate regression models is the ESOP dummy. Specification of those models is given in Table 6 Panel B.

Table 8: Univariate logistic regression results

This table reports the results for the various univariate logistic regression models. The response variable of these univariate regressions is a dummy for the provision of an ESOP, which takes value 1 if a firm provides one and value 0 if a firm does not. The coefficients, expressed by β, are measured using maximum likelihood. Because the coefficient values are not intuitive, the odds ratios are reported as well at the bottom of the table.

	Expectation	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Ln(assets)	+	0.182***								
		(4.17)								
Ln(employ)	+		0.104**							
			(2.00)							
Leverage	-			-0.147***						
				(-2.94)						
Stock vol.	+				-0.0868					
					(-0.14)					
Tobin's Q	+					0.033				
						(0.39)				
MtBratio	+						-0.0124			
							(-0.38)			
Curratio	-							0.185*		
								(1.76)		
Intcoverage	-								-0.000586	
									(-0.82)	
RD/Sales	+									0.0528***
										(2.85)
Odds ratio		1.200	1.110	0.863	0.929	1.034	0.987	1.200	0.999	1.054
Std. Err. OR		0.0524	0.058	0.044	0.471	0.087	0.340	0.124	0.001	0.001
P>chi2		0.000	0.044	0.003	0.885	0.697	0.701	0.066	0.303	0.000
N observations		466	466	466	447	464	450	410	460	312
N groups		95	95	95	92	94	91	84	95	66

t-statistics in parentheses

* p<0.10, **p<0.05, ***p<0.01

When running the multivariate regression models, the first thing that strikes is the fact that the estimated coefficient for ln(employees) shifts from positive to negative (not reported). The coefficient is thereby statistically insignificant. Furthermore, recall that the correlation between ln(assets) and ln(employees) is quite high. These are all signs that there may be multicollinearity between those regressors. Multicollinearity is a problem since it can cause unstable and unreliable estimations. Therefore, I use a variance inflation factor (VIF) diagnostic to examine whether this is the case. A VIF detects multicollinearity in regression analysis and has a lower bound of 1 and no upper bound. In the literature, there is no firm consensus which value the VIF must take to constitute a problem. I follow the often defended approach that with a VIF > 5, the regressors are highly correlated and multicollinearity is clearly present. As expected the VIF for ln(assets) and ln(employees) is quite high (10.57 and 10.75 respectively). Since these values are greater than 5, a multicollinearity problem is evident. To address this problem, I delete ln(employees) from all of the multivariate regressions, and only use ln(assets) as a proxy for firm size. For all other variables, the VIF values are below 2.5, so there appears to be no multicollinearity issue there.

The results for the multivariate logit models are presented in table 9. Model 1 is the standard multivariate model, which is expanded in models 2-6 to add robustness. In model 2, 4 and 6 the current ratio and R&D expense are added. These firm characteristics are expected to partly determine the provision of ESOPs, but there are a lot of missing values for these variables. Since STATA drops observations with missing values, the regressions with R&D and current ratio use much less data, as also shown at the bottom of table 9. Furthermore, year dummies are added to models 3-6 to control for time effects. Note that the coefficients for these dummies are not reported. In model 5 and 6, a dummy for new economy firms is added, with value 1 if firm i qualifies as a new economy firm and otherwise value 0.

Table 9 reports the estimated coefficients for the multivariate logit models. Again, the hypothesized effects of the explanatory variables are given in the second column of Table 9. As shown, the coefficients for most of the variables are of the expected sign. Exception to this are the coefficients for the market-to-book ratio and the current ratio. For the market-to-book ratio, the relationship with the ESOP dummy is estimated to be positive, for the current ratio the opposite applies. However, these estimates are statistically significant for none of the models. This implies that there is no reliable evidence that the estimated relationship between the provision of an ESOP

and those two firm characteristics truly exists. It is not possible to assure that the value of the parameters in the underlying regressions is definitely different from zero. This also applies to interest coverage and stock volatility. Although the coefficients for these variables are of the expected sign, there is no reliable evidence for a negative relationship between interest coverage and ESOP provision and the positive relationship between volatility and ESOP provision. After all, the estimated coefficient for both variables is statistically insignificant across all models. In summary, the logit model results do not provide any significant support for the prediction that illiquid firms (hypothesis), riskier firms (hypothesis 1e) and firms that face financing constraints (hypothesis 1f) are more likely to provide broad-based employee stock option plans.

Regarding the other determinants, several observations are apparent. First, the coefficient for ln(assets) is positive and highly significant across all model specifications. When the logit model uses less observations due to the addition of R&D/Sales and the current ratio, the coefficients are significant at the 1 percent level. Adding year dummies increases robustness. This implies that larger firm size is associated with a higher probability of providing an ESOP. Firms with a large asset base are thus more likely to provide broad-based stock option plans to their employees. This is well in line with hypothesis 1a, in which a positive relationship between firm size and ESOP provision is proposed. Second, the coefficient for R&D/Sales is also positive and statistically insignificant across all models in which this variable is used. When adding year dummies and the new economy dummy, I observe that the relationship between R&D/Sales becomes more diffuse, but remains positive. Greater R&D expense is thus associated with higher probability of ESOP provision. In other words, firms that invest much in R&D are more likely to provide an ESOP. This finding supports hypothesis 1h, which predicted a positive relationship between R&D expense and ESOP provision. In addition to this, the coefficient for the new economy dummy is positive and statistically significant at the 1 percent and 5 percent level in model 5 and 6 respectively. Since new economy firms are characterized by high levels of R&D, this finding gives additional support for the R&D hypothesis.

Third, the coefficient for book leverage and Tobin's Q is statistically significant and of the expected sign, but this only applies to the models in which R&D expense and the current ratio are left out (models 1, 3 and 5). When looking at those models, I observe that the probability of providing an ESOP is lower when a firm is highly leveraged. The relationship between ESOP

provision and is more evident when year dummies and the dummy for new economy firms are added, and the latter model is the most robust. This finding is consistent with the hypothesis that the agency costs of debt plays an important role in the decision to make use of an employee stock option plan. Besides I also find statistical support for the hypothesis that firms with high growth opportunities are more likely to use an ESOP. Although the coefficient for the market-to-book ratio is consistently insignificant, the coefficient for Tobin's Q is positive and statistically significant at the 5 percent level in the standard multivariate model. It remains positive and significant when adding year dummies and the new economy dummy, even though the relationship becomes less evident and the model less robust. Moreover, one should be somewhat cautious when interpreting the estimates regarding book leverage and Tobin's Q, because their coefficients are no longer significant when the current ratio and R&D/Sales are added to the model. One reason for this observation might be that without those two predictors, the estimates are influenced by omitted variables. However, it is very possible that this is caused by the great loss of observations when adding those additional regressors, since almost one third drops out.

Table 9: Multivariate logistic regression results

This table reports the results for the various multivariate logistic regression models. The response variable of these univariate regressions is the dummy for the provision of an ESOP, which takes value 1 if a firm provides one and value 0 if a firm does not. The coefficients, expressed by β, are measured using maximum likelihood. Specification of the models can be found in table 6. Odds ratios are reported in table 9A (appendix).

	Expect.	(1) D_ESOP	(2) D_ESOP	(3) D_ESOP	(4) D_ESOP	(5) D_ESOP	(6) D_ESOP
D_ESOP							
ln(assets)	+	0.692***	1.234***	0.717***	1.294***	0.781***	1.373***
		(5.55)	(4.77)	(5.66)	(4.88)	(5.95)	(4.99)
Leverage	-	-0.0666***	-0.0201	-0.0699***	-0.0381	-0.0713***	-0.0359
		(-3.53)	(-0.22)	(-3.65)	(-0.47)	(-3.66)	(-0.39)
Volatility	+	0.722	0.477	1.324	1.351	1.097	1.332
		(1.23)	(0.64)	(1.60)	(1.34)	(1.33)	(1.29)
TobinsQ	+	0.339**	0.189	0.323**	0.159	0.322*	0.136
		(2.28)	(0.86)	(2.12)	(0.72)	(1.96)	(0.58)
MtBratio	+	-0.0209	-0.114	-0.00546	-0.0816	-0.0239	-0.0690
		(-0.34)	(-1.23)	(-0.09)	(-0.87)	(-0.36)	(-0.70)
Int. cov.	-	-0.00115	-0.000633	-0.00123	-0.00071	-0.00197	-0.000737
		(-1.05)	(-0.92)	(-1.09)	(-1.02)	(-1.37)	(-0.91)
Cur. Ratio	-		0.262		0.265		0.268
			(1.22)		(1.24)		(1.26)
RD/Sales	+		0.0703***		0.0642***		0.0440*
			(2.69)		(2.46)		(1.81)
D_NE	+					1.533***	0.993**
						(4.33)	(2.26)
LR chi2		42.39	65.15	44.73	67.79	64.51	72.83
P > chi2		0.000	0.000	0.000	0.000	0.0000	0.000
Pseudo R^2		0.0721	0.1588	0.0761	0.1652	0.1097	0.1775
N		435	302	435	302	435	302
N groups		91	66	91	66	91	66
Year dummies included		No	No	Yes	Yes	Yes	Yes

t-statistics in parentheses,
* p<0.10, **p<0.05, ***p<0.01

Some conclusions can be drawn when looking at both the univariate and multivariate models together. First, my results indicate that firm risk and financing constraints do not determine the provision of ESOPs. The estimates for these variables are consistently insignificant, which indicates that German companies do not regard firm risk and the ability to take on debt as decisive criteria for ESOP provision. My results also suggest that liquidity is not a determinant of ESOP

provision. Although the univariate model gives weak evidence for a positive relationship between those variables, the multivariate models gives no statistically significant results. The positive and significant relationship between ESOP provision and liquidity is probably caused by an omitted variable, for which is controlled in the multivariate model. This implies that German firms do not regard liquidity position as a decisive criterion for ESOP provision. Furthermore, larger firms are more likely to provide broad-based employee stock option plans. The relationship between firm size and ESOP provision is positive and highly significant across all models, which indicates that firm size is an important determinant of ESOP provision. This also applies to R&D expense, although the evidence is somewhat less convincing. Based on my estimates, the probability that a firm uses an ESOP is lower when a firm is highly leveraged. Both the univariate and the multivariate find significant support for this hypothesis. Insignificance of the coefficients for book leverage in some of the multivariate models is probably caused by a great loss of observations. Lastly, there is some evidence that growth opportunities are positively related to the provision of ESOPs, but this relationship must be interpreted with caution. The univariate model gives significant results for neither the market-to-book ratio nor Tobin's Q. The multivariate models does not give significant coefficients for the MtB ratio either, but the positive relationship between Tobin's Q and ESOP provision is significant and positive in some of those models.

5.2 Labor performance effects of ESOP provision: Results

This section provides the results for the empirical analysis concerning the effects of ESOP provision on labor performance. First the results for the regression models that are used to examine the relationship between ESOP provision and employee turnover (hypothesis 2) are discussed. Thereafter, the results for the models on ESOP provision and its effects on employee productivity (hypothesis 3) are presented.

5.2.1 Effect of ESOP provision on employee turnover

The first measure of labor performance that I investigate in this thesis is employee turnover, as derived from Hausknecht & Trevor (2011) and Hencock at al. (2013). First, recall that the relationship between ESOP provision and employee turnover is hypothesized to be negative (hypothesis 3a). Since there is no data available on employee turnover or employees leaving for most of the firms, the percentage change in employees is the best available proxy for employee turnover. Note that the relationship between this proxy and ESOP provision is expected to be positive instead of negative. When the value of percentage change is highly positive after all, it is more likely that rate employee turnover rate is low. To assess this relationship, I run both univariate and multivariate OLS regression models. Specifications of these models are given in Table 8 Panel A. In all of these models, I use the percentage change in employees as the dependent variable. In the univariate regression model this variable is regressed on the ESOP dummy, which is the key explanatory variable. In the multivariate models, the dependent variable is additionally regressed on some firm characteristics, serving as control variables, and year dummies. I also use sub-sample regressions to test the effects of ESOP provision for six industry sectors separately. In all models fixed-effect estimators are used to capture time-invariant heterogeneity of the firms.

The fixed-effect regression results for the entire sample are presented in table 10. As shown the coefficient for the ESOP dummy in the univariate regression model has a positive sign. This would imply that the relationship between the percentage change in employees and ESOPs is positive. In other words, the provision of ESOPs is associated with a higher percentage growth in the number of employees and thus with a lower employee turnover rate. However the coefficient is statistically insignificant at the 10 percent level, which means that there is no reliable evidence for these associations to exist.

When control variables are added, I observe that the estimated coefficient remains positive. This is also the case when controlling for time effects, although the relationship becomes more diffuse. This would again indicate that the provision of ESOPs is associated with a higher percentage growth in the number of employees and thus with a lower employee turnover rate, if it wasn't for the fact that the estimated coefficients in these models are also not statistically significant from zero at the 10 percent level. The t-statistic in the third model, with both control variables and year dummies, is even smaller than in the other models and thus statistically less significant from zero. In summary, the results from the multivariate models do not provide any credible evidence for a positive effect of employee stock option plans on employee turnover either.

These findings are not in line with the expected effects of ESOPs on employee turnover as proposed in hypothesis 2a. This hypothesis suggests that the provision of employee stock options is negatively related to the provision of ESOPs; i.e. ESOP firms should have lower employee turnover rates than non-ESOP firms. Although the relationship between ESOP provision and the percentage change in employees seems to be positive when looking at the estimated coefficients in all models, these results do not find any satisfactory statistical support; it is just not possible to assure that the value of the parameters in the underlying regressions is definitively different from zero. To conclude, my results do not support hypothesis 2a, which therefore must be rejected.

Table 10: Fixed-effect regressions on the effect of ESOP provision on employee turnover

This table reports the results for the various fixed-effect regression models regarding the relationship between the provision of ESOPs and employee turnover. The dependent variable of these regressions is the percentage change in the number of employees, which is a proxy for employee turnover. The key explanatory variable is a dummy for the provision of an ESOP, which takes value 1 if firm i provides one and value 0 if a firm does not. The coefficients, expressed by β, are measured by Ordinary Least Squares (OLS) estimates. Fixed effects are used to control for time-invariant characteristics. Model 1 is a univariate regression model with only the key explanatory variable as a regressor. Model 2 and 3 are multivariate regression models with various control variables. To control for firm size, ln(assets) is added to the model. Furthermore, to control for profitability and growth opportunities, ROA and Tobin's Q are added (model 2). Model 3 contains year dummies to control for time effects.

	(1) $\Delta\ Emp\ (\%)$	(2) $\Delta\ Emp\ (\%)$	(3) $\Delta\ Emp\ (\%)$
D_ESOP	0.0364	0.0366	0.0297
	(0.87)	(0.89)	(0.72)
ln(assets)		0.0890***	0.118***
		(3.21)	(3.50)
ROA		0.0813	0.0465
		(0.72)	(0.41)
Tobin's Q		0.00406	-0.000497
		(0.30)	(-0.04)
F-stat	0.757	3.324	2.311
R2	0.3207	0.3390	0.3483
R2 Adjusted	0.148	0.164	0.166
N	465	464	464
Year fixed effects	No	No	Yes

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.01

The results are also contradictory to some earlier studies, such as the work of Oyer & Schaeffer (2005), which predict that the retention of employees is one of the key objectives for firms when adopting an employee stock option plan. Being able to retain employees will automatically result in lower turnover rates and lower turnover costs. My results do not support those findings. However, there may be several reasons why I find no reliable evidence for a negative relationship between ESOPs and employee turnover. The most important reason might be that the percentage change in employees is not a reliable proxy for employee turnover. One might argue that this proxy is disputable, because of the fact that the number of new employees affects the percentage change in employees, while it does not affect employee turnover at all, which may lead to a distortion. Suppose a firm has 100 employees in year t and 110 employees in year t+1. In year t+1, the number of employees has increased with 10%, so the percentage change in employees has a positive value of 0.10. This might indicate a very low turnover rate, but in fact it only indicates the difference

between the number of new employees and the number of employees that have left. Two situations, e.g. one with no employees leaving and 10 new employees and one with 30 employees leaving and 40 new employees, give the same percentage change in the number of employees. In the first situation however, the employee turnover rate is 0, while in the second situation the employee turnover rate is 30%. Given the limitations of my data, the percentage change in number of employees was the best available proxy. However, it does not preclude these kind of distortions. My data gives no insight in the impact of these distortions either. Therefore, when interpreting my results as evidence for no effect of ESOPs on employee turnover, caution should be exercised.

5.2.2 Employee turnover: results per sector

After running the regression models for the entire sample, I employ sub-sample regressions to estimate the relationship between employee turnover and ESOP provision for six sectors separately (Table 7 Panel A equation 4). The regression results for each sector are presented in Table 11.

Table 11 reports the estimation results of the fixed-effect estimators for the sub-sample multivariate regression model. For all sectors except transportation, the estimated coefficient has a positive sign. This suggests that in these five sectors, the provision of an ESOP is associated with a higher value of percentage change in employees and thus a lower employee turnover rate. However, none of these estimations has reached statistical significance. This implies that there is no reliable evidence that the suggested associations truly exist, which is consistent with the findings for the entire sample.

Something remarkable is the negative sign of the estimated coefficient for the transportation sector, which indicates that in this sector, the provision of an ESOP is associated with a higher turnover rate. This is opposite to the effect I expect based on economic theory. However, also this finding is not statistically significant. Again, the results in this section must be interpreted with caution, given the possible distortions as explained in section 5.2.2.

Table 11: Effect of ESOP provision on employee turnover per sector

This table reports the results for the fixed-effect multivariate regression model with year dummies, estimated separately for six industry sectors (Table 7, Panel A, equation 4). Specifications of the different sectors are reported in Table 2. The coefficients, expressed by β, are measured by Ordinary Least Squares (OLS) estimates. Again, various control variables are used, which are ln(assets), ROA and Tobin's Q. Note that coefficients for year dummies are not reported.

	Resources	Manufacture	Transport	Wholesale	Finance	Services
	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta\ Emp$ (%)	$\Delta\ Emp$ (%)	$\Delta\ Emp$ (%)	$\Delta\ Emp$ (%)	$\Delta\ Emp$ (%)	$\Delta\ Emp$ (%)
D_ESOP	0.0117	0.0110	-0.131	0.0790	0.00716	0.198
	(0.08)	(0.17)	(-0.62)	(1.19)	(0.07)	(1.20)
ln(assets)	0.0390	0.242***	-0.296	-0.0126	-0.0475	0.0996
	(0.06)	(4.61)	(-1.30)	(-0.05)	(-0.67)	(0.88)
ROA	-0.372	-0.112	1.456	0.0350	-0.658	-0.0206
	(-0.64)	(-0.82)	(1.05)	(0.10)	(-0.61)	(-0.04)
Tobin's Q	-0.0545	0.00184	-0.259*	0.0216	-0.0519	-0.0551
	(-0.80)	(0.10)	(-1.84)	(0.77)	(-0.59)	(-1.47)
F-stat	0.518	3.164	0.791	1.097	0.390	2.137
R_2	0.6828	0.3959	0.4696	0.5474	0.4065	0.6828
R_2 Adjusted	0.110	0.216	0.166	0.195	0.0782	0.117
N	15	245	45	33	67	59
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.01

5.2.3 Effect of ESOP provision on employee productivity

The second measure of labor performance that is assessed in this thesis, is employee productivity. The relationship between ESOP provision and employee productivity is hypothesized to be positive (hypothesis 3a). To test this, I employ both univariate and multivariate linear regression models that have the form of augmented Cobb-Douglas production functions. Specifications of these models are given in Table 8 Panel B. The dependent variable in all of these models is employee productivity, measured by the natural logarithm of sales per employee. I follow the same process as with the employee turnover model. This means that I first employee a univariate model, in which I regress the dependent variable on the key explanatory variable, which is the ESOP dummy. In the multivariate models, the dependent variable is additionally regressed on some firm characteristics, serving as control variables, and year dummies. I also use sub-sample regressions to test the effects of ESOP provision for six industry sectors separately. In all models fixed-effect estimators are used to capture time-invariant heterogeneity of the firms.

Table 12 presents the results for the fixed-effect regressions and reports the estimated coefficients for each of the models. These are the results for the entire sample. All four models indicate that the ESOP dummy has uniformly positive coefficients. In model 1, which is the univariate model, this coefficient is statistically significant at the 10 percent level. This indicates that the provision of ESOPs is associated with higher sales per employee and thus higher employee productivity. In other words, firms that provide an ESOP outperform firms that do not provide an ESOP in the year the provision is reported, as far as sales per employee is concerned.

In models 2 and 3, in which different control variables are added, the estimated coefficients for the ESOP dummy remain positive and are statistically significant at the 5 percent level. The value of these coefficients are higher than those estimated with the univariate model. This indicates that, when control variables are added, the provision of ESOPs is still associated with higher employee productivity, but that the estimated relationship is more evident and the model is more robust. When controlling for time effects (model 4), the coefficient for the ESOP dummy takes the highest value, slightly above the value that is estimated with the basic augmented Cobb-Douglas production function without ROA, Tobin's Q and year dummies (model 2). Again, this indicates that the estimated relationship is more evident and the model more robust, which makes the estimates more reliable.

Although the applied regression models are linear models, the interpretation of the coefficients estimated in those models is somewhat less straightforward than in the turnover models. It is because the dependent variable has the form of a natural logarithm. The estimated coefficient of 0.108 for D_ESOP in the fifth column of Table 12 (model 4), indicates that firms that provide employee stock option plans have, all else equal, on average 0.108 log points higher sales per employee in the year they provide these plans. The percentage that corresponds with a log points coefficient of 0.108 can be calculated as follows: $100 * e^{0.108} = 11.4\%$. In other words, firms that provide employee stock option plans have, all else equal, on average 11.4% higher sales per employee in the year they provide these plans.

As a robustness check, I allow for lags in the productivity effects of employee stock option plans. I assume that it will take at least j years (j= 1) before an ESOP has its effect on employee productivity. I again run the univariate and multivariate regression models as before, but now with the lagged value of the natural logarithm of sales per employee as the dependent variable. All other

variables are held equal. The results of these fixed-effect regression models are presented in Table 13. The estimated coefficients are always positive and statistically significant: in model 1-3 at the 5 percent level, in model 4 at the 1 percent level. The provision of an ESOP is thus associated with a positive effect on employee productivity in the year after the stock option plan is provided. More specifically, firms that provide employee stock option plans have, all else equal, on average 17.1% (=0.158 log points) higher sales per employee in the year after they have provided these plans. This positive association is consistent with my earlier findings. Therefore, the estimated effects are considered to be robust.

The findings presented in this section are well in line with the expected effects of ESOPs on employee productivity as formulated in hypothesis 3a. This hypothesis suggests that the provision of employee stock options is positively related to employee productivity. The reported estimations support this hypothesis. My results thus provide support for those authors who also hypothesize a positive relationship between ESOP provision and employee productivity, such as Sesil et al. (2002), Sesil et al. (2001) and Morikawa (2012). As well as in their studies, it is however difficult to sort out the actual mechanism associated with the results. First of all it might be that firms that have an employee stock option plan perform better "because these firms are also more likely to manage their human capital better" (Sesil et al. 2002). Furthermore, the results must be interpreted with caution as far as causality is concerned. Research of this type suffers from endogeneity problems, so there may be reverse causality. Therefore, the positive relationship does not automatically mean that ESOP provision causes an improvement in employee productivity. Moreover, my results are not consistent with Jones et al. (2010), who find no evidence for a positive relationship between employee stock option plans and employee productivity.

Table 12: Fixed-effect regressions on the effect of ESOP provision on employee productivity

This table reports the results for the various fixed-effect regression models regarding the relationship between the provision of ESOPs and employee productivity. The dependent variable of these regressions is the natural logarithm of sales per employee, which is a proxy for employee productivity. The key explanatory variable is a dummy for the provision of an ESOP, which takes value 1 if firm i provides one and value 0 if a firm does not. The coefficients, expressed by β, are measured by Ordinary Least Squares (OLS) estimates. Fixed effects are used to control for time-invariant characteristics. Model 1 is a univariate regression model with only the key explanatory variable. Model 2-4 are multivariate regression models, each specified as an augmented Cobb-Douglas production function. Various control variables are used. Following the Cobb-Douglas production function, ln(assets) and ln(employees) are used as measures for capital and labor (model 2). To control for profitability and growth opportunities, ROA and Tobin's Q are added (model 3). Model 4 contains year dummies to control for time effects.

	(1)	(2)	(3)	(4)
	ln(sales/Emp)	ln(sales/Emp)	ln(sales/Emp)	ln(sales/Emp)
D_ESOP	0.0826*	0.107**	0.0964**	0.108**
	(1.68)	(2.38)	(2.19)	(2.46)
ln(assets)		0.306***	0.333***	0.264***
		(8.73)	(9.12)	(6.37)
ln(employees)		-0.440***	-0.437***	-0.430***
		(-8.69)	(-8.30)	(-8.27)
ROA			-0.444***	-0.399***
			(-3.78)	(-3.39)
Tobin's Q			0.0273**	0.0273*
			(1.97)	(1.89)
F-stat	2.719	33.12	21.01	13.39
R_2	0.957	0.966	0.967	0.968
R_2 adjusted	0.945	0.956	0.958	0.959
N	457	457	455	455
Year fixed effects	No	No	No	Yes

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Table 13: Robustness check on the effect of ESOP provision on employee productivity

This table reports the results for the various fixed-effect regression models regarding the relationship between one-year lagged employee productivity and the provision of ESOPs. The dependent variable of these regressions is the one-year lagged value of the natural logarithm of sales per employee. Again, the key explanatory variable is a dummy for the provision of an ESOP, which takes value 1 if firm i provides one and value 0 if a firm does not. The coefficients, expressed by β, are measured by Ordinary Least Squares (OLS) estimtaes. Fixed effects are used to control for time-invariant characteristics. Model 1 is a univariate regression model with only the key explanatory variable. Model 2-4 are multivariate regression models, each specified as an augmented Cobb-Douglas production function. Various control variables are used. Following the Cobb-Douglas production function, ln(assets) and ln(employees) are used as measures for capital and labor (model 2). To control for profitability and growth opportunities, ROA and Tobin's Q are added (model 3). Model 4 contains year dummies to control for time effects.

	(1) ln(sales/Emp)_1	(2) ln(sales/Emp)_1	(3) ln(sales/Emp)_1	(4) ln(sales/Emp)_1
D_ESOP	0.143**	0.154***	0.142**	0.158***
	(2.22)	(2.58)	(2.38)	(2.61)
ln(assets)		0.247***	0.215***	0.161**
		(4.75)	(3.78)	(2.50)
ln(employees)		-0.00713	-0.0108	0.000491
		(-0.10)	(-0.15)	(0.01)
ROA			0.0651	0.102
			(0.49)	(0.74)
Tobin's Q			-0.0438**	-0.0444**
			(-2.58)	(-2.46)
F-stat	4.915	13.820	9.583	6.416
R_2	0.9594	0.9659	0.9668	0.9672
R_2 Adjusted	0.946	0.954	0.955	0.955
N	366	363	362	362
Year fixed effects	No	No	No	Yes

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

5.2.4 Employee productivity: results per sector

After running the regression models for the entire sample, I employ sub-sample regressions to estimate the relationship between employee turnover and ESOP provision for six sectors individually (Table 7 Panel B equation 5). The regression results are presented in Table 14.

For the resources, transport and services sector, the estimated coefficient has a negative sign. This would imply that in these sectors, the provision of an ESOP is associated with a negative effect on employee productivity. However, the fixed-effect estimators find that these associations are statistically insignificant. Reason for this might be that the statistical power of the regressions is reduced due to the very small sample sizes that are created by splitting up the entire sample into industry sectors. Since the estimations are statistically insignificant, there is no credible evidence

that the negative association truly exists. The positive coefficients of the wholesale and finance sector are statistically insignificant as well, hence there is also no evidence for a positive relationship between ESOP provision and employee productivity in these sectors.

With regards to the manufacturing sector, I find results that correspond to those found for the entire sample. The estimated coefficient has a positive sign and is statistically significant at the 5 percent level. This indicates that in the manufacturing sector, as well as in general, the provision of an ESOP is positively associated with employee productivity. More specifically, firms within the manufacturing sector that provide employee stock option plans have, all else equal, on average 18.2% (=0.167 log points) higher sales per employee in the year they have provided such a plan.

Table 14: Effect of ESOP provision on employee productivity per sector

This table reports the results for the multivariate regression model with year dummies, estimated separately for six specified industry sectors (Table 7, Panel B, equation 5). Specifications of the different sectors are reported in Table 2. The coefficients, expressed by β, are measured by Ordinary Least Squares (OLS) estimtaes. Again, various control variables are used, which are ln(assets) and ln(employees) (following the Cobb-Douglas production function), ROA and Tobin's Q. Note that coefficients for year dummies are not reported.

	Resources	Manufacture	Transport	Wholesale	Finance	Services
	(1)	(2)	(3)	(4)	(5)	(6)
	ln(sales/Emp)	ln(sales/Emp)	ln(sales/Emp)	ln(sales/Emp)	ln(sales/Emp)	ln(sales/Emp)
D_ESOP	-0.0668	0.167**	-0.111	0.00360	0.0113	-0.0695
	(-0.86)	(2.53)	(-0.95)	(0.09)	(0.08)	(-0.37)
ln(assets)	-0.744	0.156*	-0.0804	0.0177	0.176**	0.367***
	(-2.32)	(1.85)	(-0.49)	(0.10)	(2.50)	(2.86)
ln(employee)	-1.590***	-0.247***	-0.590***	-0.460*	-0.855***	-0.979***
	(-7.90)	(-2.99)	(-3.78)	(-2.04)	(-4.82)	(-4.95)
ROA	0.603*	-0.353**	-0.534	0.413	1.698	-0.395
	(2.38)	(-2.33)	(-0.67)	(1.52)	(1.57)	(-0.64)
Tobin's Q	-0.0523	0.0488**	-0.0321	0.0340*	-0.162*	-0.00311
	(-1.68)	(2.51)	(-0.38)	(2.10)	(-1.78)	(-0.07)
F-stat	25.36	3.984	5.068	6.789	6.867	4.867
R_2	0.9982	0.9308	0.9922	0.9986	0.9780	0.9691
R_2 Adjusted	0.992	0.910	0.987	0.997	0.966	0.953
N	15	245	40	33	63	59
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

6. Conclusion

6.1 Summary of main findings

Since the sharp increase in the use of broad-based employee stock option plans in the late 1990s, an extensive body of literature on the implications of such plans has been developed. Previous research is mainly focused on the question why companies use ESOPs and whether firms that use such plans have superior operational performance. In this thesis, I further investigate the determinants of ESOP provision and its effects on labor performance using new panel data for German publicly listed firms during 2004-2008. This data set consists of a total number of 466 observations for 95 companies. Using German data allows me to test the universal applicability of previous findings that are mostly obtained with use of US data.

Because I examine both the determinants and effects of ESOP provision, the empirical analysis in this thesis is twofold. In the first part, which covers the determinants, I find empirical evidence for a strong positive relationship between the provision of ESOPs and firm size. The applied logit models systematically find that firms with a large asset base are more likely to provide an ESOP. This supports the monitoring costs hypothesis, which states that the use of ESOPs increases with firm size, since it is more difficult to monitor performance of employees when the firm is large. Furthermore, my results indicate that firms with high levels of R&D are more likely to use broad-based stock option plans. I also find that new economy firms are more likely to use an ESOP, which provides additional support for the positive relationship between R&D expense and ESOP provision, since those firms are characterized by high R&D intensity. This is consistent with studies that predict that the impact of incentivized employees is larger when R&D levels are high. I also find some evidence that the likelihood of using an ESOP is reduced when a firm is highly leveraged and is increased when a firm has large growth opportunities, proxied by Tobin's Q. However, these results must be interpreted with caution, because they are not robust across all model specifications. In contrast to previous research, I do not find that the provision of ESOPs is determined by firm risk, liquidity and financing constraints.

The second part of my analysis investigates the effects of ESOP provision on labor performance, which is measured by employee turnover and employee productivity. First, I find no support for the hypothesis that employee turnover and ESOP provision are negatively related. After all, the estimates from all of the applied regression models are consistently insignificant. This is not

consistent with previous studies that find evidence for retention explanations for the use of broad-based employee stock option plans. However, a poor choice of proxy might be a reason for the fact that no relationship is found. Second, I do find empirical evidence for a positive relationship between the use of broad-based ESOPs and employee productivity. I estimate several augmented Cobb-Douglas production functions and observe that this relationship is robust across all of these regression models. My results are well in line with the agency theory, which predicts that employee stock options align the interests of employees with those of the firm, which results in an improvement of employee productivity.

6.2 Limitations and future research

Given the new assembled data set and the applied methodology, some limitations to this paper are apparent. First, annual reports most often give very limited information about employee stock option plans. For most of the investigated companies, data is lacking for the total amount of stock options granted, the number of employees participating, exercise prices of the options, a firms expenses on stock options etc. It is therefore not possible to investigate, for instance, the intensity with which firms use employee stock options or the costs of providing ESOPs.

Second, there might be other firm characteristics than the ones I incorporated in the logit models that determine the provision of broad-based ESOPs. Some of those possible predictors are not included because of lacking data. An example of such a possible determinant is the provision of executive stock options. Previous research suggests that when using stock options is an effective way of monitoring the top executives, a firm will use non-executive options more intensively. Unfortunately, data on executive compensation is not available for the majority of firms in my data set, so it is not possible to investigate the relationship between the provision of executive and employee stock option plans.

Third, while I have found empirical evidence for a positive relationship between the provision of broad-based employee stock option plans and employee productivity, it is difficult to unravel the underlying mechanism related to this finding. The empirical approach that is used in this study is not suitable to provide any evidence on how employee stock options affect employee behavior exactly. Further research is needed to find out if and why employees improve their performance when they are granted stock options. Furthermore it is not possible to establish a causal relationship of ESOP provision on employee productivity. Empirical analysis of the type that is used in this

thesis suffers from endogeneity problems, so there may be reverse causality. Therefore, the estimated positive relationship does not automatically mean that ESOP provision causes an improvement in employee productivity. It might be that highly productive employees are somehow more inclined to adopt a broad-based employee stock option plan.

Fourth, my empirical findings on the effect of ESOPs on employee turnover differ from those obtained in previous research. A reason for this might be that the percentage change in employees is a poor proxy for employee turnover. As previously mentioned, this proxy can cause a distortion, since new attracted employees can affect the percentage change dramatically, while at the same time the employee turnover rate is not affected at all. However, given the fact that data on employee turnover or new/leaving employees was not available, using the percentage change in employees was the most convenient approach. Obviously, a better proxy would be the actual turnover rate. Another proxy for employee turnover could be forfeited stock options, as proposed by Carter and Lynn (2004).

An interesting addition to this research could be to investigate the impact of the adoption of broad-based stock option plans on labor performance. This allows to investigate whether labor performance actually changes after a firm started to provide employee stock options. My data does not provide information about the exact year in which the ESOP was adopted. Besides, it is plausible that most firms already adopted a broad-based employee stock option plan before 2004. Therefore, to assess whether the adoption of an ESOP results in superior labor performance, an extension of the data set with earlier years is needed.

In this thesis, I focused on the determinants and effects of broad-based employee stock option plans. There are, however, other kinds of incentive-based compensation, such as profit sharing plans and bonus plans with cash payments to employees. It could be valuable to look at other types of incentive-based compensation schemes as well. More specific, it could be of interest to compare different features of the various compensation forms, to test which one of them is the most preferable. It might for instance be that those other forms improve labor performance even more or that they are less costly then ESOPs.

References

Aboody, D., Barth, M.E., Kasznik, R., 1996, SFAS 123 stock-based compensation expense and equity market values, *Accounting Review*, pp. 251-275.

Beatty, A., 1995, The cash flow and informational effects of employee stock ownership plans, *Journal of Financial Economics,* pp. 211-240.

Bell, T., Landsman, W., Miller, B., Yeh, S., 2002, The valuation implications of employee stock-option accounting for profitable computer software firms, *Accounting Review* pp. 971-996

Blasi, J., Conte, M., Kruse, D., 1996, Employee Stock ownership and Corporate Performance among Public Companies, *ILR Review*, pp. 60-79.

Carter, M.E., Lynch, L.J., 2004, The effect of stock option repricing on employee turnover, *Journal of Accounting and Economics,* pp. 91-112.

Chaplinsky, S., Niehaus, G., 1994, The role of ESOPs in takeover contests, *Journal of Finance*, pp. 1451-1470.

Core, J., Guay, W., 2001, Stock option plans for non-executive employees, *Journal of Financial Economics,* pp. 253-287.

Ding, D.K., Sun, Q, 2001, Causes and effects of employee stock option plans: Evidence from Singapore, *Pacific-Basin Finance Journal*, pp. 563-599.

Faleye, O., Mehrota, V., Morck, R., When Labor Has a Voice in Corporate Governance, *Journal of Financial and Quantitative Analysis,* pp. 489-510.

Frye, M.B., Equity-Based Compensation for Employees: Firm Performance and Determinants, *The Journal of Financial Research,* pp. 31-54.

Hall, B.J., Murphy, K.J., 2003, The Trouble with Stock Options, *Journal of Economic Perspectives*, pp. 49-70.

Hancock, J.I., Allen, D.G. Bosco, F.A., McDaniel, K.R., Pierce, C.A., 2013, Meta-Analytic Review of Employee Turnover as a Predictor of Firm Performance, *Journal of Management,* pp. 573-603.

Hausknecht, J.P., Trevor, C.O., 2011, Collective Turnover at the Group, Unit, and Organizational Levels: Evidence, Issues, and Implications, *Journal of Management*, pp. 352-388.

Hochberg, V., Lindsey, L., 2010, Incentives, Targeting, and Firm Performance: An Analysis of Non-executive Stock Options, *The Review of Financial Studies*, pp. 4148-4186.

Ittner, C.D., Lambert, R.A., Larcker, D.F., 2003, The structure and performance of equity grants to employees of new economy firms, *Journal of Accounting and Economics* 34, pp. 89-127

Jones, D.C., Kalmi, P., Mäkinen, M., 2006, The Determinants of Stock Option Compensation: Evidence from Finland, *Industrial Relations*, pp. 437-468

Jones, D.C., Kalmi, P., Mäkinen, M., 2010, The productivity effects of stock option schemes: evidence from Finnish panel data, *Journal of Productivity Analysis*, pp. 67–80.

Kandel, E., and Lazear, E., 1992, Peer pressures and partnerships, *Journal of Political Economy*, pp. 801-817

Kedia, S., Mozumdar, A., 2002. Performance impact of employee stock options. *Working paper, Harvard Business School*.

Kruse, D., 1996, Why do firms adopt profit sharing plans? *British journal of industrial relations*, pp. 515–538.

Kruse, D., Freeman, R., Blasi, J., Buchele, R., Scharf, A., Rodgers, L., Mackin C., 2004, Motivating Employee-owners in ESOP firms: Human resource policies and company performance. In Advances in the economic analysis of participatory & labor-managed firms, pp. 101-127

Landau, I., Mitchell, R., O'Connell, A., Ramsay, I., 2007, Employee share ownership: A review of the literature, *Employee Share Ownership project*.

Lazear, E.P., 2004, Output-based pay: incentives, retention or sorting?, *Accounting for Worker Well-Being*, pp. 1-25.

March, J., Simon, H., 1958, *Organizations*. New York: John Wiley & Sons.

Mehran, H., Tracy, J., 2001, The Effect of Employee Stock Options on the Evolution of Compensation in the 1990s, *FRBNY Economic Policy Review*, pp. 19-34.

Morikawa, M., 2012, Stock Options and Productivity: An empirical analysis of Japanese firms, *RIETI Discussion Paper Series 12-E-011*.

Murphy, K.J., 1999. Executive compensation. *Handbook of Labor Economics*, pp. 2485-2563.

Oyer, P., 2004, Why Do Firms Use Incentives That Have No Incentive Effects?, *Journal of Finance*, pp. 1619-1650.

Oyer, P., Schaefer, S., 2003. A comparison of options, restricted stock, and cash for employee compensation. *Unpublished working paper, Stanford University and Northwestern University*.

Oyer, P., Schaeffer, S., 2005, Why do some firms give stock options to all employees?: An empirical examination of alternative theories, *Journal of Financial Economics* 1, pp. 99-133.

Peetz, D., Frenkel, S., 1988, D Peetz 'Financial Participation by Employees: A Review of Theoretical and Practical Issues', *DIR Research Paper no. 8, Department of Industrial Relations;* pp. 403-412.

Pendleton, A., 2001, Employee Ownership, Participation and Governance: A Study of ESOPs in the UK.

Pendleton, A., 2006, Incentives, Monitoring, and Employee Stock Ownership Plans: New Evidence and Interpretations, *Industrial Relations*, pp. 753-777.

Pérotin, V., Robinson, A., 2002, Employee Participation in Profit and Ownership: A Review of the Issues and Evidence. *Leeds University Business School.*

Poutsma E., 2001, Recent trends in employee financial participation in the European Union. *Foundation for the Improvement of Living and Working Conditions.*

Poutsma, E., Kalmi, P., & Pendleton, A., 2006, The Relationship between Financial Participation and Other Forms of Employee Participation: New Survey Evidence from Europe. *Economic and Industrial Democracy*, pp. 637-667.

Scholes, M., and Wolfson, M., 1990 Employee Stock Ownership Plans and Corporate Restructuring: Myths and Reality, *Financial Management*, pp. 12–28.

Sesil, J.C., Kroumova, M.K., J.R. Blasi, J.R., Kruse, D.L., 2002, Broad-based employee stock options in U.S. 'new economy' firms, *British Journal of Industrial Relations* 40, pp. 273-294.

Sesil, J.C., Kruse D., Blasi, J., 2001, Sharing Ownership via Employee Stock Option, *Ownership and Governance of Enterprises*, pp. 96-123.

Sesil, J.C., Kroumova, M.K., J.R. Blasi, J.R., Kruse, D.L., 2005, Broad-based Employee Stock Options in the U.S.: Company Performance and Characteristics, *Working paper*.

Sesil, J.C., Lin, Y., 2011, The Impact of Employee Stock Option Adoption and Incidence on Productivity: Evidence from U.S. Panel Data, *Industrial relations*, pp. 514-534.

Spalt, O.G., 2013, Probability Weighting and Employee Stock Options, *Journal of Financial and Quantitative Analysis*, pp. 1085-1118.

Uchida, K., 2006, Determinants of stock option use by Japanese companies, *Review of Financial Economics*, pp. 251-269

Yermack, D., 1995, Do corporations award CEO stock options effectively?, *Journal of Financial Economics*, pp. 237-269.

Appendix

Table 1: Hypotheses

This table provides a summary of hypotheses regarding the determinants of the provision of employee stock options, proposed in section 2.5. These hypotheses are based on past research, discussed in the literature review, and are examined with logistic regressions.

Hypothesized determinant	Proxy	Predicted association	Literature
H1a: Firm size	Total assets, Number of employees	+	Core et al. (2001), Sesil et al. (2001)
H1b: Firm's leverage	Book leverage	-	Core et al. (2001), Yermack (1995), Uchida (2006)
H1c: Liquidity	Current ratio	-	Ding et al. (2001)
H1d: Growth opportunities	Tobin's Q, Market-to-book ratio	+	Sesil et al. (2005), Frye (2004) and Ding et al. (2001)
H1e: Firm risk	Annual stock volatility	+	Spalt (2013)
H1f: Financing constraints	Interest coverage	+	Kedia & Mozumdar (2002)
H1g: Type of industry / R&D Expense	R&D expense, dummy new economy	+	Lazear (2004) and Ittner et al. (2003)

Table 2: Distribution per sector

Panel A reports the number of observations within seven different sectors. The sectors are categorized according to the Standard Industrial Codes (SIC Codes) and companies are assigned to these sectors. Panel B reports the number of ESOP grants per sector.

Panel A: Number of observations per sector

Sector	SIC Code	N
Resources	<2000	15
Manufacturing	2000-3999	245
Transportation and Public utility	4000-4999	45
Wholesale and Retail	5000-5999	35
Finance	6000-6799	70
Services	7000-8999	65
Public Administration	9100-9729	0
Total		475

Panel B: Number of ESOPs per sector

Sector	Sic Code	N
Resources	<2000	9
Manufacturing	2000-3999	83
Transportation and Public utility	4000-4999	29
Wholesale and Retail	5000-5999	12
Finance	6000-6799	34
Services	7000-8999	24
Public Administration	9100-9729	0
Total		191
Percentage of listed firms with ESOPs		40.21%

Table 5: Employee and ESOP statistics

This table reports summary statistics of employee related variables. The variables ln(Emp) and ln(Sales/Emp) are the natural logarithms of total employees per year and sales per employee. D_ESOP is a dummy variable for the provision of employee stock options, with value 1 if firm i provides employee stock options in year t and with value 0 if it does not. ESOP n shares reports the number of shares awarded within the employee stock option program, ESOP n employees reports the number of employees that took part in the program.

	N	mean	min	median	max	sd
Employees	466	47222	59	10169	536350	90887.55
ln(Emp)	466	9.33	4.08	9.23	13.19	1.85
Δ Emp	465	1145	-88800	244	156135	11298.34
Δ Emp (%)	465	0.05	-0.68	0.03	0.90	0.16
Sales/Emp	466	399	42	237	4750	580.60
ln(Sales/Emp)	466	5.57	3.74	5.47	8.47	0.80
D_ESOP	475	0	0	0	1	0.49
ESOP n shares (mill)	105	855.73	2.57	297.56	15000.00	2503.80
ESOP n employees	36	17479.11	389	14450	78000	17297

Table 9A: Odds ratios for the multivariate logit models

This table reports the odds ratios that correspond to the various multivariate logistic regression models on the determinants of ESOP provision. The values of the odds ratio for each variable are reported for all six models.

	(1)	(2)	(3)	(4)	(5)	(6)
ln(assets)	1.998	3.434	2.049	3.647	2.184	3.947
Leverage	0.936	0.980	0.932	0.963	0.931	0.965
Volatility	2.059	1.611	3.759	3.860	2.996	3.788
TobinsQ	1.404	1.208	1.381	1.172	1.380	1.146
MtBratio	0.979	0.892	0.995	0.922	0.976	0.933
Int. cov.	0.999	1.299	0.999	0.999	0.998	0.999
Cur. Ratio		1.000		1.303		1.307
RD/Sales		1.073		1.066		1.045
D_NE					4.633	2.700