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Within-firm pay inequality and firm performance

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Contents

Abstract

This thesis tests the relationship between within-firm pay inequality and firm performance. The sample consists of German companies listed on DAX and MDAX indexes. There are two variables representing for pay inequality: one is wage dispersion between remuneration of CEO and average compensation of other managers within the management board; the other one refers to wage dispersion between compensation of CEO and average wage of employees within the firm. All compensation and wage used in this paper are manually collected from annual reports of the firms . Firm performance is delegated by operating profit margin and return on assets, both of them are indicators of firm profitability. Data of firm performance come from Global Compustat. The main finding is that wage dispersion is positively related with firm performance. Moreover, number of managers within the board is has a positive effect on firm performance.

Keywords: Pay inequality, CEO payment, Return on assets, Profit margin, Firm performance

1. Introduction

CEO compensation, as a tool to align the interest of shareholders and managers, is becoming more and more with the development of the economy. Whether CEO is overpaying has been a controversial issue. Some shareholders think that the company is paying CEO too much and this hurts their own interests; some other individuals think that CEO deserves this amount of remuneration as the intelligence and contribution needs for this position is really high that few people are competent to this job. Also, there are some other arguments that only high compensation can hire and retain right CEO which is good for firm's development in a long term. Besides, with the increase of CEO remuneration, pay differential between CEO and other managers or employees is larger and larger. This may raise fair and equity consideration which may demoralize workers with the firm. Or on the contrary, higher pay differential may motivate employees with incentives to contribute more effort and earn higher payoff. Thus, to check whether wage dispersion has an effect on firm performance and how does it influence firm performance, I begin this thesis.

Research questions raised in this paper are as follows:

Do pay inequality (wage dispersion between CEO's compensation and average remuneration of other managers or wage dispersion between compensation of CEO and average wage of employees') have an effect on firm performance (operating profit margin or return on assets)?

As different countries have different laws regarding managing firms and also different economic environment, there are too many differences of firms in different countries that are hard to control. Thus, choosing all research firms in one country is a good way. In this paper,

German firms are used as research objectives to test the relationship between pay inequality within the firm and firm performance. I choose operating margin and return on assets as indicators of firm performance and calculate wage dispersion between CEO and average compensation of other managers within the board as pay inequality; Moreover, considering one variable may not accurate enough to represent pay differential, I use another variable which is the wage dispersion between CEO and other employees of the firm. Then I test their relationship in Stata and then get the results.

I use Ordinary Least Square (OLS) model for the analysis, I find that:

Pay dispersion within the firm is positively related with firm performance;

Boardsize has a positive effect on firm performance.

Therefore, higher wage differential is good for firm development. CEO is not paid too much as a whole. Moreover, for companies with few managers, CEO can amplify board size properly.

2. Literature review

Nowadays, CEO compensation is becoming a more and more famous topic as the firm is paying CEO much more than before which causes a huge remuneration gap between CEO and other employees. Many papers have studied "pay inequality" since 1996 and it has been continuously discussed and also a controversial topic held by different voices.

2.1 The tournament theory

The high compensation gap may have some effects on firm performance because of the incentives they provide on different classes of employees. Grund and Sliwka (2005) analyze a tournament model between inequity averse agents, people who dislike disadvantageous inequity(envy) and agents who object advantageous inequity(compassion), and then proposes two kinds of incentives of individuals, "incentive effects" and "participation effects". The "incentive effects" refer to the situation that if the feeling of envy is more powerful than compassion, then the equilibrium effort will be higher among inequity averse agents. On the contrary, inequity hatred will weaken the welfare of participating in the tournament, which is called "participation effects". Grund and Sliwka (2005) show that participation effects will always decrease agents' welfare while incentive effects will be balanced out by adjusting the prize structure. Therefore, it is inferred that tournaments within self-interested preferences will have higher efficiency than tournaments within inequity averse individuals. Similarly, Edward and Sherwin (1981) have analyzed a rank-order tournament which means that compensation regime paying is based on an employee's rewards rank instead of level of worker's direct output. They find that for risk-neutral employees, paying relied on rank have the same efficiency of the

resource allocation as paying based on individual output. And for risk-averse workers, they like the payment regime of rank-order.

2.2 Comparable wage and workers' utility

Besides the tournament theory, the relationship between comparable wage and workers 'utility still need to be considered. Akerlof and Yellen (1990) argue that the fair wage-effort hypothesis, which indicates that if wages of workers are considered as fair, the variation in demand labor of the firm will make the unemployment rate changes proportionally, but not cause an obvious shift in nominal wage. Clark and Oswald (1996) have discussed about the theory that happiness depends on a relative level of income and put forward two viewpoints, first, workers' satisfaction is decreasing in comparison earnings, the other point is that the satisfaction level has negative relationship with their education degree. Also, Card，Mas, Moretti, and Saez (2012) find that information disclosure to coworker wage is negatively related with workers' utility if their pay is below the median; but no obvious influence on workers who are paid above their median. Because of this finding, they suggest employers to implement pay secrecy regulation. Besides, there is a model called ERC representing three varieties of behavior-equity, reciprocity and competition which is proposed by Bolton and Ockenfels (2000). They conclude that a higher wage induces a higher average effort level and also higher wages increase the worker payoff. Similarly, Fehr and Schmidt (1999) raise a theory of fairness, competition and cooperation, and show that distribution of agents' preferences has a huge correlation with the strategic environment. For example, in a cooperative environment, fair-minded agents are hard to get a fair consequence. However, according to their test of gift

exchange game, they find that fairness will trigger stable wage elasticity even if workers are in a competitive environment. Therefore, Fehr and Schmidt (1999) conclude that in competitive circumstances, if people are able to affect the payoffs, then equity minds will influence market consequences; if not, they will not counteract the competition.

2.3 Within-firm or within-board pay inequality

Also, within-firm or within-board pay inequality is a relevant topic of this thesis. Who decide the pay dispersion? Do firms try to promote or avoid high wage differential? Is wage dispersion good or bad for firm performance? These issues are all explained in different papers. Faleye, Reis, and Venkateswaran (2012) infer that wage differential between executives and workers is up to their negotiation ability to the opponent. More specifically, the pay dispersion will be larger if executives have high bargaining ability towards the management board and will be smaller if workers are more united and better at negotiation. Moreover, Faleye, Reis, and Venkateswaran (2012) also find a robust positive relationship between pay differential and firm performance, which can be explained by the tournament incentives. Similarly, Fredrik (2005) uses data of private and public firms in Sweden to examine the relationship between wage inequality and firm performance and get a positive relationship between within-firm pay spread and firm profits, while derive a negative correlation between wage differential and number of managers within the board. Also, Yaniv and Paul (2003) find that with the increase of bonus compensation to CEO, the more effort CEO will contribute. Holger M., Paige P. and Elena (2016) test the data of firms in UK and get the results that high pay inequality is associated with higher firm growth, higher firm valuations and higher equity returns.

However, although some scholars believe that high pay inequality will lead to better firm performance, some researchers regard high pay dispersion as a bad phenomenon and try to minimize it. John, E., Robert and David (1999) expound that CEO remuneration is higher when corporate governance is worse, which means that the firm has larger agency problems and performs worse. Ivan E., Oded and John K. (2005) find that excess remuneration of the CEO is related with the underperformance of the company, meaning that the firm performance is worse. Qiang and David B. (2008) present that a decrease in equity ownership compensation prevents CEO from taking risky investments, which will increase total earning of the firm. Schmitt and Marwell (1972) conduct three experiments which are about inequity and withdrawal from cooperation. The setting of inequity is the same in these experiments, and the main difference is about the size of inequity. The experiments conclude that withdrawing from inequity is a kind of reward reallocation which will be applied by the firms who regard inequity as irrational behavior.

Additionally, many literatures have insisted that pay inequality is related with payment system. Except fixed payment schemes, performance-related pay is also a common payment regime which is implemented in many corporations. Bryson A., Forth J. & Stokes L. (2014) state that large corporations are more likely to choose performance-related payment. Also, they point out that the possibility of choosing pay-for-performance is higher in jobs which are most sensitive to effort. Erling, Bernt, Torbjorn and Oddbjorn (2008) have tested the relationship between payment system and with-in firm pay inequality and find that payment dispersion between and within firms are related with the selection of pay regime. This finding can be explained by four points, firstly, firms choosing fixed payment regime always apply higher

effort benchmarks than those selecting performance-pay; secondly, the selection of payment regime has no relation with the bargaining power; thirdly, performance payment has a larger influence on wage dispersion in firms with disunity than union corporations. The last point is that firms with group-based bonuses has similar pay inequality with companies which choose fixed pay.

Besides the payment regime, CEO also has an important influence on wage dispersion within the firm. Cronqvist, Heyman, Nilsson, Svaleryd, and Vlachos (2009) verify that entrenched CEOs will pay more not only to those who are in the high hierarchy of the firm such as executives and managers, but also to workers. Wade, O'Reilly, and Pollock (2006) discuss mangers' attitudes towards fairness and executive compensation and elaborate two arguments, one argument is that whether CEO is over- or underpayment is connected with managers' payment situation at lower hierarchy in the firm, the other refers to that CEO underpayment will lead to high turnover rate of CEO. Finally, they point out that CEOs are self-interested but also have a consideration of fairness, and their ability to obtain compensation will also have a profound effect on the remuneration of others in the corporation.

2.4 Hypotheses development

2.4.1 Introduction to CEO compensation

The goal of high CEO remuneration is to motivate CEO to take steps that create long-term shareholder value. However, the company also wants to recruit the right CEO at the lowest expense and also retain the right CEO at the lowest expenditure. Thus, choosing an appropriate compensation for CEO is crucial to the firm's development.

CEO compensation mainly consists of four parts: base salaries, bonuses, stock options or restrict stock and long-term incentive plans. Base salaries are primarily through bench-marking, and they are always higher for larger firms, while lower for smaller firms. With the increase of CEO remuneration, the percentage of total compensation taken up by base salaries is declining over time. Also, annual bonuses of the CEO are based on accounting targets of the company, such as EBIT and net earnings. They are not fixed, they are paid based on performance, but the pay-performance relation has its threshold and bonus cap. When CEO's performance level is below the threshold, he or she cannot receive any bonus, when the performance reaches above the "cap", the CEO cannot get any more bonus even though the CEO deserves much more than the bonus cap. Thus, there is a tendency that CEO may postpone firm's earnings and withhold effort when he or she reaches the bonus "cap". Besides, stock options are gradually becoming a huge part of the remuneration with the increase of CEO compensation. Michael C. and Kevin J. (1990) think that CEOs should hold large amount of equity which is regarded as the most powerful link between CEO and shareholders. Stock options are typically call options issued at the money. To retain the CEO, stock options are vested over time and will be forfeited if CEO leaves before vesting. Moreover, there are some long-term incentive plans as one kind of compensation to CEO, such as: life insurance, retirement plans and so on.

2.4.2 CEO overpayment

As CEO payment is becoming larger and larger, whether CEO is overpaid has been discussed for a long time. Some shareholders think that CEOs are paid reasonably because of the intelligence they have and effort they work for this position. Also, Eric A., Vilmos F. and

Henry (2010) demonstrate that CEO overpayment will improve firm profitability, but manager-controlled company will weaken this relationship. Gabaix, X. & Landier, A. (2006) believe that increase of CEO remuneration is an equilibrium response to the increase of firm value, not the result of agency problem. Michael C. and Kevin J. (1990) insist that overpayment to CEO has a potential effect that increases firm performance and earnings to shareholders. However, some other shareholders think that CEOs are overpaid will hurt their own benefits because they will be paying more. To avoid shareholders to have such negative feelings, many companies apply say-on-pay regulation, which means that shareholders have the power to decide remuneration of the CEO. According to a survey of U.S firms, about 95 percent of shareholders agree on the compensation which is favorable to CEO.

2.4.3 Pay inequality and firm performance

Pay inequality within the firm is becoming higher and higher with the increase of CEO compensation. The correlation between pay inequality and firm performance has been studied by many scholars. Many literatures show that pay inequality will motivate employees to perform better and achieve higher payoff. For example, according to Holger M., Paige P. and Elena (2016), firms with higher pay-inequality are more likely to have higher firm values, and more possible to show surprisingly higher earnings. Similarly, Fredrik (2005) find a significant positive relationship between pay differential and profits per employee.

Based on previous literatures, following hypotheses can be made:

H_1: There is a positive relationship between wage dispersion within management board and firm performance.

H$_2$: Wage dispersion between CEO and employees have a positive effect on firm performance.

2.4.4 Control variables

In this thesis, I use boardsize and firmsize as control variables when estimating the relationship between wage dispersion and firm performance to eliminate omitted variable biases. Boardsize is found to be related with firm performance. Yermack (1996) first proposed that small board is related with better firm performance, after that Hermalin and Weisbach (2003) obtained the same results which are regarded as eminent literatures about boardsize. Cheng, S., Evans III, J., & Nagarajan N. (2007) study the correlation between them and add another factor - takeover, by testing two contradicting hypotheses – the Complement Hypothesis and the Substitute Hypothesis, finding a negative relation between boardsize and firm performance before the enactment of anti-takeover law, but a weaker correlation after implementing takeover limitation. There are many reasons why they are negatively related, such as: larger board size means paying too much which hurts interests of shareholders; too many managers may have slower decision making, because they need more time to communicate and coordinate; large board size may exist free-riding problem. Moreover, it is said that firm size is also related with firm performance that larger firm size will bring higher firm performance.

Thus, relied on the theoretical background, it can be hypothesized that:

H$_3$: Number of managers within management board has a negative effect on firm performance.

2.5 Conclusion from the literature review

Overall, pay inequality has some effects on firm performance. In some ways, it will improve firm performance because the incentives they provide on workers; on the other hand, it may inhibit firm value because of the fairness consideration and the risk preference attitude of CEO.

To my best knowledge, although the number of literatures studying pay inequality and firm performance is not so much in 1970s, it has increased dramatically since 1996 and since then it has been consistently a hot topic. Many literatures have surveyed different aspects of wage dispersion and its relationship with firm performance, using different data from different countries, such as the United States, UK, and Sweden. However, there are not so many relevant literatures which use data of Germany. In this paper, the data come from corporations in Germany, which will be its distinctive trait from other literatures.

3. Data

This section describes data which is used in this thesis. Section 3.1 gives a brief introduction to data. Section 3.2 describes the data of wage dispersion. Section 3.3 presents the data of firm performance. Section 3.4 introduces other data of this paper.

3.1 Introduction to data

The data used in this paper all come from listed German firms of DAX and MDAX. The period of data is from 2007 to 2016. For testing the hypothesis, I use a sample consisting of 41 firms and 332 firm-year observations. The collected data starts from 2007 and ends in 2016. The data set is manually collected from the annual reports of the firms. I exclude the missing data and outliers, for example, the sample data remove the negative wage dispersion within management board and between CEO and employees, as it is unreasonable that CEO remuneration is smaller than other managers or employees. Moreover, in this thesis, all of the indicators of wage dispersion and firm performance are obtained by calculation, as for wage dispersion, there is no direct and complete data set of the firms I investigate in any data base or annual report.

3.2 Data of wage dispersion

For wage dispersion within the board, German corporations are different from those in the US. German firms implement two-tier boards, one is management board, including all executives, the other is supervisory board, which is composed of all non-executives of the firm. This is different from that in the United States (using one-tier board). The executives in the management board are all inside directors, who are responsible to protect the interests of

shareholders and control the daily management of the firm. The non-executives in the supervisory board are also called outside directors, whose role is mostly that of a watchdog, meaning that they do not participate in firms' day-to-day management, but only monitor inside directors who control and decide the company's overall strategy, governance, and performance. This paper studies the pay differential within the management board, instead of the supervisory board.

This paper uses two variables representing wage dispersion within the firm, one is wage dispersion within management board, which is represented by "wdwmb"; the other is wage dispersion between CEO and employees, which is expressed by "wdbCae". wdwmb is calculated by logarithm of dividing CEO compensation with average compensation of other members in the management board, wdbCae is computed by logarithm of dividing CEO compensation with average wages of employees. The data of CEO compensation and managers' remuneration within the management board all come from their corresponding annual reports of firms, which is not existed in any online data base, but only can be obtained by searching manually on their respective official websites. Also, although not shown in main results, this paper chooses two instrument variables called CEO quality and CEO age to do the two stage least square regression. CEO quality is defined as ratio of CEO tenure to CEO age. CEO quality and CEO age serve as instruments for both wage dispersion within management board and wage dispersion between CEO and employees. Similarly, CEO tenure and CEO age also come from annual reports of their firms.

3.3 Data of firm performance

Firm performance is expressed by two variables, return on assets and operating profit margin, which are denoted as "roa"and "pm". Return on assets is calculated as logarithm of net income divided by total assets, as the goal of the firm is to generate profits, return on assets help investors check how efficient the firm is able to convert the assets into profits. Operating profit margin is calculated by dividing its operating income by its net sales revenue and then take logarithm. It measures how much profit the firm makes on one euro of sales. Thus, it is an appropriate indicator of the firm's ability to earn profits. Net income, total assets, operating income and net sales revenue are all gained from Compustat Global in WRDS of financial DataStream of Erasmus University Rotterdam.

3.4 Other relevant data

3.4.1 Data of boardsize and firmsize

Boardsize refers to the number of managers within the management board, while firmsize equals to log of total assets of the firm. Boardsize and firmsize are both treated as control variables when estimating the relationship between pay inequality and firm performance, to eliminate omitted variable bias when doing the test. Moreover, boardsize is regarded as explanatory variable when estimating the correlation between boardsize and firm performance, while firmsize is regarded as the control variable, either. The source of boardsize is the same as that of wage dispersion, which comes from annual reports of their corresponding firms. And firmsize is from Compustat Global in WRDS of financial DataStream of Erasmus University Rotterdam.

3.4.2 Data of year and industry

Besides, as the range of year is from 2007 to 2016. This paper has one fixed effect which is year fixed effect. Also, since all of the firms surveyed in this paper only have two industries which are FS and INDL, one dummy variable of industry called Financial_sector$_{i,t}$ is created in this paper. Financial_sector$_{i,t}$ equals to 1 if industry is "FS", and it equals 0 when industry is "INDL". The source of industry data is also from Compustat Global in WRDS of financial DataStream of Erasmus University Rotterdam.

4. Methodology

4.1 Ordinary Least Squares(OLS) model

In this thesis, I use two methods, one is the ordinary least squares(OLS) regression, the other is the two-stage least squares (2SLS). Both of them are panel data analysis.

OLS is a kind of linear least squares methodology to assess the unknown parameters which are in a linear regression model. It aims to minimize the differences' sum squares between the dependent variables. It is an efficient and effective way to test the correlation between dependent variable and independent variables. Fredrik (2007) uses OLS to test the relationship between firm-level pay inequality for white-collar employees and profits per worker. Dong, N. G. (2013) applies OLS regression to evaluate the relation between pay dispersion and operating margin. Hence, I use OLS to test the three hypotheses, and results will be shown in the next section.

However, there are some problems I need to consider when doing data analysis. Firstly, different firm characteristics which cannot be observed will cause omitted variable biases. For instance, progressive firms tend to have better corporate governance mechanisms which are different from mediocre firms (Adams & Ferreira, 2009). Therefore, adding industry fixed effect is a good way to solve the differences. However, because firms tested in this paper only have two industries which are FS industry and INDL industry, inserting a dummy variable of the industry called Financial_sector instead of the industry fixed effect may be more convenient and appropriate. Also, year fixed effect is added to diminish differences in global financial crisis circumstance during the time period used in this thesis. Overall, to test hypothesis 1, 2, and 3, I estimate following baseline equations, and specify this OLS model in detail in equation

(1), (2), (3), (4), (5) and (6).

$$Pm_{i,t}=\alpha+\beta*wdwmb_{i,t}+\rho*Boards_{i,t}+\lambda*Firms_{i,t}+\sigma*Financial\_sector_{i,t}+Year\_FE+\varepsilon_{i,t} \qquad (1)$$

$$Roa_{i,t}=\alpha+\beta*wdwmb_{i,t}+\rho*Boards_{i,t}+\lambda*Firms_{i,t}+\sigma*Financial\_sector_{i,t}+Year\_FE+\varepsilon_{i,t.} \qquad (2)$$

$$Pm_{i,t}=\alpha+\beta*wdbCae_{i,t}+\rho*Boards_{i,t}+\lambda*Firms_{i,t}+\sigma*Financial\_sector_{i,t}+Year\_FE+\varepsilon_{i,t.} \qquad (3)$$

$$Roa_{i,t}=\alpha+\beta*wdbCae_{i,t}+\rho*Boards_{i,t}+\lambda*Firms_{i,t}+\sigma*Financial\_sector_{i,t}+Year\_FE+\varepsilon_{i,t.} \qquad (4)$$

$$Pm_{i,t}=\alpha+\beta*Boards_{i,t}+\lambda*Firms_{i,t}+\rho*wdwmb_{i,t}+\tau*wdbCae_{i,t}+\sigma*Financial\_sector+Year\_FE+\varepsilon_{i,t.}$$

$$(5)$$

$$Roa_{i,t}=\alpha+\beta*Boards_{i,t}+\lambda*Firms_{i,t}+\rho*wdwmb_{i,t}+\tau*wdbCae_{i,t}+\sigma*Financial\_sector_{I,t}+Year\_FE+\varepsilon_{i,t.}$$

$$(6)$$

$Pm_{i,t}$ is logarithm of operating profit margin of the firm, $Roa_{i,t}$ is logarithm of return on assets of the firm, $Wdwmb_{i,t}$ is logarithm of wage dispersion between CEO and other managers within the management board, $wdbCae_{i,t}$ is logarithm of wage dispersion between CEO and other employees of the firm, $Boards_{i,t}$ is number of managers within the management board, $Firms_{i,t}$ is log of total assets of the firm, $Financial\_sector_{i,t}$ is variety of industry, equal to 1 if industry is FS industry, equal to 0 if industry is INDL industry, Year FE is year fixed effect, i stands for firm and t stands for year.

4.2 Two-stage Least Squares(2SLS) model

Nevertheless, there is one issue that OLS cannot solve: endogeneity. As there is no clear causality direction in our research objective, it is likely that high wage dispersion may bring better firm performance, however, good corporation performance may increase pay inequality within the firm. Hence, it is better to do an endogeneity test to examine whether including

endogenous variables in this test, if not, OLS is enough to examine the relationship. If endogeneity exists, to address this reverse causality, I apply one instrumental variable (IV) in a two-stage least squares (2SLS) regression to do the regression between pay differential and firm performance. IV is correlated with explanatory variable, but have no direct relationship with response variable, the only connection IV has with the dependent variable is through its relationship with the explanatory variable. And it aims to distinguish the unobserved relation between explanatory variable and response variable. Besides, 2SLS has two stages, in the first stage, I regress the explanatory variable on instrumental variable, and preserve the predicted value; in the second stage, I regress response variable on the predicted values from the first stage.

In this paper, there are two instrumental variables, one is CEO age, the other is CEO quality to test hypothesis 1 and 2. According to Gibbons & Murphy (1992), holding CEO's tenure constant, CEO's pay-performance sensitivity will increase with the growth of CEO's age, so that it can be concluded that CEO's age is correlated with wage dispersion. Besides, for the CEO quality, I define it as the ratio of CEO tenure to CEO age. As Gibbons & Murphy (1992) believe that a CEO with five-year tenure at age 65 is very possible to have diverse incentives, reputation and career concerns. Thus, I divide CEO tenure by CEO age, to represent CEO quality. Also, Gibbons & Murphy (1992) point that a 65-year-old CEO who has five-year-long tenure owns different equity ownership with a 50-year-old CEO who also have ten years of tenure. This can be inferred that CEO quality is related with CEO payment and also, wage dispersion. Additionally, Equations of 2SLS model are shown below, and details are also specified.

$$X_{it} = \alpha_0 + \alpha_1 C_a + \alpha_2 C_q + \varepsilon \tag{7}$$

$$Y_{it} = \beta_0 + \beta_1 X_{i,t} + \beta_2 \text{Boards}_{i,t} + \beta_3 \text{Firms}_{i,t} + \beta_4 \text{Financial\_sector}_{i,t} + \nu_i + \varepsilon_{i,t} \tag{8}$$

$X_{i,t}$ is logarithm of wage dispersion between CEO and other managers or logarithm of wage dispersion between CEO and other employees within the firm, $Y_{i,t}$ is logarithm of operating profit margin or logarithm of return on assets, $\text{Boards}_{i,t}$ is number of managers within the management board, $\text{Firms}_{i,t}$ is log of total assets of the firm, $\text{Financial\_sector}_{i,t}$ is dummy variable of industry's variety, equal to 1 if industry is FS industry, equal to 0 if industry is INDL industry, C_a is CEO age, C_q is CEO quality, ν_i is time fixed effect, i stands for firm and t stands for year.

5. Robustness check

5.1 Influence of wage dispersion with management board on firm performance by 2SLS model

After doing the regression, I derive a coefficient of 0.3012 between wage dispersion within management board and profit margin with a p-value of smaller than 0.01, meaning a 1% increase in pay inequality with management board will be followed with 0.3012% increase in profit margin. Similarly, the coefficient between wage dispersion within management board and return on assets is 0.2956, also with a p-value smaller than 0.01, showing a significant positive relation between wdwmb and return on assets. Just like OLS regression, wage dispersion between CEO and other managers within management board tested by 2sls methodology has a significantly positive relationship with firm performance. Table 6 below shows the results of this relationship test.

Variables	Log operating profit margin	Log return on Assets
	2SLS	2SLS
Log wdwmb	0.3012***	0.2956***
	(0.1842)	(0.2311)
Year fixed effects	Yes	Yes
Financial_sector	Yes	Yes
Firmsize	0.1653***	0.1437***
	(0.0621)	(0.7624)
Boardsize	0.8758	0.9214
	(0.0256)	(0.0312)
Constant	-4.6888***	-8.9036***
	(0.3691)	(0.616)
Observations	332	332
R-squared	0.6254	0.7024

Table 6 2SLS regressions on operating profit margin and return on assets. Standard Errors in parentheses.

Significance levels: *p<0.1 **p<0.05 ***p<0.01

5.2 Influence of wage dispersion between CEO and other employees on firm performance by 2SLS model

Results of wage dispersion between CEO and other employees and firm performance are similar with relationship between wdwmb and firm performance, showing that a coefficient of 0.4891 between wdbCae and return on assets with the p-value smaller than 0.01; and a coefficient of 0.29 between wdbCae and operating profit margin with the same p-value of 0.000<0.05, indicating a significant positive relationship between wdbCae and profit margin. Thus, wage dispersion between CEO and other employees has a positive relationship with firm performance. This result obtained by 2SLS is also consistent with hypothesis 2. Table 7 below presents the details of the results.

Variables	Log operating profit margin	Log return on Assets
	2SLS	2SLS
Log wdbCae	0.289***	0.4891***
	(0.0605)	(0.11)
Firmsize	0.0387	0.1722***
	(0.0434)	(0.7892)
Boardsize	0.0351***	0.0989***
	(0.0164)	(0.0298)
Year fixed effects	Yes	Yes
Financial_sector	Yes	Yes
Constant	-4.2622***	-7.759***
	(0.4219)	(0.7668)
Observations	332	332

R-squared	*0.6172*	*0.8357*

Table 7 2SLS regressions on operating profit margin and return on assets. Standard Errors in parentheses.

Significance levels: *p<0.1 **p<0.05 ***p<0.01

5.3 Problems about 2SLS model

Although 2SLS gets same results with OLS model about testing relationship between wage dispersion and firm performance. Instrumental variables used in the 2SLS regression may have some problems. I have proved our instrumental variables – CEO age and CEO quality have relationships with our explanatory variable – wage dispersion. However, there is no obvious evidence that CEO age and CEO quality have no direct relationship with the response variable – operating profit margin or return on assets. From another perspective, older CEOs may have more experience to avoid risky projects which will reduce the overall risk of the company, in other words, older CEOs may create more profits for the firm because of their experience. Thus, instrumental variables chosen in the 2SLS model may be not perfect. However, it is also difficult to find other more suitable IVs as when I find one IV which may seem perfect at that time, later on I always find some argument that this IV may be directly related with the response variable. Thus, finding a right IV is really challenging, in this paper, there is no perfect IV to run the 2SLS model. Overall, although OLS may ignore endogeneity problem, compared to 2SLS model which may choose inappropriate IVs, OLS is more suitable to test the research objectives, as it is likely that equations used in OLS model do not include endogenous variables.

6. Results

6.1 Summary statistics

In this thesis, I use data of German firms to investigate relationship between wage dispersion and firm performance. Besides, I examine the correlation between number of managers within management board and firm performance. All of results shown in this section are used by OLS regression. These results are regarded as main results of this thesis. Data set used in this paper is from 2007 to 2016. There are 332 firm-year observations in total, including 41 German corporations. There are many variables used to test the hypotheses proposed in this thesis, table 2 below shows the descriptive statistics of the chosen company and board characteristics. Besides, table 1 provides details about variable description, which may be an explanation of the following tables.

Variable name	*Definition*
Log pm	*Logarithm of profit margin*
Log roa	*Logarithm of return on total assets*
Year	*Firm year*
Log wdwmb	*Logarithm of wage dispersion within management board*
Log wdbCae	*Logarithm of wage dispersion between CEO and employees*
Boardsize	*Number of managers within the management board*
Firmsize	*Log of total assets*
Financial_sector	*Variety of industry, equal to 1 if industry is "FS", if not, equals 0*

Table 1 Variable definitions

Variables	Observations	Mean	St. Dev.	Min.	Max.
Log wdwmb	332	0.67166	0.30588	0.13748	2.03542
Log wdbCae	332	4.30486	1.4337	1.5891	9.5433
Log Profit margin	332	-2.5925	0.74436	-6.3251	-1.1988
Log Return on assets	332	-3.7032	1.41368	-9.272	-1.7896
boardsize	332	5.4457	2.1834	2	13
firmsize	332	10.01526	0.96633	7.917	12.3429
Financial_sector	332	0.13253	0.33671	0	1

Table 2 Descriptive values of key variables

6.2 Influence of wage dispersion within the management board on Operating Profit Margin and Return on Assets

This section is the discussion about results of hypothesis 1a and 1b. As mentioned earlier, OLS results will be applied and regarded main results of this thesis.

Based on OLS regression on profit margin and return on assets, I obtain results that wage dispersion within the management board has a significant positive effect on both operating profit margin and return on assets. Firmsize and boardsize are added to both regression to control firm and board characteristics as control variables. Besides, industry variety is added as Financial_sector as a dummy variable and year fixed effect is also added to minimize differences in different industries and in different years. The results are shown below in table 3. For the regression between pm and wdwmb, it leads to a significant p-value of 0.000 and a statistic of coefficient of 1.851, meaning that 1% increase in wdwmb leads to 1.851% increase

in operating profit margin. For the regression between return on assets and wdwmb, it also leads to a significant p-value of 0.000 and a statistic of coefficient of 3.467, meaning that 1% increase in wdwmb leads to 3.467% increase in return on assets. This is consistent with the hypothesis 1.

Variables	Log operating profit margin	Log return on Assets
	OLS	OLS
Log wdwmb	1.851***	3.467***
	(0.991)	(0.2191)
Boardsize	0.0336***	0.0932***
	(0.1602)	(0.2922)
Firmsize	0.0581	0.2008***
	(0.3937)	(0.0709)
Financial_sector	Yes	Yes
Year Fixed Effects	Yes	Yes
Constant	-4.5267***	-8.4793***
	(0.0397)	(0.6613)
Observations	332	332
R-squared	0.6314	0.6725

Table 3 OLS regressions on operating profit margin and return on assets. Standard Errors in parentheses.

Significance levels: *p<0.1 **p<0.05 ***p<0.01

6.3 Influence of wage dispersion between CEO and employees on Operating Profit Margin and Return on Assets

Similarly, I also use OLS model to test the relationship to test relationship between wdbCae and firm performance. Control variables, dummy variable and fixed effect are the same with regression between wdwmb and firm performance.

According to this regression, I observe that wage dispersion between CEO and other

employees is positively related with operating profit margin and return on assets. The

coefficient between wdbCae and profit margin is 0.4129 with a p-value of 0. For the regression

on return on assets, the result is also significant because the p-value equals to 0.000. The

coefficient of the selected variables is 0.7918. This result conforms to hypothesis 2 I propose

before. Details about results of this regression is shown in table 4 below.

Variables	Log operating profit margin	Log return on Assets
	OLS	OLS
Log wdbCae	0.4129***	0.7198***
	(0.6512)	(0.351)
Boardsize	0.0245***	0.1243***
	(0.2162)	(0.1524)
Firmsize	0.0831	0.1382***
	(0.2131)	(0.0579)
Financial_sector	Yes	Yes
Fixed Effects	Yes	Yes
Constant	-4.2572***	-8.5923***
	(0.0277)	(0.5445)
Observations	332	332
R-squared	0.6489	0.6031

Table 4 OLS regressions on operating profit margin and return on assets. Standard Errors in parentheses. Significance levels: *p<0.1 **p<0.05 ***p<0.01

6.4 Influence of Boardsize on Operating Profit Margin and Return on Assets

Besides wage dispersion, boardsize is considered to be related with firm performance. In

this part, I estimate the relationship between boardsize and profit margin and also the

relationship between boardsize and roa. The regression on testing the relationship between

boardsize and operating profit margin indicates a coefficient of 0.0284 which means that one

more board member will be associated with 2.8% increase in profit margin. Moreover, for regression between boardsize and return on assets, coefficient between observed variables is 0.0794, showing that one unit increase in boardsize will lead to 79.4% increase in return on assets. This result is significant at the 1% level because p-value equals to 0.002. However, as it shows positive effect between boardsize and firm performance, it contradicts hypothesis 3 which indicates a negative relationship between number of board members and firm performance. Results obtained by this regression are shown in table 5.

Variables	Log operating profit margin	Log return on Assets
	OLS	OLS
Boardsize	0.0284	0.7942***
	(0.1532)	(0.0255)
Year fixed effects	Yes	Yes
Financial_sector	Yes	Yes
Firmsize	0.0183	0.0966
	(0.041)	(0.6844)
Log wdwmb	-0.157	-1.7884***
	(0.342)	(0.5711)
Log wdbCae	0.4458***	1.1668***
	(0.0738)	(0.1232)
Constant	-4.6888***	-8.9036***
	(0.3691)	(0.616)
Observations	332	332
R-squared	0.6694	0.7447

Table 5 OLS regressions on operating profit margin and return on assets. Standard Errors in parentheses. Significance levels: *p<0.1 **p<0.05 ***p<0.01

7. Conclusion and Discussion

This paper aims to study the relationship between pay inequality within the firm and firm performance. Besides, I also estimate the relationship between boardsize and firm performance. Data used in this paper all come from WRDS and annual reports of their corresponding firms. Besides, I use 332 firm-year observations of German companies during the periods of 2007-2016 as our final sample which removes all outliers and missing values to estimate research objective, then I use Stata to test research question, after handling data which meet all requirements of OLS model, I use the OLS model to test the hypotheses I propose before, To represent pay inequality, I use two variables-wage dispersion between CEO and other managers within the management board; wage dispersion between CEO and employees of the firm. Firm performance is denoted by operating profit margin and return on assets. Boardsize refers to number of managers within the management board. When testing relation between wage dispersion and firm performance, I add boardsize and firmsize as our control variables, add year fixed effect to eliminate differences in different years, especially during the period of global financial crisis. I also include a dummy variable of industry as there is only two industries in our data set.

By using OLS model to test these relationship, I obtain several results, firstly, wage dispersion between CEO and other managers within the management board has a significant positive influence on both operating profit margin and return on assets, this result is concordant with hypothesis1; secondly, wage dispersion between CEO and employees is also positively correlated with operating profit margin and return on assets, which are consistent with hypothesis 2; thirdly, number of managers within the management board is positively related

with return on assets, but I cannot get any significant result from the estimation between boardsize and operating profit margin. Overall, it can be concluded that boardsize is positively related with firm performance, which is the opposite of hypothesis 3.

According to this thesis, there are some corporate governance recommendations which may be useful in managing German companies. To improve firm performance, company can increase pay inequality within the firm by pay-performance related payment which may motivate all of the employees in the firm to contribute their effort and get higher payoff. Besides, as it is proved that high wage dispersion is beneficial to firm performance, argument about whether CEO is overpaid nowadays may be clear that CEO's compensation is reasonable and promotable. Also, payment method is important. Paying CEOs though stock options or restricted stock can motivate CEOs to create more earnings for the firm and retain right CEOs, while paying CEO with annual bonuses sometimes may make CEOs postpone earnings and withhold effort, because there is a "bonus cap" that restrict CEOs' income. Additionally, although contradicted by many previous literatures, company can broaden the management board with experts in different aspects, such as managers with finance and accounting skills, managers with company's business skills, directors with technology skills and so on, which may improve the firm's profitability.

8. Limitation

To make the results of this paper more convincing, I add different control variables, fixed effect, dummy variable, and try to expand the final data set as large as I can. Also, OLS is an efficient model which is used to test the hypotheses in this paper.

However, there are still some limitations. Because of imperfection of instrumental variables used in this paper, results of 2SLS regression are not considered as main results of this thesis. However, OLS regression may exist endogeneity problem when testing the relationship between wage dispersion and firm performance, causing the estimator may not be completely accurate. As it is verified that larger wage dispersion within the firm will bring higher performance, it is also possible that companies with good firm performance will pay CEOs more as reward of their excellent performance for their job.

Except limitation of the methodology, our results may be potentially biased, because of missing years and outliers of the data set. Also, after removing all unrelated or merging all related data, there are 332 firm-year observations left. As the compensation of CEO and managers need to be collected manually, the observational sample should not be considered as small, but it is not a big sample, either. Besides, I include two control variables(boardsize and firmsize) which include firm and board characteristics to eliminate omitted variable bias. There may be some other variables which are also indicators of firm or board traits that I have not added as control variables, for example, percentage of female of the board, so maybe results of this thesis can only be a reference, but not perfectly convincing for companies to make decisions.

Additionally, the third result gained in this thesis which points out that boardsize is positively related with firm performance is not consistent with the results of many previous

prominent literatures, such as: Yermack (1996), Hermalin & Weisbach (2003), and Cheng, S.,

Evans III, J., & Nagarajan N. (2007). Thus, it is possible that there may exist some bias when

doing the regression between boardsize and firm performance.

9. Reference

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