The Effects of Monetary Reward Distribution on Company Performance

- Introducing Wage Dispersion Volatility

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Abstract

This paper aims to explore the effects of monetary reward distribution within the company on company performance. We introduce a measure called wage distribution volatility (WDV), that captures how the pay gap between the CEO and other employees varies over time. Linear regression is performed for both WDV against company alpha and relative standard deviation of CEO salary (RSDC) against company alpha for a seven year period for companies listed on the Stockholm Stock Exchange during 2010-2016. For companies with alpha $\in \{-2, 2\}$ and WDV <10 we find a significant negative correlation between WDV and performance (adjusted $R^2 = 0.191$, $p < 0.01$), and even stronger for companies with <1000 employees (adjusted $R^2 = 0.275$, $p < 0.01$). We also create a binary classifier that is able to predict the sign of alpha with 78% accuracy, given the constraints. However, most, if not all, of the effect stems from the RSDC alone. This study suggests that Swedish companies should keep the total CEO salary relatively constant, especially if the company has less than 1000 employees, and adopt the culture behind such a wage composition. We suggest further research to investigate whether WDV has an additional effect compared to RSDC or not, and to expand to different countries.

Keywords: WDV, CEO salary, wage dispersion, pay gap

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1 Introduction

1.1 Background

CEO remuneration is an invariably topical subject often discussed in media and in the academic literature. The trigger for debate is often increases of CEO salaries due to bonus programs. The idea of variable compensation is that the CEO is motivated to work more in the shareholder's interests by compensation contracts that are tied to stock price changes. Motivating employees at lower levels with such contracts is however not common. This may evidently be because employees at lower levels have even less impact on the stock price than the CEO.

In the academia total CEO remuneration and different remuneration components are often linked to company performance. Evidence of CEO remuneration tied to company performance is inconclusive. Instead, research suggests that intrinsic motivation outperforms extrinsic motivation for non-routine tasks and that contingent pay may even impede performance for creative tasks [1]. Company performance is a wide topic and can be measured in numerous ways. E.g. Fahlenbrach and Stulz (2010) measures performance as resistance to financial crisis and finds a negative relationship to CEO bonuses [2] and Smirnova and Zavertiaeva finds inconclusive evidence when measuring performance as Sharpe ratio and ROA [3].

There are also numerous studies investigating the effect of monetary compensation for other employees. For example, as early as 1960, McGregor critically discusses variable pay. He states that even though the logic for variable pay is evident, issues such as prioritizing approval of fellow colleagues and distrust in the incentive system is prevailing [6]. Kohn (1995) further discusses the effects of variable pay on motivation, and states a number of disadvantages [5].

The so called CEO pay gap is a comparison of CEO pay and other manager pays. How such a gap influences company performance incorporates other mechanisms. Henderson (2017) looks at the issue from both a behavioral and economical view. The behavioural view suggests that because more equal pay promotes collaboration, greater coordination needs encourage smaller pay gaps, and the combination of greater needs and smaller gaps enhances firm performance. The economic view implies the opposite because larger gaps create tournament-like incentives that address monitoring problems associated with joint decisions [4]. An extension of the pay gap would be to study the pay differences between employees at different levels than just top management. Further, it

may be interesting to study this notion as a dynamic measure, incorporating fluctuations of the pay gap in addition to size. To the knowledge of the authors, this has not been studied in detail before.

1.2 Purpose

This report introduces a new perspective on monetary compensation by introducing the concept of wage distribution volatility (WDV). The WDV is a measure of how much the relative pay difference between the CEO and other employees fluctuates over time. A low WDV indicates that all employees are rewarded and punished similarly in good and bad times. A high WDV indicates that either the CEO or the other employees have a highly variable salary, or that both have a highly variable salary that is uncorrelated with each other. The report investigates how this amount of "fairness" within a company affects its performance. The concept of pay gap volatility amounts for interesting mechanisms not covered by looking at each group separately, or just looking at the size of the pay gap.

Section 2 describes relevant research related to this topic and introduces possible mechanisms affecting the results. Section 3 and 4 describe the data and methods, respectively. The method is centered around a linear regression model, described in section 4.4, but a binary classifier in the form of a support vector machine is also implemented. Section 5 acknowledges potential biases of the results. The results and corresponding discussion is presented in section 6. The report concludes in section 7, including recommendations for future research.

2 Extended Background and Mechanisms

WDV is based on monetary data and captures extrinsic motivation in the form of monetary compensation. However, the definition of the WDV is such that it may serve as a measure of fairness within the company. Intrinsic motivation is therefore a highly important aspect affecting the outcome of our study, in addition to extrinsic motivators. Even though our aim is not to draw conclusions regarding drivers and motivators for employees besides the pure monetary aspect, extrinsic and intrinsic motivation is interlinked in a complex relationship, and many of the mechanisms behind WDV as a predictor for performance are intrinsic. Kohn (1995) motivates a number of factors pointing towards a complicated relationship between intrinsic and extrinsic motivation, e.g. 1) Employees may feel punished if an expected reward is not given. 2) Effective team work is undermined by reward schemes that create competition. 3) Rewards pulls the focus away from root-causes of problems, towards temporary solutions. 4) Monetary incentives weakens intrinsic motivation by shifting focus to the amount of pay from the work itself [5]. While Kohn and many other authors are skeptical towards reward programs (see e.g. McGregor (1960) [6]) the obvious logic of reward programs is that employees work harder for more money. It also has to be stated once again that WDV measures the change of the pay gap over time, which captures how evenly distributed the rewards are within the company, expressing a sense of fairness. The mechanisms behind the relationship between WDV and performance thus vary in nature. In this section, a few of the most important mechanisms are presented.

2.1 The Macroeconomic Aspects in Sweden

Sweden is, according to Statista [7], the second most unionized country in the world at 67 percent of total employees. The effects of unionization are according to Lemieux (1998) increased average wages as well as compressed returns to observable measures of skill [8]. This means that the variance of employee salary is decreased when introducing unions. Especially, dramatically lowering the employee wage in bad times does not seem to be common in a highly unionized country. Lemieux uses data from Canada, which is the sixth most unionized country. This suggests that a high WDV in Sweden is mostly due to changes in CEO salary, and less because of a variable component in the salaries for other employees. This does not however exclude the possibility that a low WDV may coexist with a highly variable CEO salary, if the company policy is such that all employees

gets rewarded in good times. This may still prove to be a factor worth investigating, making the WDV contributing more information than just using the volatility of the CEO salary.

Another factor regarding unionization is that it may contribute to employees striving more towards overall pay-equality and 'fairness' when it comes to compensation. Swedish companies might with this reasoning be more prone to applying a wage distribution that contributes to a lower WDV than other countries. If there is a correlation between 'fairness' and performance, this could imply that Swedish workers, and employers for that matter, value the collective good and promotes these ideas through a fair distribution of earnings, keeping employees happy and motivated. Sweden would therefore have a lower WDV than most other countries. Former king Gustaf VI Adolfs motto: Plikten framför allt - Duty above all, might still be very much relevant in today's Sweden if this is the case.

2.2 Profit Sharing and the Free Rider Problem

A classic dilemma concerning profit sharing is the free rider problem. In big firms, where individual performance is hard, perhaps even impossible, to measure, rewarding employees as groups for good performance might be the only feasible compensation plan a manager can design. The idea of rewarding every employee for a job well done is generous and would be the most natural way of compensating the employees, in the ideal world that is. The problem arise when the most talented employees feel mistreated and overlooked by management, and even though they get a piece of the profit-pie, they are not content, due to the fact that the rest of his or her co-workers, who might not deserve this reward as much, also de facto gets rewarded. A generous compensation plan implemented in this way might rather create discontent among the employees that the company most want to retain. A Tournament model might be more fitting, as hard working employees will strive toward a promotion, rather than sharing at their current level. [9]

The implication on our study is that larger firms with more employees who have a harder task monitoring every worker will probably not contribute to a possible correlation as much as smaller firms. Large firms may by this reasoning have a higher WDV than smaller firms. Smaller firms on the other hand, where individual effort is more easily monitored, should naturally in more cases have a profit-sharing program in place.

2.3 Productivity and Motivation

High productivity should not be perceived as the only factor affecting performance, but productivity is nonetheless important for any company. In a study by Pfeffer and Langton (1993) [10], high wage dispersion within academic departments have shown clear negative effects on individual faculty members satisfaction and research productivity. The results also point out that the negative effects of wage dispersion are lower at private universities, when salaries are less likely to be known. This shows that one's relative standing in the wage hierarchy has a negative effect, if that information is disclosed to the individual. The authors continue to discuss the effects on performance and concludes that pay-for-performance is not always the case in many firms. The individual salary level may not be solely based on performance but on other factors as well, such as favoritism. These results tell us that low wage dispersion may be more important in companies where salaries are more likely to be known, such as smaller companies, where relations between management and employees may be more intimate. The findings in the article also have implications on wage dispersion and performance, as compensation may not always be a result of satisfactory individual performance. Further, Levine (1989) [13] argues that a more compressed wage structure increases productivity.

Van Herpen et. al. [11] discuss how reciprocity and fairness is important in employee motivation. In order to maximize incentives, "the surplus, created by the agency contract should be fairly divided". He continues to argue that for risk averse agents, transparency plays an important role, as a transparent system communicates the rules associated with the contract, creating better understanding and a higher level of support.

This theory suggests that the effect of wage dispersion on performance have filters that make a relationship harder to deduce. It depends e.g. on the level transparency and the personalities of individuals in the firm. While the theory covers wage dispersion and not WDV, it is close at hand to carry these effects over to WDV as well.

2.4 Tournament Theory

Lazear and Rosen (1981) [12] invents tournament theory to analyze the effect of wages on incentives. They show that when workers are risk neutral, wages based upon rank induce the same efficient allocation of resources as an incentive reward scheme based on individual output levels. This suggests that some amount of WDV, based on rewards being biased towards higher hierarchical levels, may not be negative for performance.

The conclusion of previous research seems to be that some wage dispersion has a positive effect on firm performance. This is further discussed by Heyman (2002) [14]. He states that there are conflicting views as to how more compressed wage structures affect firm performance and he also uses the tournament model to show how "the prize" of a promotion is used as an incentive when monitoring of each workers performance is costly. Heyman's conclusion is that there is a positive relationship between wage dispersion and firm performance for white-collar-workers between 1991 and 1995. This is however not straightforward to assume is valid for WDV, in addition to wage distribution. Others argue that individual effort as well as cooperation is reduced when the wage distribution is perceived to be unfair (Akerlof and Yellen, 1990) [15]. A high WDV is intuitively unfair, which is arguably the reason for the attention in media, but since the studies do not explicitly mention profit sharing or some other sense of WDV, we treat conclusions about WDV with precaution.

2.5 Preferences Among Graduates

Lyons et al. (2010) [16] present that millennials in Canada found that the most important factor of a job was rapid advancement and pay rises with the average expectation for a promotion within 15 months. However, 71 percent would accept a less-than-ideal first job. They show that graduates in Canada put more emphasis on individualistic factors and a nurturing environment than a high initial salary. They do however, expect rapid advancement and also the opportunity to develop new skills. The results support that a high wage distribution might not be perceived as something bad, but rather that millennials see this as an opportunity. As a clear majority are willing to start at a less-than-ideal firm, it also supports a higher wage distribution. It might also be the case that with ambition to make more money in the future, comes the realization and the understanding that one must start with a low salary but that the promise of high return in the future attracts graduates. The results presented by Lyons is consistent with previous research by Quinn Trank et. al (2002) [17]. They conclude that high achieving graduates put great emphasis on challenging and rewarding work, opportunities for training and promotion opportunities. This group also show tendencies toward favoring pay-schemes based on individual rather than group performance, which is also consistent with Lyon's conclusion, that millennials put greater emphasis on individualistic factors. No evidence suggest however, that high achievers are willing to start at a less-than-ideal-firm and work their way up. What all graduates seem to favour, is individualistic treatment and

the prospect of rapid advancement.

In firms that are abundant of these employees, rewarding and punishing the higher levels relatively more than the lower levels may be an attractive feature. This is further evidence on that the relationship between WDV and performance depends on which kind of employees the company has, and it may be a point to test for differences in e.g. industry.

2.6 Human Capital

Performance, equity and monetary based incentives have in the past been more of a privilege for top management rather than for lower level employees. In recent years however, more companies have adopted company wide incentive programs. Decision-making is performed on all levels in most firms and aligning all employees with the shareholders ambition have therefore become more important (Frye, 2004) [18]. Frye shows a significant positive relation between Equity-Based-Compensation for employees and firm performance, indicating that when firms become more human capital intensive, compensation plans become more important for retaining employees.

3 Data

Compensation for the CEO, the total compensation for all employees, and the number of employees were manually collected from annual reports for 129 companies registered on Stockholm Stock Exchange in August 2014. This corresponds to 49 % of the listed companies. The companies are divided into ten industries. These industries can be seen in e.g. [19].

Shareholder return, $R_{j,t}$, was collected from Yahoo Finance as adjusted returns (adjusted for both dividends and splits). Weekly values of the expected market return, $E(Rm_t)$, and the risk free rate, Rf_t, were collected from the Swedish House of Finance data center.

All data were collected for the seven year period 2010-2016. From the annual reports 871 instances of salary and employee data was collected. 91 of the 129 companies had complete data for the whole period (also considering that some companies did not have complete stock data on Yahoo) and were used in the model, meaning that 637 instances of salary and employee data were used in the end. We would like to stress that even though each of the 91 companies exist seven times in the data, each company only exists as one data point in the end. This is because we always calculate the volatility or mean of a certain measure over the whole period. For example, each company only has one WDV and one alpha. This means that we cannot and should not consider fixed effects.

As it was discovered during initial data analysis that firms with more than about 1000 employees did not produce any pattern, the data is slightly biased towards companies with less than 1000 employees. Furthermore, the choice was also biased towards firms that provided annual reports in Swedish with well-structured information for all collected data. Other than this, the sample can still not be considered randomized since no sophisticated sampling method was implemented, even if the samples were picked in a random fashion.

The final analysis consists of companies with less than 1000 employees, WDV below 10 and alpha between -2 and 2. With these restrictions, 39 companies were eligible.

The salary data collection was possible since Swedish corporate law (ÅRL, 5 Kap, 40 §) requires all listed companies to disclose information about the remuneration of top managers including the CEO in their annual reports.

4 Methods

4.1 The Ideal Experiment: Enabling better Comparison Between Firms

A comparison between all firms regardless of characteristics is not ideal. In the ideal world, firms with different WDVs would be compared only to firms with all other parameters fixed. This is necessary for determining causation and not just correlation.

One group of parameters is those affecting performance. Hawawini et al. (2003) demonstrated that variance in firm performance is more attributable to industry-level factors rather than firm-level factors for firms in the US [24]. However, McNamara et al. (2005) take issue with their methodology and demonstrate that this is not the case [25]. Matyjas (2014) determines that the industry effects have no significance for performance, and displays some evidence for some effect from firm specific factors for Polish companies [26]. Furman (2000) investigates four OECD countries and finds that firm-specific factors are predominantly determining performance, even though industry and corporate parent effects are also important [27]. Duhaime and Stimpert (1990) summarize that industry, extent of diversification, economical, as well as organizational factors influence performance [28]. Using alpha as performance measure incorporates economical effects and also the industry effect of leverage. While it is unclear how much industry affects the results, industry differences will be tested for in the analysis.

Discussions about firm specific factors are often revolving around financial measures or ownerships (see e.g. Chandrapala and Knápková (2013) and Barbosa and Louri (2005) [29] [30]). However, the firm specific parameters we are most concerned about is the internal motivating factors for the employees at each company, which will affect how the company responds to a certain WDV. These may in fact also be seen at industry-level. One mechanism behind this is explained in section 2.5. Additionally, it would not be surprising e.g. if employees at companies in the financial sector may be more accepting and motivated by large executive bonuses, than employees in tech-firms. There probably exist a multitude of firm-specific factors to separate by, however the only such factor used in this report is size expressed as the number of employees. Size may be of significant importance as discussed in section 2.2. Only using size as a separating firm-specific factor may be a significant deviation from the ideal experiment.

As no sophisticated sampling method was implemented, the sample is not random-

ized appropriately. However, this effect is mitigated by the fact that our initial sample of 129 companies covers 49 % of the population (the number of companies registered on the Stockholm Stock Exchange in 2014 was 265). Clustering of standard errors for a small sample would oftentimes be necessary, but there are arguments against the need for clustering in this context. Abadie et al. argue that clustering is either a sampling design or experimental design issue [20]. If the sample is a subset of clusters, there is a sampling design issue. However, our sample includes all industries and most likely all other relevant clustering dimensions (to be precise, when applying all boundaries, the industries utilities, telecommunications, and oil & gas are not prevalent, but it can be reasonably argued that the number of these companies would not be more than very few even if including the whole population). This is due to the large size of our sample. If the assignment is correlated within the clusters, there is an experimental design issue. Because our treatment is assigned at the individual level (and we do not have multiple time periods) this does not either apply to our data. Thus, we find support for not implementing clustering of standard errors in this report, since we do not have a significant sampling or experimental design issue. Clustering is therefore not implemented.

4.2 Measuring Performance

There are many metrics for judging firm performance (see e.g. Al-Matari et al. (2014) for a review of many accounting and market based performance dimensions [21]). Bacidore et al. (1997) discuss the operating versus trading-based performance. They state that shareholders are interested in the abnormal returns, which is the excess of what one would expect to earn for a company in the particular systematic risk class. A positive abnormal return means that the shareholder has earned more than the risk-adjusted cost of capital. A negative abnormal return means inadequate compensation for risk. [22]

The abnormal stock returns is measured by alpha. The alpha for firm i in time period t is defined as the shareholder return, $R_{i,t}$, minus the expected shareholder return, $E(R_{i,t})$.

$$\alpha_{j,t} = R_{i,t} - E(R_{i,t}) \tag{1}$$

$E(R_{i,t})$ is calculated using the capital asset pricing model (CAPM), which states that

$$E(R_{i,t}) = Rf_t + \beta_i[E(Rm_t) - Rf_t], \tag{2}$$

where Rf_t is the risk free rate in period t, $E(Rm_t)$ is the expected market return in

period t, and β_i is the sensitivity of the expected excess asset returns to the expected excess market returns. β_i is a measure of the firm's systematic risk. It is calculated in this report for every firm i as

$$\frac{Cov(R_{i,t}, Rm_t)}{Var(Rm_t)} \tag{3}$$

The problem with alpha is that shareholder wealth creation need not be the same as firm performance. In the long run, the alpha and any other performance should converge, but they are not generally the same in a one-year period [22]. The company may be "cooking the books" or implementing other methods for short-term gains affecting the stock price. However, since we aggregate the performance for a seven year period, this problem is diminished. If a company has a positive alpha in total during this period, it has arguably performed well. With regard to the seven year period, we therefore suggest that alpha is an appropriate measure for company performance.

4.3 Choosing Independent Variables

4.3.1 Wage Dispersion Volatility

The point of this study is to compare how WDV affects firm performance. The WDV is a measure of how much the relative pay difference fluctuates over years. A high WDV is caused by a highly variable salary of either the CEO or of the other employees, or that both is variable with different performance metrics in the foundation. A low WDV means that the salaries for the CEO and the other employees fluctuates together in a correlated manner, or that none of the salaries fluctuates significantly at all.

If $\mathbf{C}$ and $\mathbf{A}$ are vectors with the CEO salary and average employee salary for every year respectively, the WDV is defined as

$$10000\frac{\sqrt{Var(\mathbf{C}/\mathbf{A})}}{Mean(\mathbf{C})} \tag{4}$$

The WDV is thus adjusted for the size of the CEO wage in order to eliminate the size dependence. It is multiplied by 10000 in order to obtain more convenient numbers. $\mathbf{C}$ and $\mathbf{A}$ include seven data points for every company, and the result is one WDV value for every company.

An improvement would be to collect remuneration data for all executives in addition to the CEO. This would have made the possibility of a concept closer to the Gini

coefficient possible. The Gini coefficient is an economical measure of the inequality, for example in income distribution, built on the Lorenz curve. Including welfare services, Sweden has the lowest Gini coefficient in the world [23]. In order to save time however, we assume that a certain CEO salary either suggests a certain philosophy for other executives, or that the CEO salary on its own is enough for other employees to feel the effect.

4.3.2 Relative Standard Deviation of CEO Salary

The relative standard deviation of CEO salary (RSDC) may capture most of WDV. This may be because $\mathbf{C}$ is significantly more varying than $\mathbf{A}$, as motivated in section 2. This motivates an investigation of RSDC against alpha, as well as a multiple regression with RSDC together with WDV against alpha. We define RSDC as

$$\frac{\sqrt{Var(\mathbf{C})}}{Mean(\mathbf{C})} \tag{5}$$

4.3.3 CEO Salary

Finally, the size of the CEO salary is analyzed. Since the WDV and RSDC is adjusted for the size of CEO salary, it may be interesting to see the effect of CEO salary as a complement. The CEO salary is the vector $\mathbf{C}$, and the variable used will be

$$Mean(\mathbf{C}) \tag{6}$$

4.4 Regression Model

Linear regression was implemented in the programming language R. The assumptions for linear regression are 1) that the relationship is linear, 2) That there is no auto-correlation between residuals, 3) Homoscedasticity, 4) Multivariate normality (univariate in our case) and 5) No or little multicollinearity (not relevant when having only one regressor). As only one independent variable is used for the prediction, it is possible to see the validity of the assumptions for the linear regression directly in the plot. Especially the linearity and homoscedasticity is straightforward to see in our plots. We will plot the residuals of the model as well as the Q-Q plot in order to demonstrate the auto-correlation and normality assumptions explicitly.

Alpha was the target in all experiments. The first analysis included all data with

WDV as the predictor. Then, the selection was restricted to companies with less than 1000 employees. Further, the selection was limited to companies with alphas between -2 and 2, as well as a WDV below 10.

The equation for the regression model is the following.

$$\mathbf{y} = \beta_0 + \beta_1 \mathbf{x} + \epsilon \tag{7}$$

$\mathbf{y}$ is a vector of the alphas for every company and $\mathbf{x}$ is a vector of observed values in the regressor (predictor). β_0 is the intercept, β_1 a parameter interpreted as the slope, and ϵ the error term.

The predictor $\mathbf{x}$ is the WDV for every company in with the three different data selections described above. Additionally, RSDC and the mean of CEO salary is used as predictors in separate regressions using equation (7). In total, we perform five regressions using this model with different predictors $\mathbf{x}$. Three using WDV (4), one using RSDC (5), and one using the mean of CEO salary (6).

A multiple regression with WDV and RSDC does not fulfill the multicollinearity condition. The covariance between these two are 0.67. Figure 11 in the appendix displays this covariance.

4.5 Binary Classifier

We use a binary classifier in order to further investigate how the WDV serves as a predictor for success. The classifier also visualizes the results in an alternative way. A support vector machine (SVM) serves this purpose well. The boundary of a support vector machine is easily controlled through setting the kernel and adjusting the slack parameter C. The kernel specifies the constraint on the boundary, and C sets the relative importance of avoiding slack versus getting a wider margin. We used a linear kernel in order not to overfit. We used a wide margin of $C = 10$ since our data undoubtedly contains a lot of information not accounted for. The SVM originally has low bias and high variance but increasing the slack lowers the variance and increases the bias. While a much higher variance than that of the linear regression surely leads to overfitting, a slightly higher variance may capture a pattern not seen in the linear model. The SVM was generated in R without any further modifications.

In order to test the prediction accuracy of the SVM, the data will be split into 75% training data and 25% test data.

5 Potential Biases in the Study

Different firms use different performance measures as basis for their respective reward programs. Our predictor is based on internal comparison of wages within each company, and does not take into account factors that may affect how the employees at each firm react to certain WDVs. Discriminating only by size and industry does probably leave a significant amount unaccounted for.

Another problem with the predictor is its use of all employees no matter the company structure. Additionally, the underlying data is compiled of salaries from the whole companies, as groups. Companies have low wage employees in developing countries to a varying extent, entirely disconnected from the work environment in Sweden and other Western countries. These employees will arguably not expect to be rewarded differently depending on the state of the company, and have little information about other parts of the company, if any information at all. Comparison of companies with different number of employees in developing countries is therefore fallacious. Figure 12 in the appendix shows two deceivingly similar companies in the same industry, where one of them has a third of the workforce in Sri Lanka.

Change of CEO and the associated severance pay may distort the results. A change of CEO usually means a significantly higher total salary for the year because of extra remuneration for both the new and especially the prior CEO. As WDV is based on total CEO salary, this problem is not avoided. However, the extra total CEO remuneration may also be a factor that we want to capture. Extensive severance pay to the CEO is preferably captured by the WDV. The problem is that the number of changes over the seven year period varies for the firms, which provides an unfair comparison.

There is also the issue of policy changes within the firm for CEO remuneration. There may be cases where the CEO receives a permanent raise or cut that may be in line with the essence of a low WDV, even though the WDV inevitably is high.

We do not consider many of the factors that may affect firm performance and at the same time might be correlated with our predictor. For example, it could be the case that foreign ownership leads to lower performance and higher variable CEO salary at the same time. The meaningful relationship would in this case be foreign ownership tied to alpha, instead of WDV tied to alpha. Furthermore, firm performance may be the cause of a highly variable CEO or other employee salary. Perhaps companies that do worse have to make wage cuts in response, increasing WDV as an effect of poor

performance. We cannot exclude that there are unobserved variables or any other reason causing endogeneity, which means that any correlation found in this report should not be taken for granted to be a causal relationship in the desired direction.

Finally, our method for exclusion of outliers is very basic. For alpha, we judge that a firm with less than -2 or more than 2, is delivering too abnormal returns to be part of the study, since a high absolute alpha means that something specific outweighs all other factors abnormally. For WDV, we discovered that most values is below 10, and that firms with WDV above 10 had unusual characteristics in some sense, e.g. numerous CEO replacements. The results depend strongly on where the lines are drawn. This is for example seen in the different results of the previously mentioned Hawawini et al. [24] and McNamara et al [25].

6 Results

6.1 Linear Regression

When using all data, we find no correlation between WDV and alpha, arguably due to outliers. This is seen in figure 1. Figure 1 serves as the motivation for limiting WDV and alpha. However, it is also seen that our limits for alpha and WDV is decided rather arbitrarily.

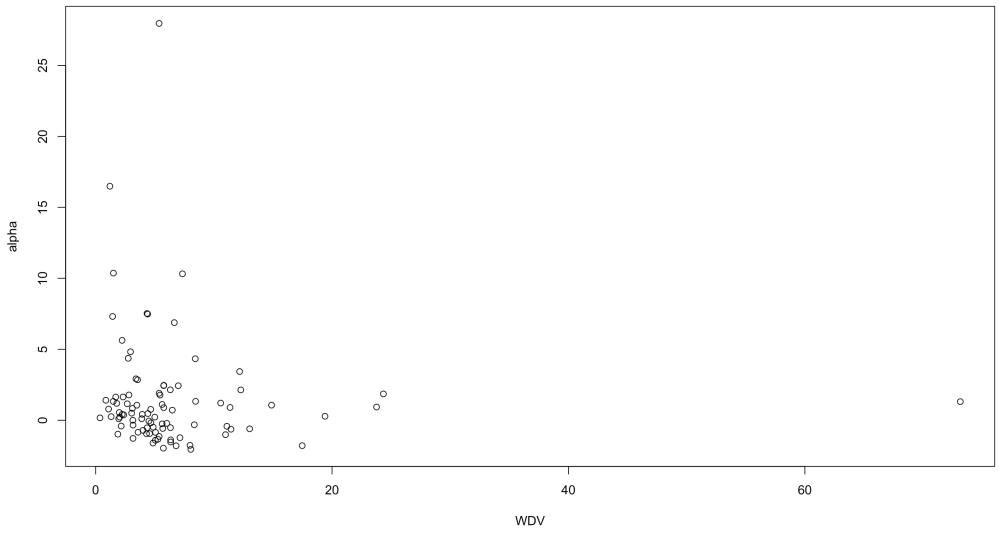

Figure 1: WDV as a predictor for alpha without exclusion of outliers. We see a pattern for companies with limited alpha and WDV.

When limiting the selection to alpha between -2 and 2 as well as limiting WDV to less than 10, we find a significant correlation. Focusing on companies with less than 1000 further improves the correlation. This also limits the problem of employees in developing countries, since the vast majority of Swedish companies with less than 1000 employees do not have many of those employees.

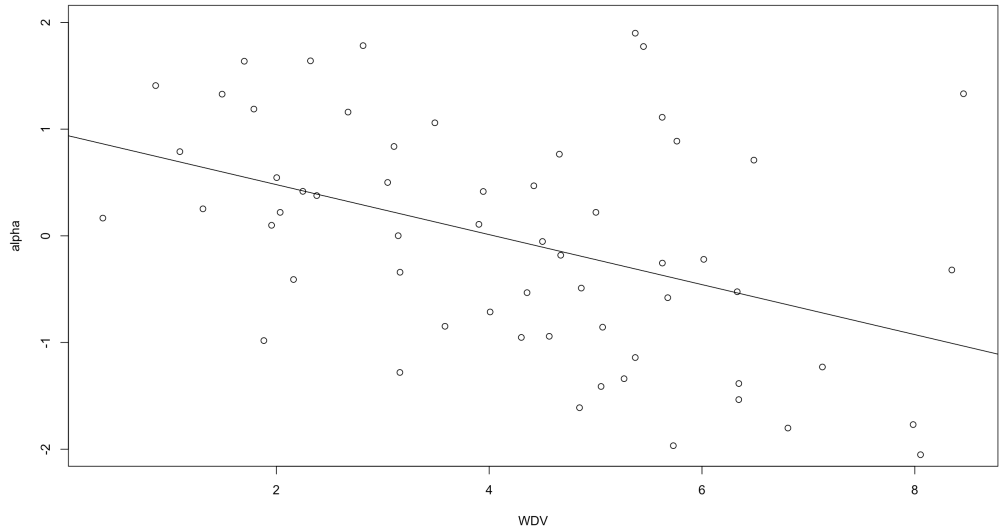

Figure 2: WDV as a predictor for alpha for companies with WDV < 10 and alpha between -2 and 2. Adjusted R-squared: 0.18.

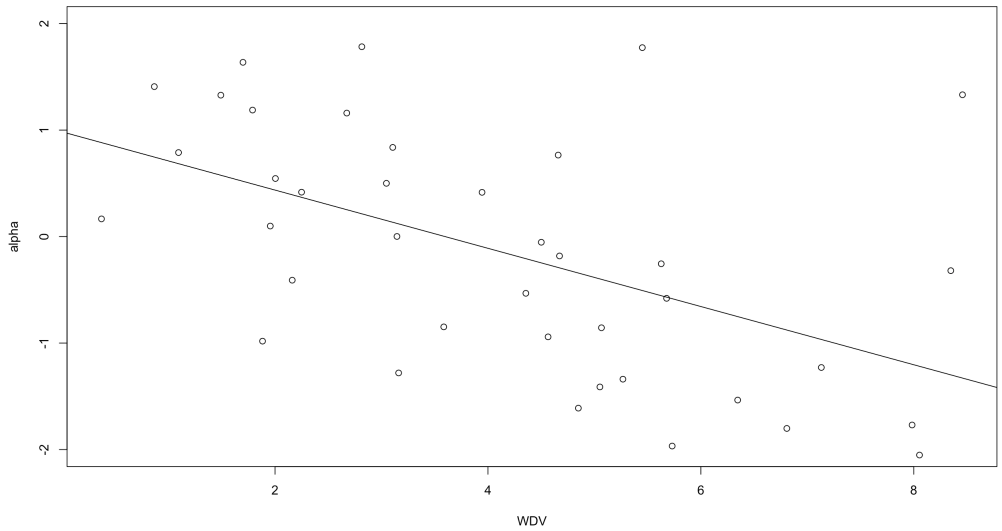

Figure 3: WDV as a predictor for alpha for companies with less than 1000 employees, WDV < 10 and alpha between -2 and 2. Adjusted R-squared: 0.26.

If lowering the limit of WDV so that the two data points furthest to the right in figure 3 is excluded, the adjusted R-squared increases to 0.44. This highlights the importance of the boundary for outliers. See table 2 in the appendix for the complete regression information of figures 1, 2 and 3.

Figure 4 displays the correlation between the RSDC and alpha. The adjusted R^2 is close to that of figure 3. This suggests that WDV is not a better predictor for performance

than RSDC. WDV may still convey additional information, even though this information is not enough to produce a significantly better result. The correlation of 0.67 is not high enough to prove an argument that WDV is useless when already having RSDC. We present no analysis of **A** separately and no closer analysis of the relationships between the different parameters to be able to deduce a possible information or prediction gain from using WDV. The main question is if the found relationship between WDV and alpha is solely due to successful companies keeping salary for all employees including CEO constant, or if the trend persists even for companies with a higher employee salary volatility, as long as the CEO also has a high salary volatility. It is less common that employees get a varying salary to the extent of the CEO (if the CEO has a highly varying salary), and we have not investigated how often this occurs in our data. This means that we may have missed a potentially stronger relationship between WDV and alpha, compared to RSDC and alpha.

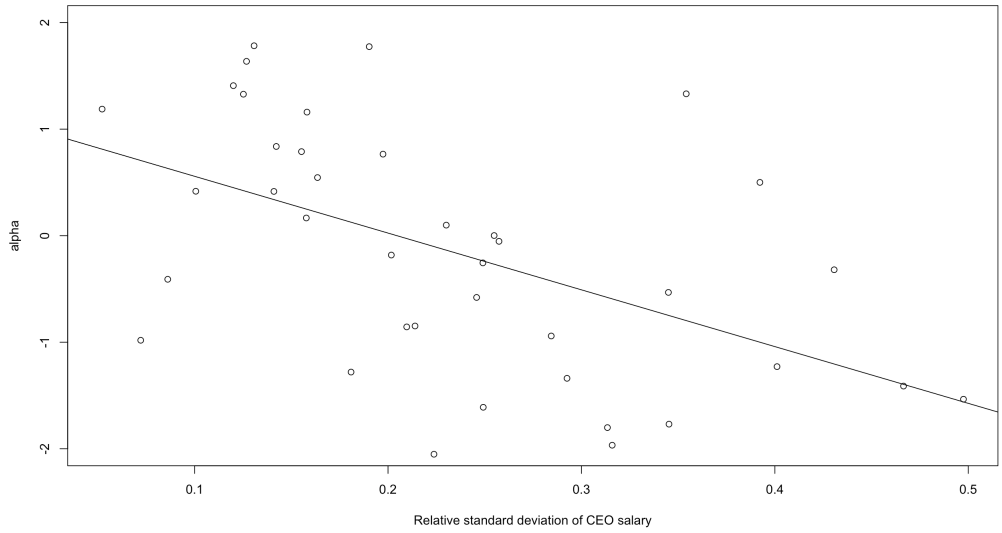

Figure 4: Relative standard deviation of CEO salary (RSDC) as a predictor for alpha for companies with less than 2000 employees, WDV < 10 and alpha between -2 and 2. Adjusted R-squared: 0.25.

Just using the CEO salary as predictor for alpha yields no significant relationship, as seen in figure 5. This suggests that the size of the CEO salary has nothing to do with performance for companies within the specified outlier boundaries.

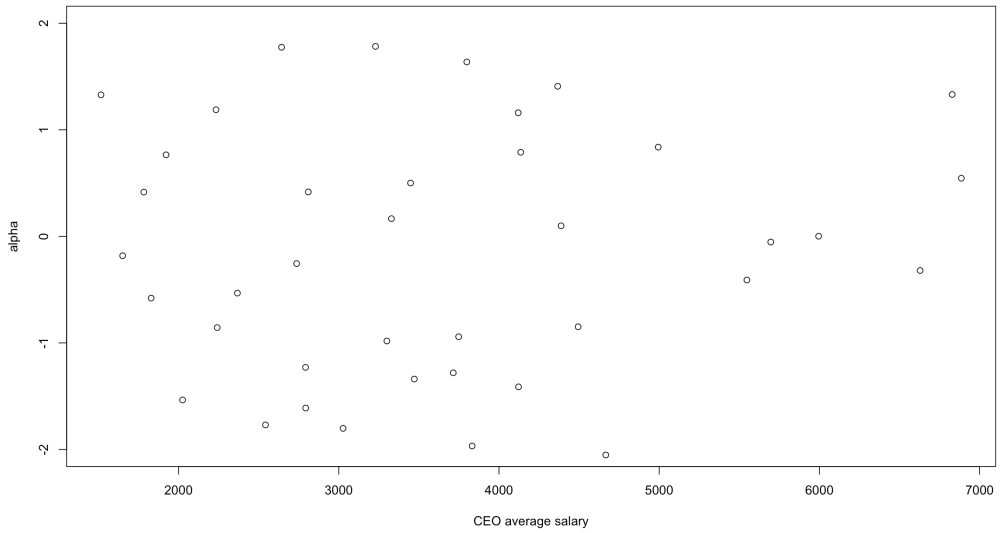

Figure 5: CEO salary as a predictor for alpha for companies with less than 2000 employees, WDV < 10 and alpha between -2 and 2.

The residuals for figure 3 are plotted in figure 9 and the Q-Q plot is in figure 10, in the appendix. These show that the conditions 2 and 4 for linearity are fulfilled. The fulfillment of the other conditions can be seen directly in the previous plots.

Regarding biases, we can see examples of severance pay issues and policy changes in the underlying data. For example, in Malmbergs elektriska, the CEO recieved about 1 million SEK and one year received a permanent raise to about 2 million SEK, while salaries of the company otherwise fluctuated together with the salary of the CEO. 2 million SEK is still a low salary for a CEO of a listed company. The essence of what we want to capture suggests a low WDV for this company, but in reality the one time raise severely impacts the WDV. Malmbers elektriska was however excluded due to an alpha above 2.

As stated in the method, the comparison would also be separated by industry and size. Figure 6 reveals the industry for each data point presented earlier in figure 3. Since there are only 39 data points in the sample, divided over seven industries, comparing the fit for each industry will not be fruitful. We judge that this is the case even when not limiting the sample to less than 1000 employees, producing 59 data points, supported by the fact that the naked eye could not find anything particularly interesting even for this graph (not shown in the report). We therefore conclude that no particular difference between the industries is proved.

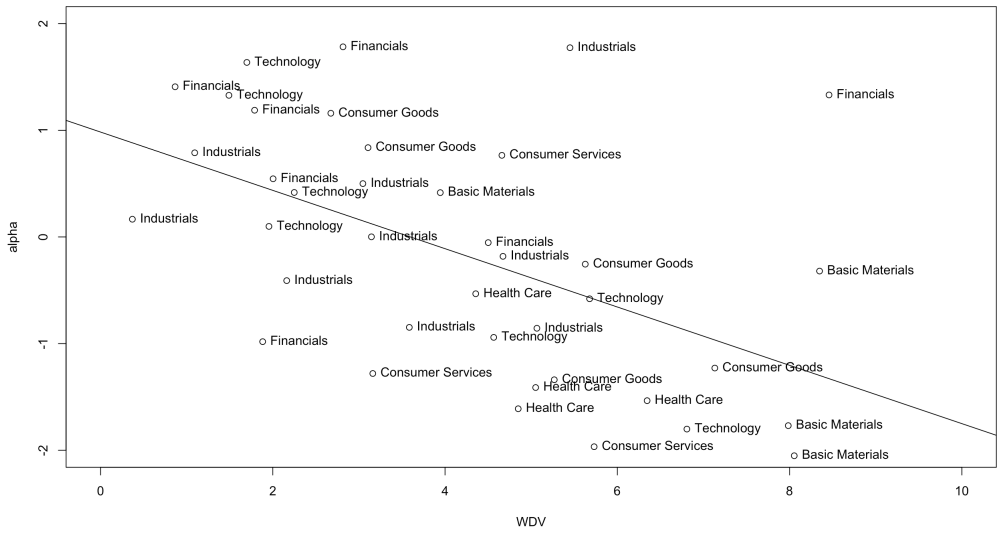

Figure 6: WDV as a predictor for alpha for companies with less than 1000 employees, WDV < 10 and alpha between -2 and 2. The data points are labelled with their respective industry.

The mechanisms presented in section 2 helps to illuminate the results. Profit sharing and the free rider problem along with monitoring difficulties is one explanation to why the pattern weakens with larger companies. Furthermore, when workers are more informed about their standing in the compensation hierarchy, which is more often the case for smaller companies, they are more prone to take interest in receiving a fair compensation. The macroeconomic aspects in Sweden is a possible explanation for finding a strong relationship overall, and for smaller companies in particular. Unionization and the mindset in Sweden including less hierarchies make Sweden a rather special case, and it would be interesting to investigate if the strength of the relationship varies together with the degree of e.g. unionization for different countries. Mechanisms pointing towards different trends for different industries did not have a fair chance to be discussed because of the low amount of data points for each industry, making drawing conclusions difficult.

6.2 SVM

The SVM model yields a different graphical overview of the relationship between WDV and alpha, which also includes the number of employees. This method enables detailed separation by size, which was the second separating factor for closing in on the ideal experiment. Including firms with more than 1000 employees (limited to 10000 because

of outliers far above these numbers), leads to a fair amount of miss-classifications as seen in figure 7. However, when reducing the sample to 1000 employees, the classification performs remarkably well as seen in figure 8. We can see that the threshold of 1000 employees serves its purpose well, and no further separation is constructive, perhaps due to the limited number of data points.

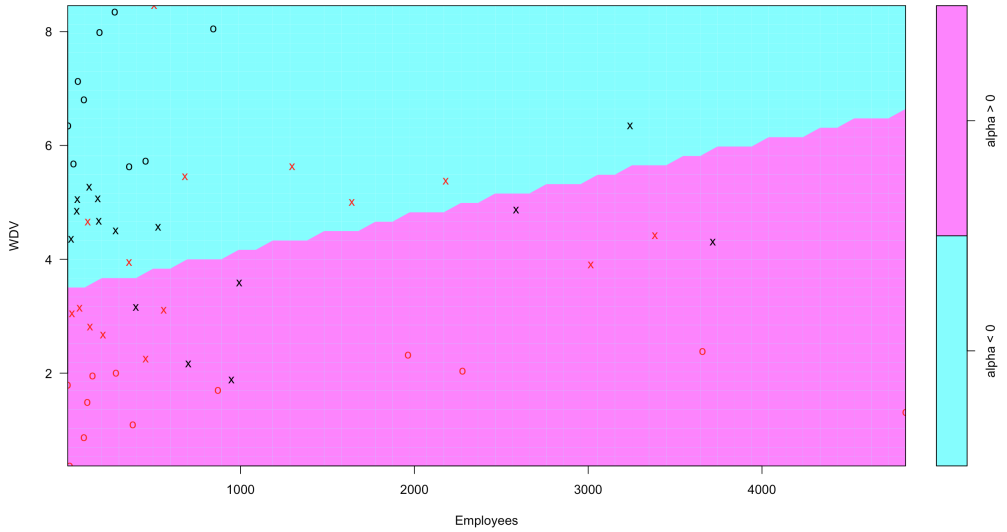

Figure 7: WDV combined with the number of employees as a predictor for alpha for companies with less than 10000 employees, WDV < 10 and alpha between -2 and 2. Red cross or ring marks a company with positive alpha, while black means negative alpha. The rings are the data points that serve as support vectors for the model.

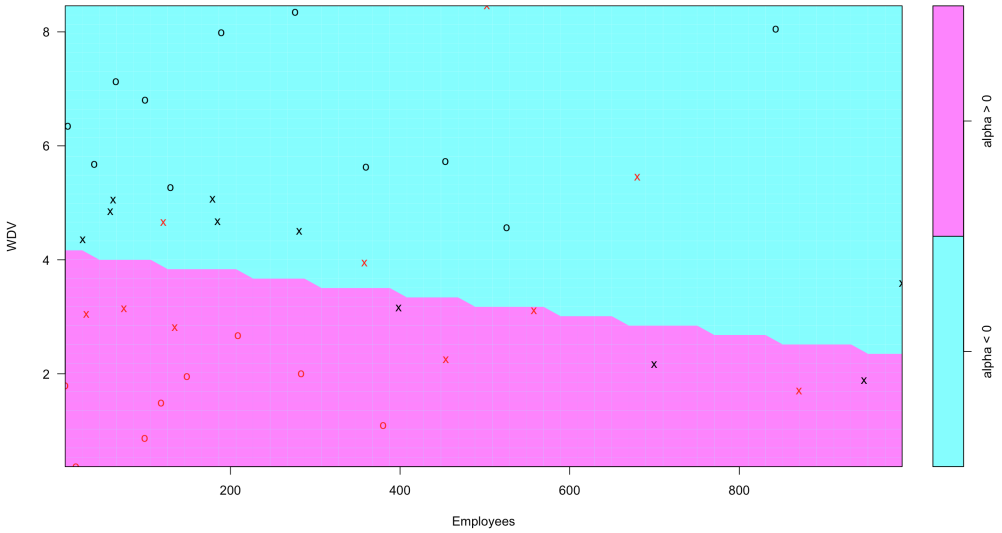

Figure 8: The same as Figure 7 except that the data is limited to companies with less than 1000 employees.

The prediction quality after training on 75% of the sample is presented in table 1. Observe that the number of predictions is small because of the limited number of companies below 1000 employees and alpha $\in \{-2, 2\}$ in our sample, and that the prediction is for 25% of this sample.

	Truth	
Prediction	alpha < 0	alpha > 0
alpha < 0	3	1
alpha > 0	1	4

Table 1: SVM accuracy

The numbers on the diagonal is the correctly classified companies. The accuracy of the model is thus 78%. According to this, we can look at a company within the specified number of employees and alpha at the Stockholm Stock Exchange, and determine with a 78% accuracy if that company has a positive or negative alpha. Of course, the exact number of 78% will not persist when changing sample size, but it has still been proven that this model performs remarkably well above chance. This brings into question if the method in some way is endogenous, as discussed in section 5. Perhaps companies with large WDV have a large WDV because they have not performed well and had to make temporary cuts to e.g. salary, making the salaries volatile. This would imply that a company cannot expect to become more successful by keeping salaries constant. If the model

is indeed producing a causal relationship in the desired direction, this report provides strong support for keeping the CEO salaries relatively constant over time for the specified company characteristics. Considering the theory presented in the introduction in section 2 as well as section 2.1 and 2.2, we furthermore argue that salaries for other employees than the CEO should be held relatively constant. Only striving towards keeping salaries constant however, without adopting the company culture related to this practice, may render futile results anyway.

7 Conclusion

This paper has presented a new way of analyzing wage dispersion by introducing wage dispersion volatility as a predictor for success. We present new research in a field that previously focused either on management compensation or employee compensation separately, and neither as relative changes over time. Measuring relative volatility based on intra-company wage dispersion enables comparison between different companies with different remuneration plans. The regression analysis shows clear indications that with a lower WDV, companies are more likely to perform above average, i.e. positive abnormal returns. In Sweden, especially for companies with less than 1000 employees, having a more 'fair' compensation scheme pays off. One concern with our paper is the cause of WDV, as it could depend either on average wages changing or the CEO wage changing, or both. By using RSDC as a predictor for alpha, $R^2 = 0.25$, while using WDV as a predictor for alpha resulted in $R^2 = 0.26$. This means that the RSDC to a large extent explains WDV. It remains a question however, if the inclusion of average employee salary contributes anything. The average employee salary was not investigated further. We suspect that there are few companies that have a constant CEO salary but varying average employee salary, producing a high WDV this way, or highly varying salaries that correlate enough to produce a low WDV. This means that even if WDV would be able to better explain alpha than RSDC, lack of data may be an obstacle for further research. The paper finds support in previous research on similar topics. Mainly, typical Swedish values concerning fairness in the workplace along with heavy unionization explain why we see a strong trend. Other research have pointed out the effect of salary transparency, as well as monitoring difficulties. The findings in this research align with our results that fairness is more important in relatively smaller companies.

Finally, a comment about the causality between WDV or RSDC and alpha has to be made. It should not be taken for granted that we have found causality in the described direction and that endogeneity does not exist. Unobserved variables correlated with both WDV and alpha, e.g. foreign ownership, may explain the results. It could also be the case that firms react to bad times by increasing volatility of salaries. This has neither been proved nor disproved in this paper. The SVM is able to predict the sign of alpha with 78% accuracy. From a pessimistic standpoint, this high number alone suggests that either the data selection is skewed, or there is some form of unaccounted relationship.

For future research, it would be interesting to compare our results with other countries with similar characteristics beside unionization, to see how this might affect WDV. Another topic of interest would be to conduct further research focusing more specifically on different industries. Further, one could investigate if low-WDV firms having a highly variable CEO salary also fit the trend shown between WDV and alpha. This connects to the main question left unanswered: if RSDC fully explains the WDV or if the combination with average employee salary add further prediction accuracy. The average employee salary was not investigated separately, and doing so may be a first step for further research in this topic. Low-WDV firms could also be further investigated in order to find a common denominator among these.

8 Appendix

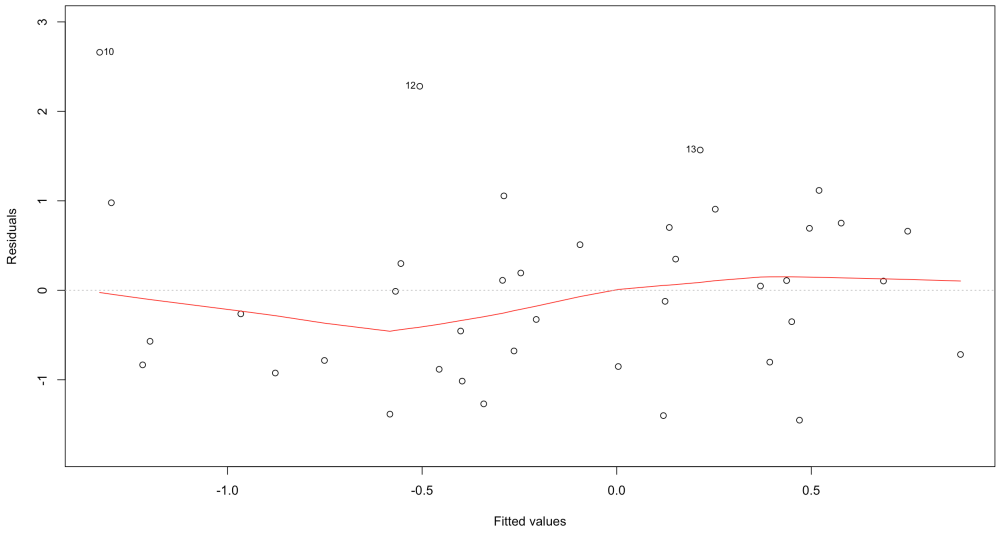

Figure 9: Residuals from the plot in Figure 3

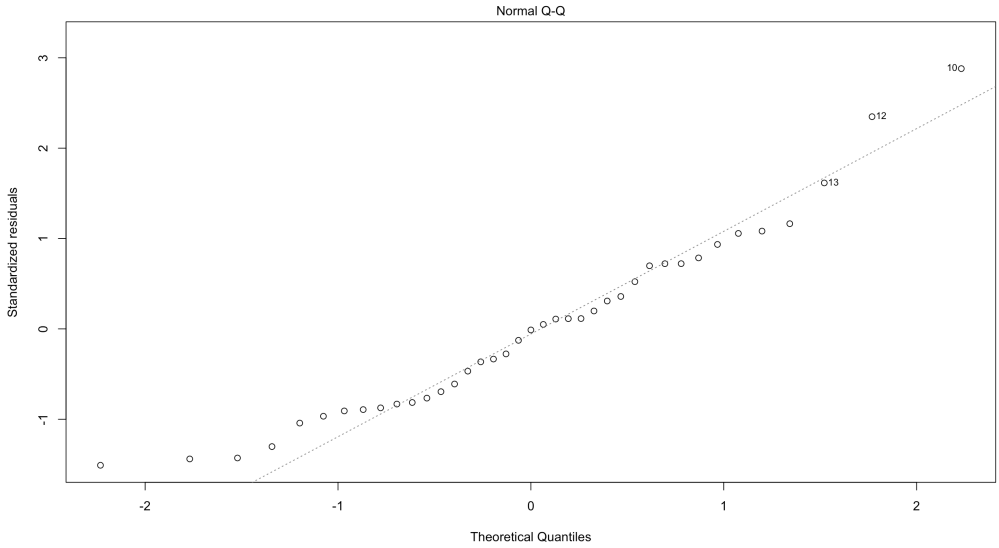

Figure 10: Q-Q from the plot in Figure 3

	Dependent variable:		
	alpha	alpha	alpha
	(1)	(2)	(3)
WDV	−0.031	−0.234***	−0.274***
	(0.052)	(0.064)	(0.073)
Constant	1.686***	0.949***	0.985***
	(0.548)	(0.299)	(0.341)
Observations	91	59	39
R^2	0.004	0.191	0.275
Adjusted R^2	−0.007	0.177	0.256
Residual Std. Error	4.112 (df = 89)	0.971 (df = 57)	0.989 (df = 37)
F Statistic	0.368 (df = 1; 89)	13.485*** (df = 1; 57)	14.061*** (df = 1; 37)
Note:			*p<0.1; **p<0.05; ***p<0.01

Table 2: Summary of the three regressions with WDV as predictor. (1) includes all data, (2) is limited to WDV < 10 and alpha $\in \{-2, 2\}$, (3) is additionally limited to less than 1000 employees.

	Dependent variable:
	alpha
RSDC	−5.331***
	(1.452)
Constant	1.091***
	(0.374)
Observations	39
R^2	0.267
Adjusted R^2	0.247
Residual Std. Error	0.994 (df = 37)
F Statistic	13.475*** (df = 1; 37)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 3: Summary of the regression with relative standard deviation of CEO salary as predictor.

	Dependent variable:
	alpha
RSDC	-2.995
	(2.023)
WDV	-0.166
	(0.102)
Constant	1.235^{***}
	(0.376)
Observations	39
R^2	0.317
Adjusted R^2	0.279
Residual Std. Error	0.973 (df = 36)
F Statistic	8.353^{***} (df = 2; 36)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 4: Summary of the regression with WDV and RSDC as predictors. This regression was subject to multicollinearity and is therefore rendered useless. The table serves as a reference for any future interest.

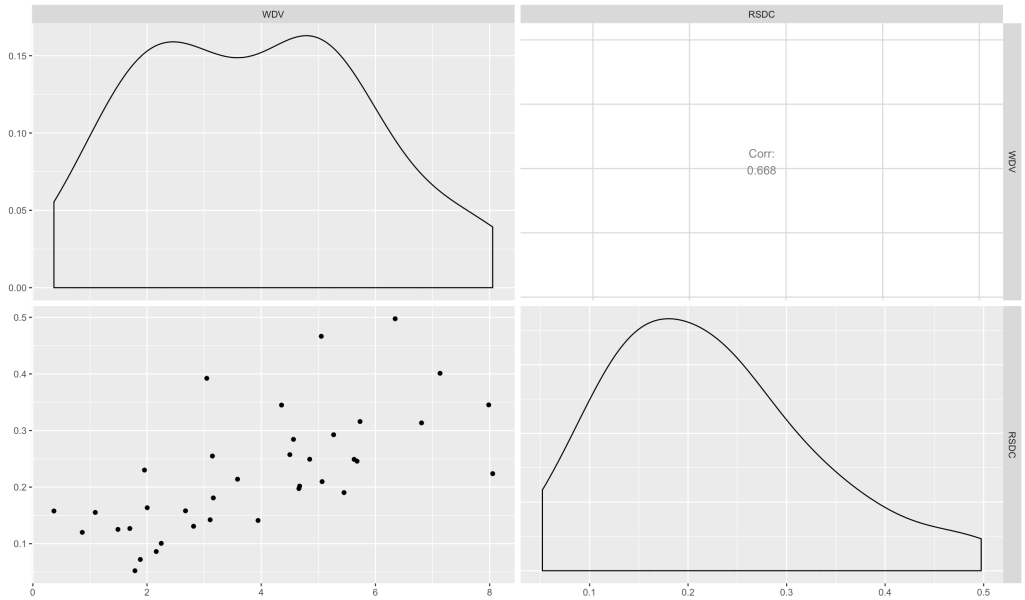

Figure 11: The correlation between WDV and RSDC visualized.

Average number of employees

	2016	of whom men	2015	of whom men
Sweden	299	64%	316	63%
Belgium	61	77%	63	81%
Czech Republic	120	94%	117	93%
Germany	197	90%	197	91%
Mexico	300	90%	254	90%
Luxembourg	4	75%	3	67%
USA	1,436	88%	1,421	88%
China	303	64%	287	67%
Sri Lanka	1,005	96%	1,010	96%
UK	216	88%	103	84%
Spain	87	94%	87	93%
Total	**4,028**	**87%**	**3,858**	**87%**

(a) Hexpol

	AVERAGE NUMBER OF FULL-TIME EQUIVA-LENTS	OF WHICH WOMEN	AVERAGE NUMBER OF FULL-TIME EQUIVA-LENTS	OF WHICH WOMEN
	2016		2015	
Parent company				
Sweden	2 369	448	2 422	467
Spain	11	5	11	6
Group companies				
Estonia	8	2	8	2
France	13	6	13	5
Germany	23	10	20	10
Hong Kong	5	1	6	1
Italy	8	3	7	3
Japan	2	-	-	-
Netherlands	77	38	104	37
Poland	7	6	7	4
Portugal	1	-	1	-
Russia	1	1	1	1
Singapore	6	3	6	3
Spain	-	-	268	50
Switzerland	3	1	3	1
UK	443	49	429	50
US	12	5	9	3
Total Group companies	**609**	**125**	**882**	**170**
Total Group	**2 989**	**578**	**3 315**	**643**

(b) Holmen

Figure 12: Number of employees in different countries for Hexpol and Holmen. Tables collected from their respective 2016 annual reports.

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