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## "INEQUALITY AVERSION": A DISCUSSION OF THE DIFFERENTIALS BETWEEN WORKERS AND MANAGERS WAGES AND THEIR IMPACT ON THE EVALUATIONS OF INVESTORS

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# Contents

# Abstract

In recent years, there has been a tendency to gradually increase the wage of CEOs, in contrast to those of employees who most often remain at the same or lower levels. In this dissertation, the inequality of wages between CEOs and employees in US companies was studied, as well as the impact of this inequality on the valuations of investors. For this purpose, data were collected for each company from all industries for the period 2017-2020 (due to the SEC reform that was activated in 2017). In particular, the Stock Returns of the US companies were studied and specifically to what extent they are related to the Pay Ratio, as well as to other control variables such as Price-to-book Ratio, Total Assets etc. Indeed, the study of empirical analysis showed that the company's Pay Ratio and the valuation are strongly correlated. There is also a link between Stock Returns and other control variables. In general, what emerges is a negative correlation which means that the wider the wage gap, the lower the valuation and returns of companies should be expected.

# 1. Introduction

This dissertation is concerned with a matter of growing importance for contemporary entrepreneurship; that of pay inequality and the impact that it bears on a firm's stakeholders. A firm's laborers are obviously the ones who will be directly impacted by this condition, but investors may well respond to it, especially negatively, due to what is called *"behindness aversion"*.

In recent years, a lot of different considerations have come to light and have become major concerns for businesses. These considerations have definitely broadened the scope and goals of a specific firm and extended them far beyond the short-term maximization of profit or obtaining the maximum market share. Such considerations could be categorized into social, societal, moral and more.

We could name some of the notions which were invented and further worked on in the last decades which involve such concerns and related actions:

- Corporate Social Responsibility
- Employee Branding
- Business Ethics

According to the official page of the European Commission, Corporate Social Responsibility is connected to the impact that the actions of businesses bear to humans as well as the natural environment. A firm's conduct is interwoven with humans and the environment in many ways: in the working conditions that the firm's personnel is offered; the safe and healthy working environment, the respect to human rights which the firm displays, the possible innovative ideas which may bring to the table, the education and training that it will need to offer its employees. All these elements may be carried out in a positive or negative way. Corporate Social Responsibility (CSR) is alternatively named Responsible Business Conduct (RBC).

Overall, CSR is defined as the responsibility that the firms have in their impact towards society. One could claim that CSR consists of two parts:

- Following the law, concerning social and environmental issues.

- Incorporating social and environmental considerations, as well as related consumer rights and human rights concerns within their business strategy.

("Corporate social responsibility & Responsible business conduct - Internal Market, Industry, Entrepreneurship and SMEs - European Commission", n.d.)

It seems that CSR came to the spotlight from the 90's onwards and up to this day, still it exists from the early fifties, when the widely regarded as founding father of this concept, Howard Bowen, published the first edition of his book *"Social Responsibilities of the Businessman"* (Bowen, 1953).

The second related concept that is relevant to social responsibility is Employer Branding. Employer branding is a concept which attempts to diversify a specific employer through managerial efforts and thus to improve employee recruitment and retention. It is obvious that employer branding is closely related to social responsibility and employment terms which make a difference, whether it be pay and additional benefits or leave allowances. A part of the attraction that employer brand exercises is, definitely, the approval of the society due to the responsibility of that particular employer (Backhaus & Tikoo, 2004).

Lastly, Business Ethics is a concept closely related to Corporate Social Responsibility, in fact so close that it is indiscernible from a consumer standpoint. CSR and Business Ethics are worked on together in the business field and then determine the specific business strategic goals (Ferrell et al., 2019).

In this dissertation, the focus is placed on a specific issue that has raised a lot of attention: the pay inequality within firm. There is a multitude of papers concerned with this specific matter and it has been a matter that is more broadly discussed, in society and in the press. There are works dealing with more specific matters and research related to pay inequality, such as that of Moene & Wallerstein (1997), which focuses on the impact of collective bargaining.

Breza et al. (2017), on the other hand, deal with a very important matter as to the goals of this dissertation: the impact that pay inequality has on the morale of workers within an organization. In this work, another term is used as well, that of pay disparity. It is of great

interest that both output of firm employees and employee attendance are very significantly impacted and reduced.

As will be seen in the next chapter, the findings of the literature concerned with similar topics suggest that there is a correlation between pay disparity and inequality and firm performance in regards to stock values and returns. In the vast majority of the empirical models taken into consideration, there is a statistically significant and negative association between pay inequality and a firm's valuation by investors. However, as will be explained in detail in the next chapter, there are also a few instances where this correlation may be found positive or not significant; such is the case in the work of Mueller et al. (2016), for example. Overall, the matter of attempting to approach the impact of pay within-firm inequality to stock returns is an important one, as the sources indicate and because of the fact that matters of a social or moral nature have come more and more to the spotlight in business conduct in recent years.

This is consistent with the notion that was mentioned in the beginning of this introduction, the fact that there may be a behindness aversion present in some of the firm's stakeholders, which impacts it in certain negative ways. The literature review that will follow will give more views of this possibly generalized situation.

In concluding this small chapter, let us outline the contribution of this dissertation to research. As will be more clearly and comprehensively seen in the chapter to follow, the research regarding the impact of pay inequality and wage gap to a firm's performance, as this is reflected in the stock returns, is not unambiguous. There is a part of the research corpus which points towards a particular type of effect (statistically significant and negative), but there are also different papers as to their empirical findings. This dissertation is going to contribute to this ongoing research and shed more light on the topic. Furthermore, all the analysis was conducted in order to highlight the societal importance of the topic under examination. This importance is societal and also economic and entrepreneurial as well.

In addition, the thesis is organized as follows: Section 2 refers to the literature review as well as the theoretical framework, section 3 describes the methodology and more

specifically a preliminary structure of the experimental design, the main hypothesis, and the empirical strategy. Section 4 presents the purpose of the analysis along with the results and their interpretation. Finally, section 5 includes discussions, implications, limitations, and conclusions, while the thesis ends with the references and the appendix.


# 2. Literature Review and Theoretical Framework

This chapter contains a literature review of this dissertation. Briefly, some of the most important and relevant pieces of scientific and research work will be reviewed and presented.

In the work of Pan et al. (2021), the question that is raised concerns the interest that investors have on pay inequality and pay dispersion within a specific firm. The conduct of investors in equity markets and in the management of their portfolios is to be examined, as well as the ratio of the CEO as to the median worker total pay. The data used comes from U.S. companies filing data, which is utilized from the year 2018 onwards.

Overall, this article acknowledges the discussion and growing concerns that have been raised in U.S. society over wage stagnation and a lengthening gap between median employee and Chief Executive Officer (CEO) of U.S. firms.

The paper concludes that high pay inequalities, as disclosed in firms annual filing data, tend to contribute to negative returns. Moreover, high pay dispersion is even more disliked by investors rather than individually a high CEO or low median worker pay. Additionally, if investors have prosocial preferences, they rebalance their portfolios even more against firms with high pay dispersion ratios.

All in all, the findings of this study are consistent with the notion that high pay inequality ratios and dispersion tend to contribute to significantly lower returns, as announced by the firm.

The work of Mueller et al. (2016) is also one of the most closely connected to the work that is presented in this dissertation. Their article examines the pay inequality that manifests

itself within the firm. It firstly acknowledges and points out the fact that both financial regulation authorities and investing parties are highly concerned about pay inequality occurrences within firms in general. The dependent variables examined in various regressions in this paper are the following:

- Pay Ratio
- Wage (in given hierarchy level)
- Return on Assets (ROA- a standard firm performance metric)

Overall, surprisingly, based on proprietary public and private firm data, the reported findings seem to paint a somewhat different picture than the previous work.

Specifically, the findings of this paper suggest that:

- Pay inequality seems to be positively correlated with higher market valuation.
- Pay inequality seems to be positively correlated with higher values of certain performance indicators.

Overall, this paper aims to reassure the investors that high pay inequality firms do not pose a greater investment risk or yield less returns than low inequality ones and attempts to interpret the inequality to varying managerial talent within the same firm.

Breza et al. (2017), in their paper, which was formerly already mentioned, aim to examine the impact on morale of firm employees that pay disparity has. Pay disparity is one of the model variables, while employee attendance and employee output. This work attempts to test the theory that beyond economic value, there is also a relational and organizational aspect in a firm that cannot be ignored without significant consequences. The sample is derived from Indian firms and employees working in manufacturing companies.

The findings of this particular study are:

- It is suggested that pay inequality (as pay dispersion) within a firm tends to reduce output.

- It is suggested that pay inequality (as pay dispersion) within a firm tends to reduce employee/workplace attendance, in that the employees tend not to turn up in the fixed hours and days.
- If we assume that a wage is invariant, pay inequality tends to lower productivity by 0.24 standard deviations.
- If we assume that a wage is invariant, pay inequality tends to lower workplace attendance by 12%.

As was implied previously, the employee satisfaction and morale is directly influenced by pay inequality and firm performance seems to be more indirectly influenced by it. All these three different phenomena, firm performance, employee satisfaction are simultaneously examined in this paper of Green & Zhou (2019).

As to the sample, the article states that it makes use of more than 900 thousand salary data, in order to construct the variables needed. Gini coefficients are utilized in order to do this. Some of the most important findings of this particular article are as follows:

- The pay inequality manifested within a firm seems to be negatively correlated to the morale of employees.
- The pay inequality and employee morale is more intense for employees in the top and bottom quartiles.
- Wage increases increase employee morale for all types of employees.
- Base pay (basic salary, without including benefits, bonuses etc.) inequality is negatively associated to firm performance.
- Total pay inequality isn't found to have a significant correlation to firm performance.
- The findings are in support of the Equity Theory notion.

The work of Dittmann et al. (2018) is associated to pay inequality as "wage gap" and the stock returns of the firm. The question that is then posed is whether investor are dissatisfied with the potential pay inequality present in a firm. The paper acknowledges the grand gap present among employees in the same firm and that many investors tend to value pay equity

highly and to be discontent with pay inequality. The data analyzed in this paper are derived from German firms, a highly developed industrial country of the first world.

The findings of this article are the following:

- If the association between a high pay inequality and a better in-firm performance is real, then this doesn't manifest itself in the stock returns.
- A significant part of the investors display preference for low pay inequality.
- Another part of investors incorporate the wage gap into their analysis.
- Consequently, a part of investors seems to be coordinating with the general's public inequality aversion and lean towards fairness in their investing decisions.

All the aforementioned papers have a different and varying degree of relevance. The focus of this dissertation is on companies based in U.S. soil and the goal is to be able to examine the potential association between pay inequality (and at the same time inequality aversion) and stock returns. Specifically, it will be the Pay Ratio which will be examined in this dissertation, as the ratio of the CEO of a company divided by the median employee pay. In the reviewed papers, there was seen an association for the vast majority of regressions carried out and also the association was negative, that is, the high pay inequality tends to affect the firm's returns negatively. It has also been seen that research papers tend to display a negative association between high pay inequality and employee morale.

All this will be attempted to be put to test in the empirical research part of this dissertation. In the next chapter, the methodology of this project will be outlined.

# 3. Methodology and Empirical Strategy

In this brief chapter, the methodology of this dissertation will be described. That is, the data needed, the overall methods and the research questions will be delineated.

Firstly, a concise reference to the method used is in order. This dissertation is essentially an empirical research article. The methodology employed involves the following steps:

- Gathering of the needed raw data: this step involves searching appropriate data repositories and downloading the needed ones; in this instance, the salary and performance-related data.

- Preprocessing the raw data: eliminating data rows with redundancies, outliers etc.

- Inserting the processed data into the statistical software and performing the regressions (and robustness tests).

- Analysis of the regressions results.

The dataset is comprised of raw data of listed U.S. firms for the 2017-2020 time period. The time period was picked due to the pay ratio data being disclosed for the said interval by firms, according to the SEC reform adoption, which began at 1st January of 2017. The data is derived from the Eikon database.

Regarding the research question and hypothesis, the fundamental research question is the following: Do firm investors incorporate pay inequality in their evaluations of a firm? Are investors evaluations of firms manifested into their stock values?

The dependent variable here is the Stock Returns. The main independent variable is the Pay ratio between the CEO pay and the median worker pay. The whole model takes after that of Pan et al. (2021), in that it makes use of stock returns as a dependent variable, pay ratio as the main independent variable and other common variables as control variables, such as total assets, employees, market capitalization[1]. Some control variables will be also added, as well as a time-fixed effects and firm/industry-fixed effects interpretive variable, which will incorporate the specific year's impact on Stock Returns and the specific industry the company belongs to. Additionally, ROA or ROE will be used interchangeably instead of Stock Returns, in order to capture the firm's performance and its potential correlation with the wage gap within the firm. The test equation is of the following form:

**Stock Returns (or ROA or ROE)** = a. **Pay Ratio** + b. **Control variables** + c. **Time-fixed effects** + d.

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[1] More specifically, it is the logarithmic transformation of pay ratio, as well as that of market capitalization which are picked as the main independent variable and one of the control variables, respectively.

As was formerly seen and explained, most of the papers in the literature are consistent in their findings with an association between the two phenomena: pay inequality and stock returns/values. Moreover, most of the times, the association is negative. Therefore, the research hypothesis is that firms which have a lower pay inequality will perform better, as displayed in stock returns and values, than firms with a higher pay inequality.

In the next chapters, the empirical research analysis will be appropriately presented.

# 4. Results and Interpretation

## Introduction

This chapter is devoted to the presentation and interpretation of this thesis's results. The results pertain to a totality of many multiple linear regressions. These regressions could be divided into two categories: firstly, the regressions related to the empirical model in its core form, as presented in the previous chapter; these models include a logarithmic transformation of a part of the independent variables; secondly, the dependent variable of the empirical models is switched to Return on Assets or Return on Equity. The empirical model, specifically its variations which are employed, take after the work of Pan et al. (2021), which also makes use of logarithmic transformations of both market capitalization and pay ratio. The main difference of this empirical research is that this work makes use of stock returns per se, instead of cumulative abnormal returns.

In terms of variables selection, it should already be apparent that this has been carried out in accordance with the work of Pan et al. (2021), with some differentiation. The variables of book-to-price ratio, as well as the logarithmic transformation of market capitalization are both measures of (relative) market value. Total assets are the total sum of all items that a firm has bearing economic value and a very common interpretive variable in related empirical literature. Specifically, the logarithmic transformations are performed to these variables, in order to contain the impact of the outliers Pan et al. (2021).

Let it be clarified here that all the results were derived from the RStudio statistical software. This chapter will commence with descriptive or summary statistics, then move onto the

analysis of each one of the regressions' outcomes, as produced by the software and further processed, using tabulation of the results of the highest importance.

## Descriptive Statistics

This paragraph contains a presentation of basic descriptive statistics of all the variables, both dependent and independent partaking in the empirical models.

The only descriptive statistics to be presented in a tabulated form are those of the aggregated data. Still, because we are interested in the evolution of the data as well, a commentary is provided regarding the data of each year, the summary statistics of which are provided in the Appendix. The variables of the empirical models, both dependent and independent, are as follows:

- **Returns:** The Stock Returns of all the companies of the sample
- **MarketCap:** The Market Capitalization value
- **PriceToBook:** The Price-To-Book ratio value per share
- **PayRatio:** The Salary gap
- **Employees:** The (average) number of employees
- **TotAssets:** The total assets value of the company
- **ROA:** The Return on Assets value of the company
- **ROE:** The Return on Equity value of the company
- **LNMarketCap:** The logarithmic Market Capitalization of the firm
- **LNPayRatio:** The logarithmic Salary Gap of the firm

The following observations can be made regarding the statistics of the year 2017:

- The mean ROA values correspond to low to moderate performance (0.8%).
- The mean Pay Ratio, as disclosed by the companies within the sample, can be characterized as large (over 400).
- The summary statistics (Minimum and Maximum) of the number of employees variable clearly suggest that we are dealing with companies belonging to a range of very small to very large companies.

Similarly, we could make the following observations regarding the descriptive statistics of the following year, that is, the year 2018:

- The mean ROA values correspond to a much-improved firm performance, in comparison to the previous year (2.197%).
- The mean Pay Ratio, on the first year after the first related disclosure by the company, has remained stable and somewhat increased (~420).
- The value of the Price-To-Book ratio, as a mean, is relatively good, as it lies somewhere between 1 and 2 (namely, 1.86), although there are definitely companies where the Price-To-Book value would be considered unacceptable.

In the same fashion, some observations pertinent to descriptive statistics of the year 2019 are as follows:

- The mean ROA values correspond to a moderately improved firm performance, in regard to the previous year (3.247%).
- The mean Pay Ratio apparently continues to increase this year also, further surpassing the 430:1 ratio; the increase is small, yet noteworthy, given the already very high magnitude of the ratio.
- The value of the Price-To-Book ratio, as a mean, demonstrates a significant deterioration (at 2.434), although, due to the fact that it lies below the threshold of 3, it is considered acceptable.

Finally, some observations related to the summary statistics of the year 2020, are the following:

- The mean ROA values correspond to a low positive firm performance and thus resemble the year 2017 (0.901%).
- The mean Pay Ratio, as reported for this year, seems to demonstrate a very significant decrease (182.448).
- The value of the Price-To-Book ratio is also apparently at a much better mean value (0.154), in regard to previous years.

The critical remarks for each successive year are completed. At this point, the time has come to view the tabulated summary statistics for all the years.

Table 1. Descriptive statistics for the aggregated data

| Variable | N | Mean | Std. Dev. | Min | Pctl. 25 | Pctl. 75 | Max |
|---|---|---|---|---|---|---|---|
| Returns | 1723 | 10 | 47.846 | -90.274 | -15.039 | 25.339 | 1074.813 |
| MarketCap | 1723 | 13431907622.389 | 38867797914.675 | 0 | 784458993.33 | 7936339061.765 | 511232359138.11 |
| PriceToBook | 1723 | 1.973 | 26.782 | -899.64 | 1.074 | 2.829 | 331.255 |
| PayRatio | 1723 | 358.443 | 2296.412 | 0.112 | 17.231 | 103.368 | 48422.566 |
| Employees | 1723 | 15085.914 | 43430.486 | 1 | 627.25 | 9000 | 519000 |
| TotAssets | 1723 | 53990148051.115 | 248492366903.235 | 55273000 | 2596216000 | 20624825500 | 3.384757e+12 |
| ROA | 1723 | 1.771 | 13.05 | -139.65 | 0.95 | 4.835 | 169.92 |
| ROE | 1723 | 8.584 | 60.689 | -1042.3 | 7.485 | 15.52 | 828.08 |
| LNMarketCap | 1722 | 21.754 | 1.679 | 17.762 | 20.482 | 22.795 | 26.96 |
| LNPayRatio | 1723 | 3.878 | 1.44 | -2.193 | 2.847 | 4.638 | 10.788 |
| YEAR | 1723 | 2018.536 | 1.127 | 2017 | 2018 | 2020 | 2020 |

Overall, one may observe the following:

- The ROA and ROE values are on average positive and generally seem to display a moderately good performance.
- The mean Pay ratio is rather large, as it nears 400.
- The values of Price-To-Book ratio are also relatively good on average, as they are lie somewhat below 2.

## Regressions Analysis

This paragraph contains the presentation as well as the analysis of the regressions output. For each model, there are three different results to be presented here. Firstly, the regression output. This output contains the p-values, which determine an independent variable's significance, as well as the F-value and the R-squared value. Secondly, there are two

robustness tests: the multicollinearity test (Variance Inflation Factor-VIF), as well as the Breusch-Pagan test for heteroscedasticity (robust residuals)[2].

**Title: Regression Results**

|  | RETURNS |
| --- | --- |
| LNMarketCap | 8.422*** |
|  | (1.025) |
| PriceToBook | .077 |
|  | (.043) |
| LNPayRatio | -4.733*** |
|  | (1.218) |
| Employees | -0.000** |
|  | (0.000) |
| TotAssets | -0.000 |
|  | (0.000) |
| YEAR | .813 |
|  | (.991) |
| Observations | 1,722 |
| $R^2$ | .154 |

---

[2] The independent variables of the empirical models are of a greater magnitude. Therefore, overall, in order not to stifle the text with long tables, only the most important independent variables are presented in them, that is, the pay ratio, the control variables, the year-fixed effects variables, as well as a few of the firm/industry-fixed effects variables.

| | |
|---|---|
| Adjusted $R^2$ | .113 |
| Residual Std. Error | 45.053 (df = 1641) |
| F Statistic | 3.732*** (df = 80; 1641) |

| Notes: | *P < .05 |
|---|---|
| | **P < .01 |
| | ***P < .001 |
| | ANOVA Tables |

It is apparent that the model is statistically significant as a whole and that it can interpret a portion of the dependent variable's variance.

Overall, the most important statistically significant independent variables are the following:

- Logarithmic Market Capitalization
- Logarithmic Pay Ratio
- Employees

Also, a number of industry-fixed effects variables are statistically significant, such as Software, Renewable Energy Equipment & Services and many more. It is noteworthy that the Pay Ratio variable is statistically significant to the highest significance level possible (0.001), thus signifying a very strong connection and correlation between the salary gap and the stock returns.

The model does contain measures of similar concepts; thus, a multicollinearity test shouldn't be considered redundant. The results from the VIF test are given below.

**Table 3. Empirical model 1- Variance Inflation Factor (VIF) robustness test**

| | |
|---|---|
| Logarithmic Market Capitalization | 2.5091 |
| Price-to-book Ratio | 1.1464 |
| Logarithmic Pay Ratio | 2.6097 |
| Employees | 2.4882 |

| Total assets | 1.8090 |
|---|---|
| Year | 1.0567 |

No one out of the most important model interpretive variables needs to be omitted due to multicollinearity. The only independent variable with non-zero values[3] to be omitted from the model due to a high VIF value is that of Banks-fixed effects variable.

Lastly, the results from the Breusch-Pagan robustness test are provided hereafter.

Table 4. Empirical model 1 heteroscedasticity (Breusch-Pagan) test

| BP | 96.353 |
|---|---|
| Df | 80 |
| p-value | 0.1028 |

It is obvious that there are no heteroscedastic residuals in the model and therefore it is robust as a whole.

The next empirical model to be reviewed is that having ROA as a dependent variable. The first attempt at the model proved to be heteroscedastic, according to the Breusch-Pagan test. Thus, a robust linear model was attempted instead of the initial model[4]. In the next table, the statistical significance of interpretive variables and other results are displayed.

Table 5. Regression 2 results

**Title: Regression results- model 2**

|  | ROA |
|---|---|
| LNMarketCap | 1.653*** |
|  | (.228) |

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[3] A few of the firm/industry categories are omitted due to the fact that, after the preprocessing, no firms were left in the categories and consequently only had zero values.

[4] On a technical level, the significance of the robust linear model variables was implemented with the help of the packages named *MASS* and *stargazer*.

| | |
|---|---|
| PriceToBook | -.021$^*$ |
| | (.010) |
| LNPayRatio | .550$^*$ |
| | (.271) |
| Employees | -0.000 |
| | (0.000) |
| TotAssets | -0.000$^{***}$ |
| | (0.000) |
| YEAR | .080 |
| | (.221) |
| Constant | -196.994 |
| | (445.946) |
| Observations | 1,722 |
| $R^2$ | .436 |
| Adjusted $R^2$ | .408 |
| Residual Std. Error | 10.039 (df = 1641) |
| F Statistic | 15.853$^{***}$ (df = 80; 1641) |

| | |
|---|---|
| *Notes:* | $^*$P < .05 |
| | $^{**}$P < .01 |
| | $^{***}$P < .001 |
| | ANOVA Tables |

As demonstrated from the results provided above, the statistically significant variables of the empirical model are the following:

- Logarithmic Market Capitalization
- Price-to-book ratio
- Employees
- Total Assets
- Various firm/industry-fixed effects variables (Advanced medical equipment, Advertising, Aerospace, Airlines, Agricultural chemicals and many more).

However, it should be noted that in the robust –in contrast to the simple multiple linear one- ROA model, the logarithmic Pay Ratio is not statistically significant.

As noted, before, the robust model is inherently homoscedastic, therefore the only robustness test left is that of multicollinearity. Multicollinearity could be suspected, as it was present in the first empirical model; however, this time, the fixed effects variables that were the cause of multicollinearity have already been omitted as redundant. As concluded from the test's output, no multicollinearity is detected at all[5].

The third empirical model to be presented is the ROE model, in other words, the empirical model having ROE (Return on Equity) as its dependent variable. This is the last one of the regressions to be implemented in this dissertation. The significance of the model's variables, as well as other ANOVA statistical values, are displayed in the table to follow.

<div align="center">

**Table 6. Regression 3 results**

**Title: Regression results- Model 3**

</div>

|  | ROE |
| --- | --- |
| LNMarketCap | .182 |
|  | (1.143) |

---

[5] All the output from these tests is included in the Appendix.

| | |
|---|---|
| PriceToBook | .905*** |
| | (.048) |
| LNPayRatio | 2.303 |
| | (1.359) |
| Employees | 0.000*** |
| | (0.000) |
| TotAssets | -0.000*** |
| | (0.000) |
| YEAR | -.743 |
| | (1.105) |
| Constant | 1,497.123 |
| | (2,233.405) |
| Observations | 1,722 |
| $R^2$ | .346 |
| Adjusted $R^2$ | .314 |
| Residual Std. Error | 50.277 (df = 1641) |
| F Statistic | 10.850*** (df = 80; 1641) |

| Notes: | *P < .05 |
|---|---|
| | **P < .01 |
| | ***P < .001 |

ANOVA Tables

The statistically significant variables of the third empirical model are thus the following:

- Price-to-book ratio

- Employees

- Total Assets

- Various firm/industry-fixed effects variables (Auto Vehicles, Parts & Service Retailers, Biotechnology & Medical Research, Courier, Postal, Air Freight & Land-based Logistics, Healthcare Facilities & Services and more).

However, once again, the logarithmic pay ratio does not have a moderate or above connection to ROE; in fact, only a weak one.

As far as robustness tests go, the main results are presented in the next 2 tables.

**Table 7. VIF test for empirical model 3**

| Logarithmic Market Capitalization | 2.5091 |
|---|---|
| Price-to-book Ratio | 1.1464 |
| Logarithmic Pay Ratio | 2.6097 |
| Employees | 2.4882 |
| Total assets | 1.8090 |
| Year | 1.0567 |

**Table 3. Empirical model 3- Heteroscedasticity test**

| BP | 96.353 |
|---|---|
| Df | 80 |
| p-value | 0.1028 |

It is obvious that this empirical model is also robust.

In the next paragraph, there are some conclusive remarks, pertinent to the commentary already provided in this chapter.

## Concluding Remarks

In concluding this chapter, some remarks have to be made, in order to summarize the work that has been presented in this chapter. Firstly, it is apparent that the main finding of this dissertation is that there indeed is a very strong and statistically significant connection between Stock Returns on one hand and the Salary Gap on the other hand. The corresponding empirical model is able to interpret a portion of the stock returns' variance in a statistically significant manner as a whole. It is definitely noteworthy that the coefficient of the Pay Ratio is found to have a negative value. It therefore follows that a larger pay ratio has a negative effect on the cross-sections of Stock Returns, as those were aggregated for the years 2017-2020. These results suggest the existence of a connection between a firm's investors valuation and the pay ratio or, in other words, the gap between a firm's CEO compensation and the mean employee salary and the firm's valuation, as performed by investors. Also, there is a connection between Stock returns and other control variables, such as the price-to-book ratio (in all models), Employee's average (in all three models), the logarithmic transformation of market capitalization (in two of the models), total assets (in two out of the three models). However, the year-fixed effects variable has not been found to be statistically significant in any of the models.

As to the complementary regressions, there pertain to the possible connections that may exist between a firm's pay ratio and the firm's performance indicators. In this respect, there doesn't seem to be a consistent connection between these two variables. ROA doesn't seem to be significantly connected to a firm's salary gap. There also seems to be a mere weak correlation between ROE and the firms' pay ratio. Also, all the empirical models are proven to be robust, via the conduction of two well-known robustness tests, which certify the robustness of the models and the elimination of possible multicollinearity and heteroscedasticity issues.

All in all, the findings of this study are consistent with those of most previous studies, as will be further elaborated in the next chapter.

# 5.Discussion and Conclusion

In this study, it is suggested that firm's valuation and pay ratio are very strongly correlated.

As to the way this could be incorporated into current research, it is not the findings of Mueller et al. (2016), but the work of Dittmann et al. (2018), Green & Zhou (2019) and especially Pan et al. (2021) which are consistent with this study. In this dissertation, instead of Cumulative Abnormal Returns, Stock Returns are taken as a dependent variable and similar results are derived; this is very important, as Pan et al. (2021) also examine U.S. listed firms. The works of Dittmann et al. (2018), Green & Zhou (2019) are related to the findings, especially the former, as it finds an association between stock returns and pay ratio, with regard to German firms. However, the closest relation is that to the work of Pan et al. (2021), who, through taking abnormal returns as the dependent variable, find, as elaborated in the second chapter, a negative association between stock returns and pay ratio in U.S. firms. This inquiry should continue into the future, with more and more profound research papers, examining the wage gap's impact to various important variables and metrics of firms. This should especially be carried out for more countries, as the United States are not the only country fraught with very high wage gaps among firms. Also, the impact of pay ratio to future stock returns and abnormal returns should be examined.

It is obvious that policy ought to heed carefully such research findings. The widening of the salary gap, in the last decades and the wage stagnation, as it is sometimes called, is not good news for firms and managers should deal with this quite swiftly. Salaries of employees need to rise, and CEOs' compensations need to be appropriately adjusted; then firms should expect stock returns improvement.

The initial question in this study was whether firm investors do incorporate pay dispersion in their firm valuations. The measure of this valuation was the stock returns values of firms. It is suggested in this dissertation that this question is positively answered. The data for empirical research was derived from firms' own disclosure, as mandated by the SEC reform which was activated in 2017. Such data may not always be completely accurate. Also, the research was limited to U.S. firms. Lastly, more variables could have been incorporated into the empirical model, thus increasing the explanatory potential of the model.

As the pay ratio is suggested to bear a real and very strong impact to stock returns, managers should look into dealing with it from another perspective; not only the important ones related to societal and moral considerations, but also that of investors' firms valuation.

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# Appendix

This Appendix contains the total of RStudio output for the regressions conducted, as well as robustness tests.

sumtable {vtable}                                                                    Summary Statistics

## Summary Statistics

| Variable | N | Mean | Std. Dev. | Min | Pctl. 25 | Pctl. 75 | Max |
|---|---|---|---|---|---|---|---|
| 2017_Returns | 421 | 19.681 | 43.258 | -90.274 | -2.079 | 29.339 | 373.418 |
| 2017_MarketCap | 421 | 1459475 1100.599 | 3887429 3792.982 | 0 | 9836184 30.9 | 1015297 6134.08 | 3710524 53204.38 |
| 2017_PriceToBook | 421 | 3.601 | 8.296 | -61.966 | 1.465 | 3.837 | 75.834 |
| 2017_PayRatio | 421 | 413.918 | 2281.836 | 0.112 | 20.761 | 127.511 | 27267.92 6 |
| 2017_Employees | 421 | 16362.51 4 | 45311.06 2 | 3 | 692 | 11185 | 444000 |
| 2017_TotAssets | 421 | 4967146 8351.772 | 2279440 56447.82 4 | 7848800 0 | 2180157 000 | 2003690 5000 | 2.5336e+ 12 |
| 2017_ROA | 421 | 0.8 | 18.272 | -139.65 | 0.92 | 4.98 | 169.92 |
| 2017_ROE | 421 | 7.551 | 66.67 | -909.9 | 7.45 | 15.13 | 720.9 |
| 2017_LNMarketCap | 420 | 21.977 | 1.559 | 18.942 | 20.713 | 23.043 | 26.64 |
| 2017_LNPayRatio | 421 | 4.048 | 1.48 | -2.193 | 3.033 | 4.848 | 10.213 |

**Figure 1. Descriptive Statistics of the year 2017**

sumtable {vtable}                                                                    Summary Statistics

## Summary Statistics

| Variable | N | Mean | Std. Dev. | Min | Pctl. 25 | Pctl. 75 | Max |
|---|---|---|---|---|---|---|---|
| 2018_Returns | 416 | -11.29 | 25.584 | -84.825 | -25.994 | -0.648 | 182.143 |
| 2018_MarketCap | 416 | 1265014 9566.763 | 3489952 1739.447 | 1084766 88 | 8659304 31.11 | 74083113 37.965 | 3246265 94974.5 |
| 2018_PriceToBook | 416 | 1.86 | 9.594 | -166.456 | 1.036 | 2.56 | 33.812 |
| 2018_PayRatio | 416 | 420.316 | 2307.593 | 0.113 | 20.029 | 111.919 | 31626.71 8 |
| 2018_Employees | 416 | 16208.88 5 | 45781.25 5 | 3 | 727.25 | 10337.5 | 467500 |
| 2018_TotAssets | 416 | 5210153 4118.507 | 2337444 49642.26 3 | 1067660 00 | 2934213 750 | 2070050 8500 | 2.622532 e+12 |
| 2018_ROA | 416 | 2.197 | 13.094 | -123.19 | 1.178 | 6.482 | 29.41 |
| 2018_ROE | 416 | 9.599 | 51.467 | -446.15 | 9 | 17.025 | 376.72 |
| 2018_LNMarketCap | 416 | 21.768 | 1.586 | 18.502 | 20.579 | 22.726 | 26.506 |
| 2018_LNPayRatio | 416 | 4.025 | 1.501 | -2.177 | 2.997 | 4.718 | 10.362 |

**Figure 2. Descriptive statistics of the year 2018**

# Summary Statistics

| Variable | N | Mean | Std. Dev. | Min | Pctl. 25 | Pctl. 75 | Max |
|---|---|---|---|---|---|---|---|
| 2019_Returns | 427 | 29.236 | 58.141 | -70.699 | 13.93 | 36.888 | 1074.813 |
| 2019_MarketCap | 427 | 14177232359.999 | 42798616327.365 | 115164769.8 | 797606924.39 | 8210792644.43 | 437225998405.6 |
| 2019_PriceToBook | 427 | 2.434 | 12.856 | -185.7 | 1.156 | 2.483 | 132.186 |
| 2019_PayRatio | 427 | 432.651 | 3096.888 | 0.858 | 15.612 | 91.867 | 48422.566 |
| 2019_Employees | 427 | 15169.909 | 42925.186 | 2 | 635.25 | 8900 | 488000 |
| 2019_TotAssets | 427 | 58011297886.361 | 260027307040.762 | 55273000 | 28145640000 | 21330571500 | 2.687379e+12 |
| 2019_ROA | 427 | 3.247 | 8.469 | -64.56 | 1.11 | 5.09 | 42.719 |
| 2019_ROE | 427 | 14.092 | 59.607 | -553.259 | 8.985 | 16.1 | 828.08 |
| 2019_LNMarketCap | 427 | 21.786 | 1.677 | 18.562 | 20.497 | 22.829 | 26.804 |
| 2019_LNPayRatio | 427 | 3.823 | 1.42 | -0.154 | 2.748 | 4.52 | 10.788 |

Figure 3. Descriptive statistics of the year 2019

# Summary Statistics

| Variable | N | Mean | Std. Dev. | Min | Pctl. 25 | Pctl. 75 | Max |
|---|---|---|---|---|---|---|---|
| 2020_Returns | 459 | 2.521 | 47.488 | -70.445 | -20.467 | 12.627 | 434.1 |
| 2020_MarketCap | 459 | 12380492772.399 | 38514584351.889 | 51766767.36 | 517662615.44 | 7596643288.775 | 511232359138.11 |
| 2020_PriceToBook | 459 | 0.154 | 48.894 | -899.64 | 0.906 | 2.242 | 331.255 |
| 2020_PayRatio | 459 | 182.448 | 1124.524 | 0.342 | 14.31 | 85.751 | 16517.236 |
| 2020_Employees | 459 | 12819.094 | 39853.277 | 1 | 476.25 | 7508.75 | 519000 |
| 2020_TotAssets | 459 | 55922166721.571 | 268476771606.229 | 58877000 | 25529140000 | 19978722000 | 3.384757e+12 |
| 2020_ROA | 459 | 0.901 | 10.402 | -115.24 | 0.68 | 2.38 | 53.399 |
| 2020_ROE | 459 | 3.487 | 63.333 | -1042.3 | 5.475 | 12.965 | 357.58 |
| 2020_LnMarketCap | 459 | 21.507 | 1.835 | 17.762 | 20.065 | 22.751 | 26.96 |
| 2020_Ln_PayRatio | 459 | 3.639 | 1.33 | -1.074 | 2.661 | 4.451 | 9.712 |

Figure 4. Descriptive statistics of the year 2020

```
                                                                  Pr(>|t|)
(Intercept)                                                       0.375049
AllDataDiorth_C$LNMarketCap                                       4.32e-16
AllDataDiorth_C$PriceToBook                                       0.078069
AllDataDiorth_C$LNPayRatio                                        0.000305
AllDataDiorth_C$Employees                                        0.008745
AllDataDiorth_C$TotAssets                                        0.635081
AllDataDiorth_C$YEAR                                             0.423687
AllDataDiorth_C$`Advanced Medical Equipment & Technology`         0.064868
AllDataDiorth_C$`Advertising & Marketing`                        0.593939
AllDataDiorth_C$`Aerospace & Defense`                            0.020216
AllDataDiorth_C$`Agricultural Chemicals`                          0.085003
AllDataDiorth_C$Airlines                                         0.934460
AllDataDiorth_C$Aluminum                                         0.544926
AllDataDiorth_C$`Auto Vehicles, Parts & Service Retailers`        0.003760
AllDataDiorth_C$`Auto, Truck & Motorcycle Parts`                 0.539896
AllDataDiorth_C$Banks                                           0.254362
AllDataDiorth_C$`Biotechnology & Medical Research`               1.24e-07
AllDataDiorth_C$`Business Support Services`                      0.091960
AllDataDiorth_C$`Commercial REITs`                              0.076793
AllDataDiorth_C$`Commodity Chemicals`                           0.388937
AllDataDiorth_C$`Communications & Networking`                   0.075816
AllDataDiorth_C$`Computer Hardware`                             0.357545
AllDataDiorth_C$`Construction & Engineering`                    0.818935
AllDataDiorth_C$`Construction Supplies & Fixtures`              0.163029
AllDataDiorth_C$`Consumer Goods Conglomerates`                  0.664161
AllDataDiorth_C$`Consumer Lending`                              0.040354
AllDataDiorth_C$`Consumer Publishing`                           0.077518
AllDataDiorth_C$`Corporate Financial Services`                  0.006768
AllDataDiorth_C$`Courier, Postal, Air Freight & Land-based Logistics`  0.130582
AllDataDiorth_C$`Department Stores`                             0.055344
AllDataDiorth_C$`Diversified Chemicals`                         0.582788
AllDataDiorth_C$`Diversified Investment Services`               0.511254
AllDataDiorth_C$`Electric Utilities`                            0.790328
AllDataDiorth_C$`Electrical Components & Equipment`             0.071994
AllDataDiorth_C$`Electronic Equipment & Parts`                  0.022928
AllDataDiorth_C$`Employment Services`                           0.121844
```

Figure 5. Empirical model 1- Independent variables p-values (1)

```
AllDataDiorth_C$`Employment Services`                                      0.121844
AllDataDiorth_C$`Entertainment Production`                                 0.168763
AllDataDiorth_C$`Environmental Services & Equipment`                       0.245736
AllDataDiorth_C$`Financial & Commodity Market Operators & Service Providers` 0.275196
AllDataDiorth_C$`Financial Technology (Fintech)`                           0.607976
AllDataDiorth_C$`Food Processing`                                          0.055469
AllDataDiorth_C$`Food Retail & Distribution`                              0.185148
AllDataDiorth_C$Gold                                                       0.538071
AllDataDiorth_C$`Ground Freight & Logistics`                              0.099494
AllDataDiorth_C$`Healthcare Facilities & Services`                        0.005548
AllDataDiorth_C$`Home Furnishings Retailers`                              0.284968
AllDataDiorth_C$Homebuilding                                               0.728574
AllDataDiorth_C$`Hotels, Motels & Cruise Lines`                          0.590795
AllDataDiorth_C$`Industrial Machinery & Equipment`                        0.529423
AllDataDiorth_C$`Investment Banking & Brokerage Services`                 0.241073
AllDataDiorth_C$`Investment Holding Companies`                            0.104362
AllDataDiorth_C$`Investment Management & Fund Operators`                  0.309690
AllDataDiorth_C$`Iron & Steel`                                            0.153278
AllDataDiorth_C$`IT Services & Consulting`                                0.092405
AllDataDiorth_C$`Leisure & Recreation`                                    0.867205
AllDataDiorth_C$`Life & Health Insurance`                                 0.315434
AllDataDiorth_C$`Managed Healthcare`                                      0.485452
AllDataDiorth_C$`Medical Equipment, Supplies & Distribution`             7.99e-07
AllDataDiorth_C$`Miscellaneous Specialty Retailers`                       0.023741
AllDataDiorth_C$`Multiline Insurance & Brokers`                           0.000332
AllDataDiorth_C$`Multiline Utilities`                                     0.965279
AllDataDiorth_C$`Natural Gas Utilities`                                   0.438243
AllDataDiorth_C$`Non-Alcoholic Beverages`                                 0.439769
AllDataDiorth_C$`Office Equipment`                                        0.118271
AllDataDiorth_C$`Oil and Gas Refining and Marketing`                            NA
AllDataDiorth_C$`Oil and Gas Exploration and Production`                        NA
AllDataDiorth_C$`Oil and Gas Drilling`                                          NA
AllDataDiorth_C$`Oil Related Services and Equipment`                      0.832139
AllDataDiorth_C$`Online Services`                                         0.574275
AllDataDiorth_C$`Personal Services`                                       0.773277
AllDataDiorth_C$Pharmaceuticals                                           0.653326
```

**Figure 6. Empirical model 1- Independent variables p-value (2)**

```
AllDataDiorth_C$`Professional Information Services`                        0.065241
AllDataDiorth_C$`Property & Casualty Insurance`                           0.036722
AllDataDiorth_C$`Real Estate Rental, Development & Operations`            0.913068
AllDataDiorth_C$`Real Estate Services`                                    0.226166
AllDataDiorth_C$`Recreational Products`                                   0.331099
AllDataDiorth_C$`Renewable Energy Equipment & Services`                   0.006429
AllDataDiorth_C$`Residential REITs`                                       0.852722
AllDataDiorth_C$`Restaurants & Bars`                                      0.022928
AllDataDiorth_C$Semiconductors                                            0.158752
AllDataDiorth_C$Software                                                   7.42e-05
AllDataDiorth_C$`Specialized REITs`                                       0.513956
AllDataDiorth_C$`Specialty Chemicals`                                     0.020673
AllDataDiorth_C$`Specialty Mining & Metals`                               0.196752
AllDataDiorth_C$`Water & Related Utilities`                               0.443460
AllDataDiorth_C$`Wireless Telecommunications Services`                    0.350241
```

**Figure 7. Empirical model 1- Independent variables p-value (3)**

```
> car::vif(model)
                                              AllDataDiorth_C$LNMarketCap
                                                                 2.509186
                                               AllDataDiorth_C$PriceToBook
                                                                 1.146456
                                                AllDataDiorth_C$LNPayRatio
                                                                 2.690452
                                                 AllDataDiorth_C$Employees
                                                                 2.489403
                                                 AllDataDiorth_C$TotAssets
                                                                 1.812358
                                                      AllDataDiorth_C$YEAR
                                                                 1.057174
                 AllDataDiorth_C$`Advanced Medical Equipment & Technology`
                                                                 1.601503
                           AllDataDiorth_C$`Advertising & Marketing`
                                                                 1.456563
                               AllDataDiorth_C$`Aerospace & Defense`
                                                                 1.286302
                          AllDataDiorth_C$`Agricultural Chemicals`
                                                                 1.221195
                                              AllDataDiorth_C$Airlines
                                                                 3.232923
                                              AllDataDiorth_C$Aluminum
                                                                 1.221910
              AllDataDiorth_C$`Auto Vehicles, Parts & Service Retailers`
                                                                 2.253850
                       AllDataDiorth_C$`Auto, Truck & Motorcycle Parts`
                                                                 1.278279
                                                 AllDataDiorth_C$Banks
                                                                25.307627
                   AllDataDiorth_C$`Biotechnology & Medical Research`
                                                                 5.275385
                          AllDataDiorth_C$`Business Support Services`
                                                                 1.826984
```

Figure 8. Empirical model 1- VIF robustness test (1)

```
              AllDataDiorth_C$`Commercial REITs`
                                       1.601859
            AllDataDiorth_C$`Commodity Chemicals`
                                       1.170560
      AllDataDiorth_C$`Communications & Networking`
                                       1.282167
             AllDataDiorth_C$`Computer Hardware`
                                       1.166453
        AllDataDiorth_C$`Construction & Engineering`
                                       1.276863
    AllDataDiorth_C$`Construction Supplies & Fixtures`
                                       1.062063
      AllDataDiorth_C$`Consumer Goods Conglomerates`
                                       1.116909
             AllDataDiorth_C$`Consumer Lending`
                                       4.324334
            AllDataDiorth_C$`Consumer Publishing`
                                       1.230343
        AllDataDiorth_C$`Corporate Financial Services`
                                       1.509791
AllDataDiorth_C$`Courier, Postal, Air Freight & Land-based Logistics`
                                       2.089813
            AllDataDiorth_C$`Department Stores`
                                       1.055815
            AllDataDiorth_C$`Diversified Chemicals`
                                       1.067320
        AllDataDiorth_C$`Diversified Investment Services`
                                       1.228952
              AllDataDiorth_C$`Electric Utilities`
                                       1.523192
      AllDataDiorth_C$`Electrical Components & Equipment`
                                       1.188339
          AllDataDiorth_C$`Electronic Equipment & Parts`
                                       1.188177
             AllDataDiorth_C$`Employment Services`
                                       1.835709
```

**Figure 9. Empirical model 1- VIF robustness test (2)**

```
              AllDataDiorth_C$`Entertainment Production`
                                       1.175385
         AllDataDiorth_C$`Environmental Services & Equipment`
                                       1.509247
AllDataDiorth_C$`Financial & Commodity Market Operators & Service Providers`
                                       2.333127
          AllDataDiorth_C$`Financial Technology (Fintech)`
                                       1.059625
              AllDataDiorth_C$`Food Processing`
                                       1.549850
          AllDataDiorth_C$`Food Retail & Distribution`
                                       1.063154
                        AllDataDiorth_C$Gold
                                       1.228757
          AllDataDiorth_C$`Ground Freight & Logistics`
                                       3.987436
        AllDataDiorth_C$`Healthcare Facilities & Services`
                                       3.237295
          AllDataDiorth_C$`Home Furnishings Retailers`
                                       1.126715
                   AllDataDiorth_C$Homebuilding
                                       1.114970
          AllDataDiorth_C$`Hotels, Motels & Cruise Lines`
                                       1.693802
        AllDataDiorth_C$`Industrial Machinery & Equipment`
                                       1.167266
      AllDataDiorth_C$`Investment Banking & Brokerage Services`
                                       3.332340
          AllDataDiorth_C$`Investment Holding Companies`
                                       1.057795
    AllDataDiorth_C$`Investment Management & Fund Operators`
                                       4.261153
                 AllDataDiorth_C$`Iron & Steel`
                                       1.547171
```

**Figure 10. Empirical model 1- VIF robustness test (3)**

```
AllDataDiorth_C$`IT Services & Consulting`
                                   1.099555
AllDataDiorth_C$`Leisure & Recreation`
                                   1.051833
AllDataDiorth_C$`Life & Health Insurance`
                                   1.098922
AllDataDiorth_C$`Managed Healthcare`
                                   1.023781
AllDataDiorth_C$`Medical Equipment, Supplies & Distribution`
                                   1.036840
AllDataDiorth_C$`Miscellaneous Specialty Retailers`
                                   1.005977
AllDataDiorth_C$`Multiline Insurance & Brokers`
                                   1.103677
AllDataDiorth_C$`Multiline Utilities`
                                   1.009185
AllDataDiorth_C$`Natural Gas Utilities`
                                   1.016236
AllDataDiorth_C$`Non-Alcoholic Beverages`
                                   1.028981
AllDataDiorth_C$`Office Equipment`
                                   1.030942
AllDataDiorth_C$`Online Services`
                                   1.067548
AllDataDiorth_C$`Personal Services`
                                   1.028126
AllDataDiorth_C$Pharmaceuticals
                                   1.027084
AllDataDiorth_C$`Professional Information Services`
                                   1.010903
AllDataDiorth_C$`Property & Casualty Insurance`
                                   1.022982
AllDataDiorth_C$`Real Estate Rental, Development & Operations`
                                   1.001971
```

**Figure 11. Empirical model 1- VIF robustness test (4)**

```
AllDataDiorth_C$`Recreational Products`
                                   1.017258
AllDataDiorth_C$`Renewable Energy Equipment & Services`
                                   1.009360
AllDataDiorth_C$`Residential REITs`
                                   1.012863
AllDataDiorth_C$`Restaurants & Bars`
                                   1.267894
AllDataDiorth_C$Semiconductors
                                   1.004675
AllDataDiorth_C$Software
                                   1.053875
AllDataDiorth_C$`Specialized REITs`
                                   1.072039
AllDataDiorth_C$`Specialty Chemicals`
                                   1.035157
AllDataDiorth_C$`Specialty Mining & Metals`
                                   1.017924
AllDataDiorth_C$`Water & Related Utilities`
                                   1.015005
AllDataDiorth_C$`Wireless Telecommunications Services`
                                   1.020536
```

**Figure 12. Empirical model 1- VIF robustness test (5)**

```
> lmtest::bptest(model)

        studentized Breusch-Pagan test

data:  model
BP = 64.082, df = 80, p-value = 0.9031
```

Figure 13. Empirical model 1- Heteroscedasticity (Breusch-Pagan) test

```
==================================================================
                                       Dependent variable:
                                  --------------------------
                                              ROA
------------------------------------------------------------------
LNMarketCap                               0.225***
                                          p = 0.000

PriceToBook                               -0.010***
                                          p = 0.000

LNPayRatio                                 0.052
                                          p = 0.142

Employees                                 0.00001***
                                          p = 0.000

TotAssets                                 -0.000***
                                          p = 0.000

YEAR                                       -0.038
                                          p = 0.193

`Advanced Medical Equipment              Technology`
                                          p = 0.000

`Advertising                             Marketing`
                                          p = 0.00000

`Aerospace                               Defense`
                                          p = 0.000

`Agricultural Chemicals`                  6.863***
                                          p = 0.000

Airlines                                  3.522***
                                          p = 0.000
```

Figure 14. Empirical model 2- Independent variables p-values (1)

```
Aluminum                                                  -1.690**
                                                          p = 0.011

`Auto Vehicles, Parts                       Service Retailers`
                                                          p = 0.000

`Auto, Truck                                   Motorcycle Parts`
                                                          p = 0.00000

`Biotechnology                                 Medical Research`
                                                          p = 0.000

`Business Support Services`                          7.177***
                                                          p = 0.000

`Commercial REITs`                                   1.373***
                                                          p = 0.001

`Commodity Chemicals`                                  0.750
                                                          p = 0.330

`Communications                                       Networking`
                                                          p = 0.000

`Computer Hardware`                                   1.456*
                                                          p = 0.057

`Construction                                        Engineering`
                                                          p = 0.000

`Construction Supplies                                  Fixtures`
                                                          p = 0.005
```

**Figure 15. Empirical model 2- Independent variables p-values (2)**

```
`Consumer Goods Conglomerates`           8.343***
                                          p = 0.000

`Consumer Lending`                       0.737***
                                          p = 0.00003

`Consumer Publishing`                    5.263***
                                          p = 0.000

`Corporate Financial Services`           1.579***
                                          p = 0.0004

`Courier, Postal, Air Freight       Land-based Logistics`
                                          p = 0.000

`Department Stores`                      8.422***
                                          p = 0.000

`Diversified Chemicals`                   1.039
                                          p = 0.435

`Diversified Investment Services`        -0.252
                                          p = 0.704

`Electric Utilities`                     0.801*
                                          p = 0.075

`Electrical Components                 Equipment`
                                          p = 0.000

`Electronic Equipment                     Parts`
                                          p = 0.000

`Employment Services`                    9.012***
                                          p = 0.000
```

**Figure 16. Empirical model 2- Independent variables p-values (3)**

```
`Entertainment Production`                        -1.449*
                                                p = 0.061

`Environmental Services                        Equipment`
                                                p = 0.000

`Financial                          Commodity Market Operators
                                                p = 0.000

`Financial Technology (Fintech)`                  -0.826
                                                p = 0.532

`Food Processing`                               12.689***
                                                p = 0.000

`Food Retail                                  Distribution`
                                                p = 0.000

Gold                                             1.855***
                                                p = 0.006

`Ground Freight                                Logistics`
                                                p = 0.000

`Healthcare Facilities                          Services`
                                                p = 0.000

`Home Furnishings Retailers`                    10.461***
                                                p = 0.000

Homebuilding                                     5.738***
                                                p = 0.000

`Hotels, Motels                               Cruise Lines`
                                                p = 0.000
```

Figure 17. Empirical model 2- Independent variables p-values (4)

```
`Industrial Machinery                          Equipment`
                                                p = 0.000

`Investment Banking                    Brokerage Services`
                                                p = 0.000

`Investment Holding Companies`                    1.560
                                                p = 0.237

`Investment Management                     Fund Operators`
                                                p = 0.000

`Iron                                            Steel`
                                                p = 0.000

`IT Services                                  Consulting`
                                                p = 0.004

`Leisure                                     Recreation`
                                                p = 0.00000

`Life                                   Health Insurance`
                                                p = 0.811

`Managed Healthcare`                             5.267***
                                                p = 0.000

`Medical Equipment, Supplies             Distribution`
                                                p = 0.000

`Miscellaneous Specialty Retailers`              2.828***
                                                p = 0.0003

`Multiline Insurance                           Brokers`
                                                p = 0.051
```

Figure 18. Empirical model 2- Independent variables p-values (5)

```
`Natural Gas Utilities`                                    1.399***
                                                         p = 0.010

`Non-Alcoholic Beverages`                                 19.502***
                                                         p = 0.000

`Office Equipment`                                          1.811*
                                                         p = 0.056

`Online Services`                                         13.229***
                                                         p = 0.000

`Personal Services`                                       15.018***
                                                         p = 0.000

Pharmaceuticals                                           10.365***
                                                         p = 0.000

`Professional Information Services`                       11.446***
                                                         p = 0.000

`Property                                      Casualty Insurance`
                                                         p = 0.000

`Real Estate Rental, Development                      Operations`
                                                         p = 0.697

`Real Estate Services`                                     2.742***
                                                         p = 0.00004

`Recreational Products`                                    8.644***
                                                         p = 0.000

`Renewable Energy Equipment                            Services`
                                                         p = 0.109
```

Figure 19. Empirical model 2- Independent variables p-values (6)

```
`Residential REITs`                                        2.097**
                                                         p = 0.026

`Restaurants                                              Bars`
                                                         p = 0.000

Semiconductors                                            7.957***
                                                         p = 0.000

Software                                                  0.202
                                                         p = 0.539

`Specialized REITs`                                       0.757***
                                                         p = 0.0001

`Specialty Chemicals`                                     1.783***
                                                         p = 0.00002

`Specialty Mining                                        Metals`
                                                         p = 0.125

`Water                                      Related Utilities`
                                                         p = 0.105

`Wireless Telecommunications Services`                    6.307***
                                                         p = 0.000
```

Figure 20. Empirical model 2- Independent variables p-values (7)

```
                                           AllDataDiorth_C$LNMarketCap
                                                            2.509100
                                           AllDataDiorth_C$PriceToBook
                                                            1.146451
                                            AllDataDiorth_C$LNPayRatio
                                                            2.609730
                                            AllDataDiorth_C$Employees
                                                            2.488228
                                             AllDataDiorth_C$TotAssets
                                                            1.809099
                                                 AllDataDiorth_C$YEAR
                                                            1.056715
                  AllDataDiorth_C$`Advanced Medical Equipment & Technology`
                                                            1.031334
                            AllDataDiorth_C$`Advertising & Marketing`
                                                            1.037904
                               AllDataDiorth_C$`Aerospace & Defense`
                                                            1.045466
                              AllDataDiorth_C$`Agricultural Chemicals`
                                                            1.010091
                                            AllDataDiorth_C$Airlines
                                                            1.090607
                                            AllDataDiorth_C$Aluminum
                                                            1.007177
                  AllDataDiorth_C$`Auto Vehicles, Parts & Service Retailers`
                                                            1.061362
                          AllDataDiorth_C$`Auto, Truck & Motorcycle Parts`
                                                            1.020134
                       AllDataDiorth_C$`Biotechnology & Medical Research`
                                                            1.073385
                             AllDataDiorth_C$`Business Support Services`
                                                            1.067437
```

**Figure 21. Empirical model 2- VIF robustness test**

```
(Intercept)                                                      0.502741
AllDataDiorth_C$LNMarketCap                                      0.873446
AllDataDiorth_C$PriceToBook                                      < 2e-16
AllDataDiorth_C$LNPayRatio                                       0.090421
AllDataDiorth_C$Employees                                        8.03e-09
AllDataDiorth_C$TotAssets                                        1.44e-05
AllDataDiorth_C$YEAR                                             0.501558
AllDataDiorth_C$`Advanced Medical Equipment & Technology`       0.245811
AllDataDiorth_C$`Advertising & Marketing`                       0.826955
AllDataDiorth_C$`Aerospace & Defense`                           0.512699
AllDataDiorth_C$`Agricultural Chemicals`                         0.391494
AllDataDiorth_C$Airlines                                        0.267190
AllDataDiorth_C$Aluminum                                        0.588869
AllDataDiorth_C$`Auto Vehicles, Parts & Service Retailers`      0.001328
AllDataDiorth_C$`Auto, Truck & Motorcycle Parts`                0.894966
AllDataDiorth_C$`Biotechnology & Medical Research`              < 2e-16
AllDataDiorth_C$`Business Support Services`                      0.617741
AllDataDiorth_C$`Commercial REITs`                              0.671965
AllDataDiorth_C$`Commodity Chemicals`                           0.715193
AllDataDiorth_C$`Communications & Networking`                    0.422637
AllDataDiorth_C$`Computer Hardware`                             0.564233
AllDataDiorth_C$`Construction & Engineering`                     0.883528
AllDataDiorth_C$`Construction Supplies & Fixtures`              0.939477
AllDataDiorth_C$`Consumer Goods Conglomerates`                  0.987336
AllDataDiorth_C$`Consumer Lending`                              0.021617
AllDataDiorth_C$`Consumer Publishing`                           0.996127
AllDataDiorth_C$`Corporate Financial Services`                  0.738884
AllDataDiorth_C$`Courier, Postal, Air Freight & Land-based Logistics`  0.000176
AllDataDiorth_C$`Department Stores`                             0.932635
AllDataDiorth_C$`Diversified Chemicals`                         0.744938
AllDataDiorth_C$`Diversified Investment Services`               0.781718
AllDataDiorth_C$`Electric Utilities`                            0.763057
AllDataDiorth_C$`Electrical Components & Equipment`             0.750498
AllDataDiorth_C$`Electronic Equipment & Parts`                  0.928631
AllDataDiorth_C$`Employment Services`                           0.403756
AllDataDiorth_C$`Entertainment Production`                      0.513060
AllDataDiorth_C$`Environmental Services & Equipment`            0.615182
```

**Figure 22. Empirical model 3- Independent variables p-values (1)**

```
AllDataDiorth_C$`Financial & Commodity Market Operators & Service Providers`   4.700e+00
AllDataDiorth_C$`Financial Technology (Fintech)`                                1.394e+02
AllDataDiorth_C$`Food Processing`                                               1.388e+01
AllDataDiorth_C$`Food Retail & Distribution`                                   -1.643e+02
AllDataDiorth_C$Gold                                                           -9.992e+00
AllDataDiorth_C$`Ground Freight & Logistics`                                   -1.057e+00
AllDataDiorth_C$`Healthcare Facilities & Services`                             -3.809e+01
AllDataDiorth_C$`Home Furnishings Retailers`                                   -2.734e+00
AllDataDiorth_C$Homebuilding                                                   -2.040e-01
AllDataDiorth_C$`Hotels, Motels & Cruise Lines`                                -3.194e+01
AllDataDiorth_C$`Industrial Machinery & Equipment`                              7.262e+00
AllDataDiorth_C$`Investment Banking & Brokerage Services`                       1.003e+01
AllDataDiorth_C$`Investment Holding Companies`                                 -6.419e+00
AllDataDiorth_C$`Investment Management & Fund Operators`                        9.426e+00
AllDataDiorth_C$`Iron & Steel`                                                 -4.570e+00
AllDataDiorth_C$`IT Services & Consulting`                                     -3.712e+01
AllDataDiorth_C$`Leisure & Recreation`                                         -9.716e+00
AllDataDiorth_C$`Life & Health Insurance`                                      -9.346e-01
AllDataDiorth_C$`Managed Healthcare`                                           -7.188e+00
AllDataDiorth_C$`Medical Equipment, Supplies & Distribution`                   -1.319e+02
AllDataDiorth_C$`Miscellaneous Specialty Retailers`                            -3.554e+00
AllDataDiorth_C$`Multiline Insurance & Brokers`                                 1.083e+02
AllDataDiorth_C$`Multiline Utilities`                                          -5.681e+00
AllDataDiorth_C$`Natural Gas Utilities`                                        -4.033e+00
AllDataDiorth_C$`Non-Alcoholic Beverages`                                       5.568e+00
AllDataDiorth_C$`Office Equipment`                                             -1.635e+01
AllDataDiorth_C$`Online Services`                                              2.249e+01
AllDataDiorth_C$`Personal Services`                                            3.291e+02
AllDataDiorth_C$Pharmaceuticals                                                -9.773e+00
AllDataDiorth_C$`Professional Information Services`                            -5.770e+01
AllDataDiorth_C$`Property & Casualty Insurance`                                -8.214e+00
AllDataDiorth_C$`Real Estate Rental, Development & Operations`                 -6.312e+00
AllDataDiorth_C$`Real Estate Services`                                         -2.315e+01
AllDataDiorth_C$`Recreational Products`                                         1.765e+01
AllDataDiorth_C$`Renewable Energy Equipment & Services`                        -1.506e+01
AllDataDiorth_C$`Residential REITs`                                            -8.729e+00
AllDataDiorth_C$`Restaurants & Bars`                                           -3.659e+01
```

**Figure 23. Empirical model 3- Independent variables p-values (2)**

```
AllDataDiorth_C$`Restaurants & Bars`                         -3.659e+01
AllDataDiorth_C$Semiconductors                               -4.524e+00
AllDataDiorth_C$Software                                      7.893e+00
AllDataDiorth_C$`Specialized REITs`                           1.202e+00
AllDataDiorth_C$`Specialty Chemicals`                        -1.790e+00
AllDataDiorth_C$`Specialty Mining & Metals`                  -7.615e+00
AllDataDiorth_C$`Water & Related Utilities`                  -5.017e+00
AllDataDiorth_C$`Wireless Telecommunications Services`       -2.315e-01
```

**Figure 24. Empirical model 3- Independent variables p-values (3)**

```
                              AllDataDiorth_C$LNMarketCap
                                                 2.509100
                              AllDataDiorth_C$PriceToBook
                                                 1.146451
                              AllDataDiorth_C$LNPayRatio
                                                 2.609730
                              AllDataDiorth_C$Employees
                                                 2.488228
                              AllDataDiorth_C$TotAssets
                                                 1.809099
                              AllDataDiorth_C$YEAR
                                                 1.056715
        AllDataDiorth_C$`Advanced Medical Equipment & Technology`
                                                 1.031334
                 AllDataDiorth_C$`Advertising & Marketing`
                                                 1.037904
                    AllDataDiorth_C$`Aerospace & Defense`
                                                 1.045466
                   AllDataDiorth_C$`Agricultural Chemicals`
                                                 1.010091
                              AllDataDiorth_C$Airlines
                                                 1.090607
                              AllDataDiorth_C$Aluminum
                                                 1.007177
        AllDataDiorth_C$`Auto Vehicles, Parts & Service Retailers`
                                                 1.061362
                 AllDataDiorth_C$`Auto, Truck & Motorcycle Parts`
                                                 1.020134
                 AllDataDiorth_C$`Biotechnology & Medical Research`
                                                 1.073385
                    AllDataDiorth_C$`Business Support Services`
                                                 1.067437
```

**Figure 25. Empirical model 3- VIF robustness test**

```
        studentized Breusch-Pagan test

data:  model
BP = 96.353, df = 80, p-value = 0.1028
```

**Figure 25. Empirical model 3- Heteroscedasticity test**