The influence of CEO compensation on firm performance and its relation to economic growth

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Abstract:

This paper examines the link between CEO compensation and firm performance and its relation to economic growth on the non-financial EuroNext 100 firms from the period 2009-2016. This study uses two different models to estimate the relationship, namely fixed effects panel-data and Arellano-Bond linear dynamic panel-data where firm performance is lagged (t-1). Moreover, the compensation is divided into cash compensation and equity-based compensation and firm performance is measured using accounting-based measures (ROE & ROA) and a market-based measure (Tobin's Q). The empirical results show that there is a significant positive relationship between cash compensation and the accounting-based measures for both models. Furthermore, CEO compensation and firm performance are also significantly positively related to economic growth based on the accounting-based measures for both models.

Keywords:

CEO compensation, firm performance, economic growth, agency theory, optimal contracting theory, managerial power theory, EuroNext 100

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1. Introduction

Chief executive officer (CEO) compensation has been viewed as an important factor to mitigate the conflict of interest between shareholders and managers in a firm. It has been acknowledged by many that CEO compensation could play an important role to align interests. However, there is a controversy surrounding the level of CEO compensation, with multiple articles[1] either defending or criticizing the excessive amounts being paid to the CEO and other executives. The discussion has even led to researches on the public opinion and its influence on CEO compensation (Kuhn, 2010; Kuhnen & Niessen, 2012). Kuhn (2010) finds that: "an overwhelming majority of individuals believes that top executives earn more than they deserve..." (p. 16). However, CEO pay continues to rise worldwide[2], and so the pay gap[3] between executives and typical workers is continuously increasing as well. Even though a large amount of people disagrees with the current executive compensation, most firms are not changing the overall level of executive remuneration. According to Kuhnen & Niessen (2012), firms only lower the type of pay that is most criticized in the press but increase less contentious types of pay. Hence, the overall compensation level stays the same. Critics argue that executive remuneration is too weakly linked to firm performance, so executives receive excessive compensation. Hence, the problem arises whether the excessive compensation influences firm performance.

There have been many studies that examine the relationship between executive compensation and firm performance. However, it seems that these studies have different conclusions regarding this topic. There are studies that find a positive relationship between executive compensation and firm performance (Cheng & Farber, 2008; Ozkan, 2011). Other studies conclude that there is a negative relationship between executive compensation and firm performance (Core, Holthausen, & Larcker, 1999; Newton, 2015). Furthermore, there are some studies that report no relation at all between executive compensation and firm performance (Gomez-Mejia, Larraza-Kintana, & Makri, 2003; Parthasarathy, Menon, & Bhattacharjee, 2006). Thus, whether executive

[1] There have been multiple articles on this topic in different magazines, such as The New York Times, The Economist, Fortune, etc. The one that 'started' the controversy: 'The great CEO pay heist' (Colvin, 2001) and some more recent ones, such as: 'Neither rigged nor fair' (The Economist, 2016).

[2] CEO pay continues to rise throughout the world. The Economic Policy Institute (2014) mentioned the continuous rise of CEO pay in the US. The same can be said for Europe, according to ABC News (2010). A recent article from Bloomberg (2018) confirms that there has been a dramatic increase in CEO pay over the last decades. However, the US and Europe aren't the only continents that have seen an increase. According to a study by Willis Towers Watson (2017), Asia has shown strong economic growth and an accompanying demand for top management positions, which are driving up the base salaries.

[3] The pay gap between CEO and worker has been increasing every year, excluding the financial crisis. The CEO-to-worker pay ratio was 20-to-1 in 1965, 30-to-1 in 1978, 59-to-1 in 1989, 123-to-1 in 1995, 197-to-1 in 2009, and 271-to-1 in 2016. This comparison was made using the compensation of CEOs in America's largest firms (Mishel & Schieder, 2017). Europe has seen similar situations, however, it differs across countries. The UK being at 182-to-1 in 2018, the Netherlands has a 165-to-1 ratio in 2018, Germany has a 135-to-1 ratio in 2018, while Norway has one of the lowest at 20-to-1 in 2017 (Melin & Lu, 2017; ETUC, 2018)

compensation has an influence on firm performance is an ongoing issue. In addition, most studies have been conducted for American firms (Kuo, Lin, Lien, Wang, & Yeh, 2014; Gao & Li, 2015; Newton, 2015). This study will focus on European firms. Another part of this study is the relation of CEO compensation and firm performance to economic growth. Even though there haven't been many studies regarding this topic yet, the conclusion of these studies are similar to each other. The main conclusion in the papers is that GDP growth has a significant influence on both CEO compensation and firm performance (Brito & Vieira, 2013; Campbell, et al., 2016; Galván, Martinez, & Rahman, 2017). In this paper, I will examine the link between CEO compensation and firm performance and its relation to economic growth on the non-financial EuroNext 100 firms. Hence, the research question is as follows: "What is the influence of CEO compensation on firm performance and its relation to economic growth on non-financial firms listed on the EuroNext 100?"

This paper contributes to the literature in three ways. First, prior studies use various data sets and analyze only the relationship between CEO compensation and firm performance. However, as far as my knowledge extends there are only a handful of papers that also relate CEO compensation and firm performance to economic growth. Second, this paper uses both accounting-based and market-based measures for firm performance. CEO compensation is most commonly linked to accounting-based measures in practice. However, Smirnova & Zavertiaeva (2017) argue that accounting-based measures are backward looking. On the other hand, market-based measures are forward looking, since they provide current performance and future expectations. Third, dissimilar to prior research that focuses mostly on the US, this paper examines the link of CEO compensation and firm performance on European firms. The analysis should provide both researchers and practitioners with a helpful comprehension, since Europe is differently characterized in both the governance system and the market situation compared to the US.

The empirical results indicate that there is a positive relationship between CEO compensation and firm performance. In particular, the accounting-based measures (ROE and ROA) for firm performance are both significantly positively related to cash compensation, whereas the market-based measure (Tobin's Q) is insignificant. Furthermore, equity-based compensation is only significant regarding ROA. After lagging the firm performance (t-1), the results still indicate that there is a positive relationship between CEO compensation and firm performance. However, equity-based compensation is insignificant in all cases. Figure 1[4] shows a visual representation of the relationship between accounting-based measures and CEO compensation from four different firms in the sample.

[4] The link between cash compensation, ROE and ROA are definitely visible. Equity does not seem to have a relationship throughout the whole period, but still comes close in some years. The equity line has been altered to a dash dot line to oversee the results better. It would be hard to distinguish the differences between the other variables if equity had a normal line as well.

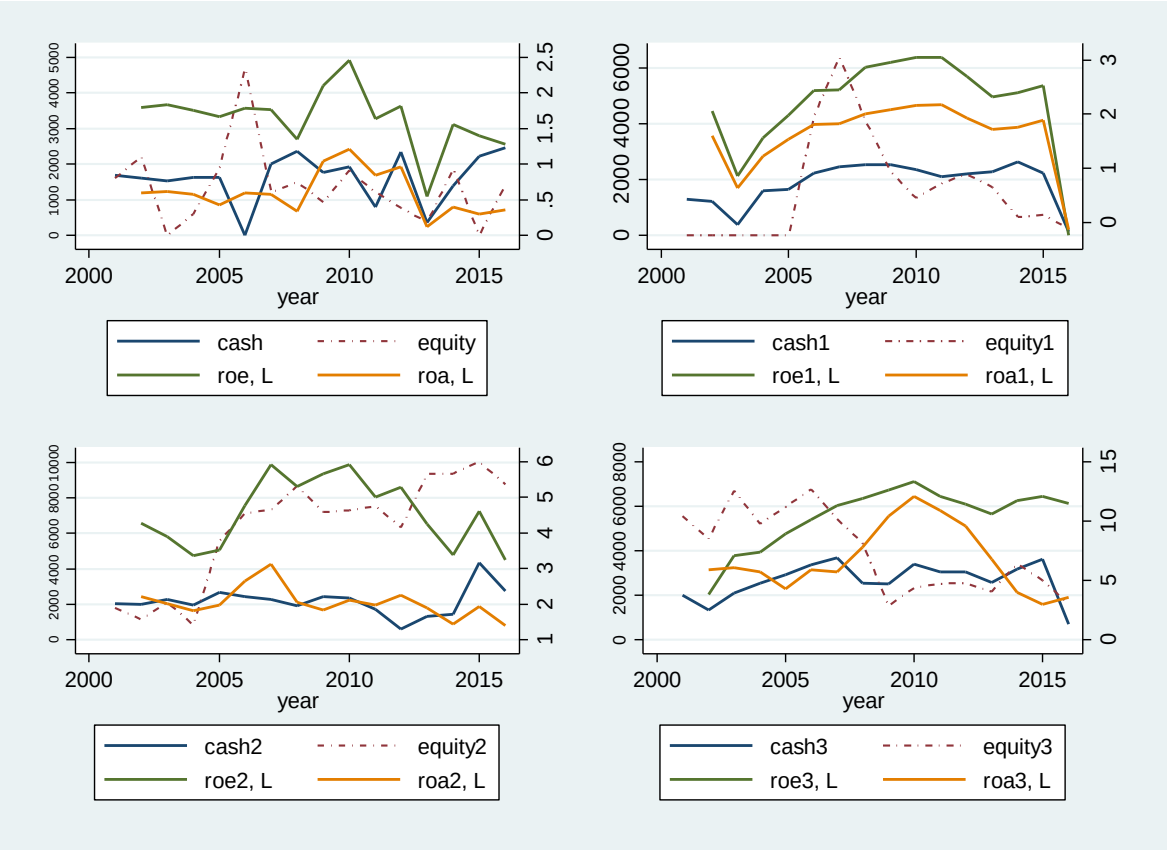

Figure 1: Time-series representation of relationship between compensation and firm performance

It shows that cash compensation is related to both ROE and ROA throughout the whole period, while equity-based compensation is off on certain years but there is still a link between them. The insignificant results of equity-based compensation might be because it is usually linked to non-financial targets within a firm. That there is almost no relation between equity-based compensation and firm performance can be seen in the figure. Perhaps, Tobin's Q is insignificant since CEO compensation is mostly linked to financial targets within a firm. The financial targets are directly related to accounting-based measures. Hence, it is difficult for a market-based measure to pick up this relationship. The added control variables have the expected sign, but are in most cases insignificant.

The estimation between CEO compensation and firm performance and its relation to economic growth confirms that economic growth has an influence. Again, the accounting-based measures are significant, while the market-based measure is insignificant. However, this could be due to the fact that Tobin's Q is calculated with market capitalization. Market capitalization is the market value of a firm in regards to their stock value. Based on the findings of Levine & Zervos (1998) it can be argued that economic growth positively influences the stock markets. Hence, the effect of economic growth could already be captured by Tobin's Q. The added control variables have the expected sign and are in most cases significant.

The remainder of this paper is organized into four sections. In Section 2, the relevant literature is discussed, and the hypotheses are formulated. In Section 3, the data, model, and variables are specified. Empirical results are presented in Section 4. Finally, the conclusion is provided in Section 5.

2. Literature review

This section is divided into six subsections. First, a brief description is given of the current state of CEO compensation. Second, the agency theory is explained in detail. The third subsection describes the optimal contracting theory. The managerial power theory is explained in the fourth subsection. The fifth subsection describes economic growth. Finally, the findings of prior research will be discussed, and the hypotheses will be formulated with regards to the related works.

2.1 CEO compensation

CEO compensation is generally defined as the sum of base salary, cash bonuses, stocks, stock options, and other forms of compensation and benefits (Bognanno, 2010). After taking a random sample of the EuroNext 100 firms, it has become clear that most executive compensation measures are calculated somewhat similar to each other. The compensation is usually calculated as follows: the CEO has a fixed base salary, an annual cash bonus if a financial target is reached, and a long-term investment plan in which the CEO receives stocks or stock options which is related mostly to a non-financial target.

The level of executive compensation has been up for public debate for a long time now, especially in periods of economic distress. Academic researchers positioned themselves on both sides of the debate over whether the level of executive compensation is justified. The main argument of the researchers that are in favor of the current level of CEO compensation is in accordance with the agency theory and optimal contracting theory, which is discussed in detail in paragraph 2.2 and 2.3. They believe that the interests of manager and shareholder can be aligned by using incentives for the manager. The increase in components of compensation that are linked to firm performance, e.g. stock options, are viewed to be the best choice to align the interests. Furthermore, another argument is that there is a competitive market for executive talent, in which the level of CEO compensation reflects the intensive bidding by firms (Hall & Murphy, 2003; Terviö, 2008). The main argument of the researchers against the current level of CEO compensation use the managerial power theory as explanation, which is discussed in detail in paragraph 2.4. They argue that CEO's have power over the board's decision-making processes in determining the CEO compensation. Hence, the CEO can influence the board to decide on a higher level of compensation or less performance-sensitive compensation (Bebchuk, Fried, & Walker, 2002).

In regards to my research, it is important to keep in mind that these theories can influence the relationship between CEO compensation and firm performance. This can be expressed in several ways. For instance, would a CEO work harder to achieve a certain target, which would result in a higher compensation? Perhaps the CEO would, but it is also possible that the CEO opts for a fraudulent way, such as manipulating or misstating figures (Efendi, Srivastava, & Swanson, 2007). Or, would the firm be better off if the CEO reaches an almost unreachable target? The CEO might have taken excessive amount of risks to reach the target. This could have negative consequences in the long-run, since it was fully focused on short-term performance (Bognanno, 2010).

2.2 Agency theory

Agency theory explains how to organize relationships where one determines the work, and another undertakes it (Eisenhardt, 1989; Shane, 1998; Mole, 2002). Ross (1973) describes the agency problem as follows: "an agency relationship has arisen between two (or more) parties when one, designated as the agent, acts for, on behalf of, or as representative for the other, designated the principal, in a particular domain of decision problems." (p. 134) In other words, the principals are the owners/shareholders of a firm, while the agents are the managers and the other executives. The managers and other executives are hired to maximize shareholder value. However, in practice this is hardly ever the case. Figure 2 shows a visual representation of the agency theory.

Three agency problems usually arise under conditions of incomplete information and uncertainty, which characterize most business settings. The agency problems are: adverse selection, moral hazard, and hold-up (Shane, 1998). Adverse selection happens when the principal cannot determine whether the agent is acting on behalf of the interest of the principal. Moral hazard occurs when the principal is unable to verify if the agent is putting forth any effort. The hold-up problem arises when one of the parties tries to renegotiate an agreement when the other party has made a commitment already (Shane, 1998; Mole, 2002).

An agency problem occurs when the goals, interests, or risk preferences of the principal and agent are misaligned. Costs that are incurred by the firm due to this problem are called agency costs. Although agency costs are hard to quantify, it usually manifests in various forms, e.g. costs of contracting and monitoring, a drop in productivity, or loss of firm value (Bebchuk, Fried, & Walker, 2002; Depken, Nguyen, & Sarkar, 2005). A substantial amount of literature empirically examines the effect of executive pay on

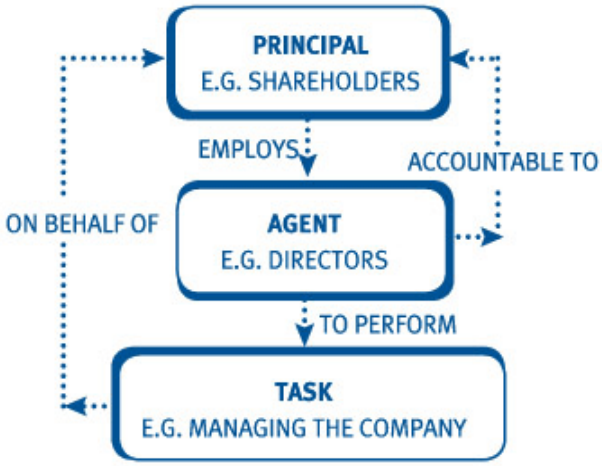

Figure 2: Visual representation of the agency theory

agency conflicts (Kang, Karim, & Rutledge, 2002; Bebchuk & Fried, 2003; Coles, Daniel, & Naveen, 2006; Cambini, Rondi, & Masi, 2015), however, the results are mixed. The general conclusion from these studies is that the agency problem of misalignment of interests is never fully solved due to the assumptions of other theories, i.e. the optimal contracting theory and the managerial power theory.

2.3 Optimal contracting theory

There is no contract that can perfectly align interests of the principals and agents. Therefore, the optimal contract would be one that minimizes agency costs. The executive compensation scheme is designed to minimize the agency costs and to align the interests of principals and agents (Bebchuk & Fried, 2006). Bebchuk et. al. (2002) state that the designer should be concerned with: "(1) attracting and retaining high quality executives, (2) providing executives with incentives to exert sufficient effort and to make decisions that serve shareholders' interests, and (3) minimizing overall costs" (p. 762). I will briefly explain these elements and their value for my research.

First, a high-quality executive is hard to come by since they usually possess a rare combination of skills and instincts. These individuals are uncommon and the competition for these individuals is usually high. Hence, compensation is an important factor to attract such an individual to your company. Second, the company provides incentives to persuade managers to make an effort and make decisions that maximize shareholders' interests. This is the most common agency problem, which is explained in more detail in paragraph 2.2. Third, the compensation scheme is a cost for the company, however, it is a necessary investment to attract highly skilled individuals. The designer should find a compensation scheme that offers the best incentives to the manager at the lowest cost for the company (Bebchuk, Fried, & Walker, 2002).

Regarding the controversy in the introduction, defenders can use the optimal contracting theory to defend their standpoint. The optimal contracting theory has the assumption that the board designs the contract for the manager, which provides incentives to maximize shareholder value. These incentives are necessary to align the interests between managers and shareholders. Hence, this view recognizes that there could be an agency problem, since managers will not naturally seek to maximize shareholder value. This means for my research that the managers are expected to behave according to the contract to receive their compensation. Thus, an increase in firm performance should lead to rewarding the manager with compensation.

2.4 Managerial power theory

The managerial theory suggests quite the opposite of the optimal contracting theory. Bebchuk & Fried (2006) argue that boards rarely engage in arm's length contracting, which is the assumption in optimal contracting theory, due to the power that CEO’s have over board members. This power

originates from specific structural and social-psychological mechanisms that might influence the board's decision-making processes. For example, a highly skilled CEO can make a take-it or leave-it offer for the compensation package. The board would have to accept the offer, since the other option is to hire another manager with a less appropriate level of skill. Or, the CEO has appointed a board member himself, so the board member might feel obligated to return the favor to the CEO. Hence, these mechanisms create certain difficulties for the board to challenge compensation arrangement that would be in more interest of the CEO than the shareholders. This usually results in higher levels of compensation or less performance-sensitive compensation (Bebchuk & Fried, 2006; Carberry, van Essen, & Otten, 2015).

With reference to the controversy in the introduction, critics can use the managerial power theory to explain their criticism. The managerial power theory suggests that CEO's have power over the board, so they can arrange their own compensation scheme. Thus, CEO's or other executives can decide to give themselves more compensation or less-performance sensitive compensation. This would lead to more agency problems and thus resulting in misalignment of interests between CEO's and shareholders. Due to the misalignment of interests, it could mean that firm performance would be negatively influenced by CEO compensation.

2.5 Economic growth

The determinants of economic growth have been a centuries long controversy. Currently, there are basically two categories of economic growth theories. Those based on the traditional Solow growth model and those based on the concept of endogenous growth. Solow's model (1956) is focused on exogenous rates of change in population & technological progress and capital accumulation. The model predicts that market-based economies eventually reach a constant growth rate if it has the same rate of technological progress and population growth. On the other hand, the endogenous growth theory is based on the idea that long-run growth is determined by economic incentives. Additionally, the endogenous growth model assumes that countries have accelerating growth rates and growth rates differ substantially among countries (Romer, 1986).

The traditional model of Solow left too many unanswered questions regarding growth differentials across countries and the mechanisms of technological progress, which gave rise to the endogenous growth theories. Even though the endogenous growth theory has also left some unanswered questions, economists did figure out multiple determinants, such as education, capital investment, political stability, and trade barriers (Gould & Ruffin, 1993). In recent studies, it has come to light that there are still other determinants of economic growth (Brito & Vieira, 2013; Campbell, et al., 2016; Galván, Martinez, & Rahman, 2017). These other determinants are firm performance and

CEO compensation. Due to this recent development, economic growth will be considered when testing the relationship between CEO compensation and firm performance.

2.6 Related works

The academic literature on executive compensation and its influence on firm performance is quite extensive, especially regarding US companies. However, studies that take European firms into account are relatively limited. As far as my knowledge extends, there hasn't been a lot of research yet regarding Europe as a whole. There have been some researches that have taken one European country into account, such as the UK (Ozkan, 2011), France (Yamina & Mohamed, 2017) and Italy (Brunello, Graziano, & Parigi, 2001). However, a research regarding the effect of executive compensation on firm performance in Europe as a whole has not seen much popularity yet. In addition to that, the relation of economic growth to CEO compensation and firm performance has only been examined by a couple of studies. Similar studies that research the effect of executive compensation on firm performance and its relation to economic growth are discussed briefly below.

Core et. al. (1999) analyze the association between the level of CEO compensation and the quality of firms' corporate governance and the influence on firm performance. A sample of 205 publicly traded US firms is used over a three-year period. They find consistent evidence of a negative relation between the compensation predicted by the board and ownership structure and subsequent performance. This result indicates that the board and ownership variables are related to the firm's governance's effectiveness, rather than being a determinant of CEO compensation. Hence, firms with weaker governance structures encounter greater agency problems, which results in extracting a greater compensation for the CEO and in turn makes the firm performance even worse. This is in line with the thinking of critics of the level of executive compensation. In a more recent study, Newton (2015) investigates the intersection between CEO-to-employee relative pay, organizational performance, and governance quality in the context of a large sample of US non-profit organizations in the period 2008-2010. The study finds that relative pay is negatively related to performance. These results indicate that executive compensation is not determined by the performance of a firm. This result is in line with the results Core et. al. (1999) found, but with a different sample. Hence, it might be worthwhile to research if the same results would be found with European companies.

Gomez-Mejia et. al. (2003) test the determinants of executive compensation in family-controlled public corporations. The analysis is based on 253 family-controlled firms over a four-year period (1995-1998). The results were somewhat unexpected. Gomez-Mejia et. al. (2003) call it as follows: "... an interesting and complex agency dynamic: altruistic family motives are at work when family CEOs are at the helm, but these motives manifest themselves not in higher pay but rather, in risk protection." (p. 234) In other words, there was no significant relationship found between the

executive compensation and firm performance in family-controlled public corporations. Again, this unexpected result should be considered while performing my research. Even though the sample dataset is different, similar results would have a completely different reason for having no relationship.

Gregg et. al. (2012) examine the relationship between executive cash compensation and firm performance for a sample of large UK companies, in particular the financial services industry. The period is from 1994-2006, since incentive misalignment is one of the causes of the global financial crisis of 2007/2008. Their findings show that there is little relation between cash compensation and firm performance. On the other hand, Ozkan (2011) finds a positive and significant relationship between CEO cash compensation and firm performance using a dataset of UK non-financial firms in the period 1999-2005. Both papers used the generalized method of moments system (GMM-system) estimation method to estimate the results. The difference in their results is probably due to the difference in data samples. Even though, both studies used large UK firms, one study focuses on financial firms, while the other focuses on non-financial firms. The evidence from these studies suggests that there are differences between financial and non-financial firms. Hence, this study will focus on only one, which will be the non-financial firms.

Cambini et. al. (2015) study the impact of economic regulation and corporate governance on incentive mechanisms in European energy firms. The study is based on 59 publicly traded electricity and gas utility firms from 12 European countries over the period 2000-2011. The results show positive and statistically significant relationships between CEO pay and accounting and market-based performance measures. Gao & Li (2015) research the CEO pay-performance sensitivity and make a distinction between privately-held and public firms. Their research uses a sample of over 5000 unique firms over a period of 1999-2011. Results show that both private and public firm CEO pays are positively and significantly related to firm accounting performance. Smirnova & Zavertiaeva (2017) examine whether executive compensation is performance sensitive and, vice versa, whether firms that perform well pay their executives more. Their analysis is based on a sample of 330 large European firms in the period 2009-2013. Both accounting- and market-based measures are used to estimate the firm performance. The results are that both executive compensation influences firm performance and vice versa. Furthermore, tying bonuses to accounting-based measures enhances corporate internal performance. Whereas linking market-based measures to a bonus does not improve firm performance. In all studies the firm performance was lagged, since economic theory suggests that past firm performance has an impact on current compensation. Thus, this study will also include a regression with lagged firm performance.

In accordance with the optimal contracting theory, an increase in CEO compensation should lead to higher productivity, and subsequently, to greater firm performance. Conyon & Freeman

(2004) empirically verify the positive effect of CEO compensation on greater firm performance. The results show that firms that use higher levels of CEO compensation tend to outperform other firms in productivity and financial performance. Cooper et. al. (2016) investigate whether excess CEO compensation is related to the performance of the firm on US firms in the period 1994-2015. Their results imply that CEO compensation does not always lead to greater firm performance. In fact, according to the study excess CEO compensation leads to a decrease in firm performance, which is in contrast to the findings of Conyon & Freeman (2004).

Even though the literature shows mixed empirical findings, the main theory (agency theory) suggests that interests of the agents and principals can be aligned by using appropriate incentive systems. So, notwithstanding the absence of an overall consensus, the first hypothesis is as follows:

Hypothesis 1: *CEO compensation has a positive effect on firm performance.*

Brito & Vieira (2013) analyze the impact of firms' aggregate performance on economic growth. The analysis is based on a sample of 26 OECD countries in the period 1970-2008. The results show that the performance variable is statistically significant as a determinant of GDP growth per capita. Hence, firm performance can be seen as one of the determinants of GDP growth in a country. This result is in line with the research of Galván et. al. (2017), whom also find that firms contribute to a country's GDP greatly. However, Galván et. al. (2017) take a smaller sample and it is not across countries. Their sample is based on the family-owned businesses of Spain in the period 2007-2015.

The paper of Campbell et. al. (2016) examines the relation between the prevalence of CEO long-term equity-based incentive pay and its impact on GDP growth. The study is based on a sample of Towers Perrin's clients across 22 countries from the period 2001-2005. The clients of Towers Perrin were mainly large firms. Their results support their first intuition, since they found that national economic performance is enhanced by CEO long-term equity-based compensation incentives. However, they also mention that the economic performance is only enhanced, when the incentives are used judiciously and with parsimony.

Therefore, in accordance with the prior studies, the second hypothesis is:

Hypothesis 2: *CEO compensation and firm performance are related to economic growth.*

3. Data and research method

This section is divided into three subsections. First, a brief description is given of the data. Second, the model and methodological approach will be discussed. The third subsection describes the dependent, independent and control variables for this study.

3.1 Data

The sample consists of 71 European non-financial listed firms on the EuroNext 100 over an eight-year period from 2009 to 2016. The chosen period is the most recent period that the BoardEx database provides. The BoardEx database did not provide executive compensation of every firm of the EuroNext 100, hence the sample size is 'only' at 71 firms. The sample is composed of large firms operating in different industries. The CEO compensation data were obtained from the BoardEx database. The International Monetary Fund's (IMF) World Economic Outlook reports were used to obtain the data for the gross domestic product (GDP) growth of Europe. The data of firm performance and the control variables have been retrieved from Orbis and the Thomson Reuters Database. Appendix A provides a list of companies included in the study, in which the name, country and industry are mentioned. Furthermore, a summary of number of firms and observations per country can be found in Table A1.

3.2 Model

The regression model that will be used in this paper for the impact of CEO compensation on firm performance and the relation to economic growth are as follows:

$$Perf_{it} = \beta_1 Cash_{it} + \beta_2 Equity_{it} + \beta_3 Lev_{it} + \beta_4 Vola_{it} + \beta_5 Size_{it} + \beta_6 Ceoten_{it} + \beta_7 Ceoage_{it} + \beta_8 Ceoage2_{it} + \beta_9 Firmage_{it} + \beta_{10} Firmage2_{it} + U_{it}$$

$$Perf_{it} = \beta_1 Cash_{it} + \beta_2 Equity_{it} + \beta_3 GDPeu_{it} + \beta_4 Size_{it} + \beta_5 Firmage_{it} + \beta_6 Firmage2_{it} + U_{it}$$

This study considers both accounting-based measures as well as market-based measures to represent firm performance (Antie & Smith, 1986; Lambert & Larcker, 1987). Following Murphy (1985), Barro & Barro (1990), Ozkan (2011), Gao & Li (2015), and Raithatha & Komera (2016), this paper will use return on equity (ROE) and return on assets (ROA) as accounting-based measures of firm performance. Tobin's Q is used as market-based measure of firm performance. Furthermore, a few control variables are included that might influence the pay-performance relationship. A description of all variables is provided in Table 1.

This study will use a panel data analysis to analyze the relationship between CEO compensation and firm performance. In addition to that, it will also be tested to its relation to economic growth. For both analyses a fixed effects regression without lag and an Arellano-Bond linear dynamic panel-data regression with lagged firm performance will be used.

3.3 Variables

As mentioned in section 3.2, the dependent variable is firm performance, which will be measured using accounting-based measures and market-based measures. The accounting-based measures are ROE & ROA, while the market-based measure is Tobin's Q. Return on equity is defined as the ratio of

Table 1
Descriptive statistics for firm performance, CEO compensation, GDP growth, and control variables

The data sample consists of 568 total observations of 71 firms between 2009 and 2016. The firm performance and control variables data have been retrieved from Orbis and Thomson Reuters. The compensation data have been acquired from the BoardEx database. The economic growth data have been taken from the international monetary fund (IMF) world economic outlook reports. A full description of all variables can be found in Table B1.

Panel A: Firm performance

The return on equity is a ratio of profit before taxes to the total book value of equity. The return on assets is a ratio of profit before taxes to the total book value of assets. Tobin's Q is measured by the ratio of market capitalization to total book value of assets. Market capitalization can be measured by multiplying the outstanding shares with the share price.

	2009	2010	2011	2012	2013	2014	2015	2016
Return On Equity (ROE)								
Mean	15,77	21,18	20,32	17,12	15,80	16,27	14,92	14,62
S.D.	18,25	15,26	15,61	19,42	15,45	14,09	16,82	23,49
Min	-18,27	1,21	-11,11	-52,09	-27,98	-8,91	-22,16	-134,03
Max	108,69	96,13	82,07	77,74	76,44	84,62	92,58	105,59
Return On Assets (ROA)								
Mean	5,36	7,81	7,61	6,54	6,59	6,52	5,53	5,80
S.D.	6,31	6,98	7,33	9,00	8,61	7,70	6,89	6,58
Min	-8,76	0,55	-3,74	-20,77	-6,83	-1,89	-6,24	-3,02
Max	25,55	35,00	33,89	44,08	46,26	44,25	47,37	49,00
Tobin's Q (Tobin)								
Mean	0,84	0,86	0,77	0,91	1,06	1,10	1,02	0,94
S.D.	1,00	1,03	0,97	1,22	1,35	1,64	1,27	0,92
Min	0,04	0,04	0,03	0,03	0,06	0,06	0,06	0,07
Max	6,69	6,35	5,45	6,38	8,29	11,18	8,99	5,26

Panel B: CEO compensation

The compensation data is divided into cash and equity-based compensation. The division has been made to ascertain which form of compensation has a larger impact on firm performance. Both variables are unfixed. The total compensation is a sum of the cash and equity-based compensation. The total compensation is not included in every regression, since it would lead to omitted variables if the cash and equity variables are already included. Hence, it is used as a robustness check to see if the total compensation has a significant influence on the firm performance. The data is measured in 1.000's of euro's.

	2009	2010	2011	2012	2013	2014	2015	2016
Cash compensation (in €000's)								
Mean	1.751	2.177	2.109	2.239	2.147	2.266	2.418	2.564
S.D.	1.216	2.035	1.911	1.631	1.652	1.729	1.474	1.453
Min	0	0	0	0	0	0	0	67
Max	6.600	14.245	12.926	10.571	10.911	11.061	6.586	7.447
Equity compensation (in €000's)								
Mean	2.706	3.702	2.100	1.998	2.973	2.710	3.116	3.366
S.D.	3.285	8.010	2.064	1.780	2.169	1.938	2.564	2.781
Min	46	60	68	106	94	95	144	155
Max	17.759	50.804	8.582	8.362	9.350	9.371	10.602	11.088
Total compensation (in €000's)								
Mean	3.409	4.519	3.457	3.347	3.686	3.793	4.217	4.759
S.D.	3.358	6.666	2.870	2.413	2.754	2.867	3.160	3.422
Min	34	50	45	35	124	90	166	181
Max	19.780	51.787	13.796	11.072	12.877	15.561	15.532	15.070

Panel C: GDP Growth EU

The IMF world economic outlook reports were used to obtain the data for the GDP growth of Europe. Every firm will have the same value per year, since it is the GDP growth of Europe as a whole, since all firms in the dataset are in Europe.

	2009	2010	2011	2012	2013	2014	2015	2016
GDP Growth EU (Gdpeu)								
Mean	-0.043	0.021	0.017	-0.004	0.003	0.018	0.023	0.020
S.D.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Min	-0.043	0.021	0.017	-0.004	0.003	0.018	0.023	0.020
Max	-0.043	0.021	0.017	-0.004	0.003	0.018	0.023	0.020

Panel D: Control variables

The included control variables are leverage, volatility, firm size, CEO tenure, CEO age, and firm age. Leverage is measured with the debt to equity ratio. Volatility is annualized using the monthly closing prices of the whole period. Firm size is the natural logarithm of the book value of total assets. CEO tenure is the amount of years that the CEO has worked in the same company. CEO age is the age of the current CEO in that year. Firm age is the age of the firm. Furthermore, both CEO age and firm age are also squared in order to capture the effect of aging.

	2009	2010	2011	2012	2013	2014	2015	2016
Leverage (Lev)								
Mean	2.86	2.69	2.73	2.77	2.47	2.53	2.57	3.36
S.D.	2.60	2.59	2.67	2.87	2.42	2.48	2.71	6.63
Min	0.01	0.01	0.01	0.00	0.00	0.00	0.43	0.45
Max	14.32	14.26	14.67	15.72	13.27	12.58	16.71	48.49
Annualized volatility (Vola)								
Mean	0.32	0.24	0.25	0.24	0.22	0.20	0.26	0.23
S.D.	0.14	0.08	0.08	0.09	0.10	0.07	0.09	0.09
Min	0.13	0.12	0.07	0.10	0.10	0.10	0.14	0.12
Max	0.75	0.46	0.46	0.50	0.69	0.54	0.65	0.62
Firm size (Size)								
Mean	17.44	17.54	17.59	17.62	17.61	17.68	17.76	17.82
S.D.	1.19	1.17	1.16	1.16	1.15	1.15	1.07	1.07
Min	13.86	14.01	14.14	14.18	14.23	14.18	15.87	15.91
Max	20.38	20.41	20.40	20.45	20.44	20.55	20.60	20.61
CEO tenure (Ceoten)								
Mean	5.08	5.61	6.14	6.45	7.13	6.73	7.34	7.30
S.D.	4.46	4.56	4.66	4.59	4.79	5.29	5.52	5.52
Min	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Max	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00
CEO age (Ceoage)								
Mean	54.61	54.69	55.14	55.58	56.44	56.11	56.73	56.79
S.D.	6.16	6.10	5.80	5.42	5.51	5.62	5.62	5.62
Min	41.00	42.00	43.00	44.00	45.00	46.00	43.00	43.00
Max	67.00	68.00	69.00	70.00	71.00	72.00	73.00	74.00
Firm age (Firmage)								
Mean	72.31	73.30	74.30	75.30	76.30	77.30	78.30	79.15
S.D.	59.74	59.75	59.75	59.75	59.75	59.75	59.75	59.73
Min	0.00	0.00	1.00	2.00	3.00	4.00	5.00	6.00
Max	345.00	346.00	347.00	348.00	349.00	350.00	351.00	352.00

profit before taxes to book value of equity. Return on assets is defined as ratio of profit before taxes to total assets. Tobin's Q is defined as the ratio market capitalization to total assets. Market capitalization is measured as share price times outstanding shares.

The independent variables are CEO compensation, which is divided into cash and equity-based compensation and GDP growth from Europe. The division has been made to test which part of the compensation actually impacts the firm performance. Furthermore, total compensation is added as a variable as well to check for robustness. Total compensation is the sum of cash and equity compensation. In contrast to Brito & Vieira (2013), I have decided to take GDP growth of Europe as a whole instead of the GDP growth per capita. This is because my sample is based on only European countries instead of Brito & Vieira's OECD countries that are all over the world.

Control variables are added to control for possible effects on the pay-performance relationship. The control variables are leverage, volatility, firm size, CEO tenure, CEO age, and firm age. The leverage of a firm is defined as ratio of total debt to total equity. Volatility is measured by the monthly closing prices. Firm size is defined as the natural logarithm of total assets. CEO tenure is the amount of years that the CEO has worked in the same company. CEO age is the age of the current CEO in that year. Firm age is the age of the firm. Furthermore, both CEO age and firm age are also squared in order to capture the effect of aging. These control variables have been chosen, since they are commonly used in prior research (Gomez-Mejia, Larraza-Kintana, & Makri, 2003; Huang & Chen, 2010; Gregg, Jewell, & Tonks, 2012; Cambini, Rondi, & Masi, 2015; Newton, 2015; Cooper, Gulen, & Rau, 2016; Smirnova & Zavertiaeva, 2017). Consequently, the correlation between all the variables and a variance inflation factor (VIF) test can be found in Table 2.

4. Results

This section is divided into two subsections. The first subsection formulates an answer on the first hypothesis. The second hypothesis will be answered in the second subsection. Furthermore, both subsections are divided into two subsubsections in which the results of the two different models are discussed. The robustness check results can be found in Appendix C.

4.1 The effect of CEO compensation on firm performance

Hypothesis 1 states that CEO compensation has a positive effect on firm performance. Hence, better firm results lead to higher executive compensation. To verify this hypothesis, I use two different regression analyses. The first regression is a fixed effects regression without any lag and the second is the Arellano-Bond linear dynamic panel-data regression where the dependent variable is lagged (t-1). The results of both regressions can be found in Table 3.

Table 2
Correlation matrix and the variance inflation factor test.

The data sample consists of 568 total observations of 71 firms between 2009 and 2016. The firm performance and control variables data have been retrieved from Orbis and Thomson Reuters. The compensation data have been acquired from the BoardEx database. The economic growth data have been taken from the international monetary fund (IMF) world economic outlook reports. A full description of all variables can be found in Table B1.

Panel A: Correlation matrix

The correlation coefficients of the variables are presented in Pearson correlation. * P<0.10, ** P<0.05, *** P<0.01.

	ROE	ROA	Tobin	Cash	Equity	Total	Leverage	Ann. Volatility	Firm size	CEO tenure	CEO age	CEO age2	Firm age	Firm age2	GDP EU
ROE	1														
ROA	0.7506 ***	1													
Tobin	0.4647 ***	0.7318 ***	1												
Cash	0.1680 ***	0.1631 ***	0.0696 *	1											
Equity	0.0890 **	0.1355 ***	0.1202 ***	0.1188 ***	1										
Total	0.1497 ***	0.1868 ***	0.1324 ***	0.5434 ***	0.8981 ***	1									
Leverage	-0.1863 ***	-0.2812 ***	-0.2835 ***	-0.0156	-0.1045 **	-0.0953 **	1								
Ann. Volatility	-0.0884 **	-0.0319	-0.0419	0.0640	-0.0578	-0.0206	0.1077 **	1							
Firm size	-0.1443 ***	-0.3569 ***	-0.5043 ***	0.2630 ***	-0.0523	0.0723 *	0.3894 ***	0.1141 ***	1						
CEO tenure	0.0898 **	0.0965 **	0.0857 **	-0.0063	-0.0281	-0.0266	0.0270	-0.1281 ***	-0.1251 ***	1					
CEO age	-0.1047 **	-0.1696 ***	-0.1947 ***	0.0703 *	-0.0752 *	-0.0325	0.0689	0.0133	0.0741 *	0.4265 ***	1				
CEO age2	-0.0974 **	-0.1672 ***	-0.1951 ***	0.0747 *	-0.0786 *	-0.0334	0.0658	0.0123	0.0720 *	0.4407 ***	0.9977 ***	1			
Firm age	0.0131	0.0010	-0.0512	-0.0416	0.0598	0.0321	-0.0659	-0.0592	-0.0126	0.0478	-0.0621	-0.0655	1		
Firm age2	-0.0422	-0.0358	-0.0599	-0.0547	0.0596	0.0261	-0.0732 *	-0.0124	0.0020	-0.0056	-0.0897 **	-0.0944 **	0.8873 ***	1	
GDP EU	0.0288	0.0490	0.0275	0.1239 ***	0.0155	0.0679	-0.0055	-0.2440 ***	0.0688	0.0953 **	0.0715 *	0.0691	0.0230	0.0131	1

Panel B: Test for multicollinearity

The variance inflation factor (VIF) test is used to check for multicollinearity. I excluded the total compensation, because it would get omitted in the regression. Furthermore, ceoage2 and firmage2 were both not included, because both variables are squared versions of the other variables (CEO age and firm age). The VIF test would be influenced by these variables, which would give greater estimates than it should.

Variable	VIF	1/VIF
Cash	1.14	0.8772
Equity	1.04	0.9615
Leverage	1.23	0.8130
Volatility	1.11	0.9009
Firm size	1.35	0.7407
CEO tenure	1.30	0.7692
CEO age	1.27	0.7874
Firm age	1.02	0.9804
GDP EU	1.10	0.9091
Mean VIF	1.17	

Academics have argued on what the maximum value of the VIF test should be to check for multicollinearity. All the values (5, 10, 20 & more) are higher than the mean VIF from this research (O'brien, 2007). Hence, notwithstanding the absence of an overall consensus, it is possible to conclude that there is no multicollinearity in this case.

4.1.1 Fixed effects without lag

The results in Table 3 show that firm performance, based on both accounting and market-based measures, and CEO compensation positively influence each other. Even though, the equity variable is insignificant for ROE and Tobin, it is still positive. Hence, hypothesis 1 is confirmed without lagged firm performance. These findings are in accordance with previous studies on the positive influence of accounting-based measures (Huang & Chen, 2010; Ozkan, 2011; Cambini, Rondi, & Masi, 2015; Smirnova & Zavertiaeva, 2017) and market-based measures (Cambini, Rondi, & Masi, 2015; Raithatha & Komera, 2016; Smirnova & Zavertiaeva, 2017). The insignificant results of equity-based compensation might be because some firms do not use equity-based compensation or at least not every year. Furthermore, the equity-based compensation data had some missing values. Thus, the equity-based compensation is zero in a couple cases, which possibly influences the results. Another possible reason is because equity-based compensation is too weakly linked to firm performance. As described in paragraph 2.1, equity-based compensation is mostly linked to non-financial targets. Tobin's Q could be insignificant since CEO compensation is usually linked to financial targets within a firm, which are directly related to the accounting-based measures. These results can be used by both sides of the controversy. The defending side can use the significantly positive relation to argue that compensation is necessary. Whereas, the critics can use the insignificant results of equity-based compensation to explain that compensation is too weakly linked to firm performance.

Table 3
Regression results from fixed effects with and without lagged firm performance for hypothesis 1.

The data sample consists of 568 total observations of 71 firms between 2009 and 2016. The firm performance and control variables data have been retrieved from Orbis and Thomson Reuters. The compensation data have been acquired from the BoardEx database. The economic growth data have been taken from the international monetary fund (IMF) world economic outlook reports. A full description of all variables can be found in Table B1.

The expected sign is predicted in accordance to economic theory and prior research. Cash and equity compensation is predicted as positive, since it is expected that the compensation is positively influencing the firm performance. According to the study of De Jong (2002), leverage does not increase firm performance, thus resulting in a negative sign. Volatility is measured with monthly stock prices, so a volatile stock is expected to have a negative influence on firm performance (Dutt & Humphery-Jenner, 2013). It is expected that a large firm can enhance their firm performance, hence, a positive sign is expected. As CEO tenure becomes larger, the CEO has worked longer at the same firm, which will have a positive influence on firm performance. CEO age is expected to have a positive influence, since it represents the experience the CEO has over his/her lifetime. CEO age2 is expected to have a negative influence, because as people get older the effect of age is lessened. The expected sign of firm age is negative, since an older firm does not have to be more profitable. However, firm age2 is expected to have a positive sign, since it is more likely that an older firm will have better firm performance. T-statistics can be found in the parentheses under the coefficient. * P<0.10, ** P<0.05, *** P<0.01.

	Expected	Fixed effects without lag				Arellano-Bond linear dynamic panel-data with lag		
Variables	sign	ROE	ROA	Tobin		ROE	ROA	Tobin
Cash	+	1.634 ***	0.545 ***	0.0227		1.058 *	0.430 **	0.0108
		(3.53)	(3.64)	(1.25)		(1.79)	(2.49)	(0.49)
Equity	+	0.133	0.146 **	0.0124		0.236	0.100	0.0100
		(0.68)	(2.30)	(1.61)		(1.02)	(1.52)	(1.18)
Leverage	-	-1.515 ***	-0.190 **	-0.0297 ***		-1.904 ***	-0.196 **	-0.0358 ***
		(-6.64)	(-2.57)	(-3.30)		(-7.32)	(-2.57)	(-3.59)
Ann. Volatility	-	-19.840 ***	-3.235	0.0545		-17.89 **	-1.070	0.0475
		(-3.07)	(-1.55)	(0.21)		(-2.27)	(-0.47)	(0.16)
Firm size	+	10.50 ***	-4.128 ***	-1.049 ***		7.957 **	-8.464 ***	-2.045 ***
		(4.32)	(-5.24)	(-10.94)		(2.29)	(-8.47)	(-17.31)
CEO tenure	+	0.202	0.0739	-.00707		-0.0819	-0.0344	-0.0133
		(0.83)	(0.94)	(-0.74)		(-0.23)	(-0.33)	(-1.02)
CEO age	+	0.223	0.340	0.119		-3.101	-0.507	0.246 **
		(0.12)	(0.55)	(1.59)		(-1.00)	(-0.56)	(2.14)
CEO age2	-	-0.00325	-0.00255	-0.000908		0.0275	0.00490	-0.00198 *
		(-0.19)	(-0.46)	(-1.34)		(0.99)	(0.61)	(-1.92)
Firm age	-	-1.642 ***	-0.141	0.0745 ***		-1.218 **	0.0766	0.139 ***
		(-4.40)	(-1.17)	(5.07)		(-2.48)	(0.55)	(7.51)
Firm age2	+	0.00157	0.000513	-0.00000359		-0.00973	-0.000380	-0.0000547
		(0.89)	(0.89)	(-0.05)		(-0.43)	(-0.57)	(-0.65)

A somewhat surprising result is the significant negative influence of firm size for ROA and Tobin. According to economic theory, one would expect CEO's of larger firms to be paid more than a CEO of a smaller firm. However, the results in Table 3 show that this is not the case. One possibility is that the sample does not include large differences in firm size, since the included firms are all in the EuroNext 100. The firms in the EuroNext 100 are all considered to be large firms, hence the size might not matter in this sample. Another explanation could be that larger firms are valued lower by the market or that smaller firms are outperforming the larger firms.

Leverage and volatility have the expected sign (both negative) and are in most cases significant. This is in line with the previous studies of Cheng & Farber (2008), Raithatha & Komera (2016), and Smirnova & Zavertiaeva (2017). In addition to that, firm age is significant for ROE and Tobin, however, it has the wrong sign for Tobin. Since Tobin is a market-based measure, it might

indicate that firm age does matter in market situations, so it is significantly positive. As mentioned in Table 3 the expectation was that firm age shouldn't influence firm performance, since new firms can still be included in the EuroNext 100 if they have become bigger than a firm that was already in there.

The other control variables mostly have the correct sign, but none of them are significant. These results are quite peculiar, since I expected them to have some kind of influence on firm performance. Especially CEO tenure is surprising to me. The expectation was that CEO's that have been at the firm for a longer period would be able to perform better than CEO's that have joined the firm recently. However, according to the results this is not the case. Perhaps, the firm could be better off with having a new CEO every few years to get fresh ideas and a different set of skills to reach a higher performance. The same can be said for CEO age. As people get older, it is expected that they get more experience, so they can handle different situations better. And again, this is not the case according to the results. It is possible that after a certain age, you have experienced most problems and should be able to handle them. The data shows that the youngest CEO is around 40 for the whole period, hence they have had a vast amount of working experience already.

4.1.2 Arellano-Bond linear dynamic panel-data with lag

The results in Table 3 show that firm performance, based on both accounting and market-based measures, and CEO compensation also positively influence each other when firm performance is lagged. Even though all equity-based compensation and the cash compensation for Tobin are insignificant, they are still positive. Hence, hypothesis 1 is confirmed with lagged firm performance. This finding is in line with the studies of Huang & Chen (2010), Cambini et. al. (2015) and Smirnova & Zavertiaeva (2017).

The major differences between the different regressions for ROE are the level of significance for the significant variables. Cash compensation went from the 1%-level to the 10%-level. Furthermore, volatility, firm size, and firm age all went from the 1%-level to the 5%-level. The other control variables have all changed sign, which is somewhat surprising, since it goes against economic theory. However, it does not change the fact that all of these are insignificant. The main difference regarding ROA is that the equity-based compensation turned insignificant. Moreover, the same thing happens to the control variables as it did with ROE.

The difference in results for Tobin are more interesting. Two variables have turned significant after lagging firm performance. CEO age and CEO age2 have turned significant and have the expected sign. This would indicate that the economic theory is right regarding CEO age. Thus, the older the CEO, the better the firm results will be. However, the effect of age is lessened after people have reached a certain age.

The significant positive results between CEO compensation and firm performance gives leverage to the defending side of the controversy. The reason for giving compensation to executives is to maximize shareholder value. An increase in firm performance can lead to an increase in shareholder value, hence it can justify that CEO compensation is a necessary incentive for executives.

4.2 The relation to economic growth

Hypothesis 2 formulates that CEO compensation and firm performance are related to GDP growth. Thus, an increase of CEO compensation and firm performance are a result of an increase in GDP growth. To confirm this hypothesis, I use two different regression analyses. The first regression is a fixed effects regression without any lag and the second is the Arellano-Bond linear dynamic panel-data regression where the dependent variable is lagged (t-1). The results of both regressions can be found in Table 4.

4.2.1 Fixed effects without lag

The results in Table 4 show that CEO compensation, firm performance and economic growth are indeed related to accounting-based measures. Hence, hypothesis 2 is confirmed without lagged firm performance. This finding is in line with the study of Brito & Vieira (2013). Nevertheless, Brito & Vieira use a different set of accounting-based measures. Even though the market-based measure is insignificant, it still shows a positive sign as expected. As far as my knowledge extends, there aren't any previous studies that analyze the relation between CEO compensation, economic growth and firm performance based on market-based measures. A possible explanation of the insignificant result of Tobin is that Tobin's Q already captures the effect of GDP growth. Tobin's Q is measured using the market capitalization, which is the share price multiplied by outstanding shares. According to Levine & Zervos (1998), economic growth positively influences the stock markets. Hence, the effect of GDP growth could already be captured by Tobin's Q.

The control variables are mostly significant, but there are some extraordinary results. The sign of firm size for ROA & Tobin and firm age for Tobin are wrong. These extraordinary results were already addressed in paragraph 4.1.1.

4.2.2 Arellano-Bond linear dynamic panel-data with lag

The results in Table 4 show that CEO compensation, firm performance and economic growth are still related to accounting-based measures. Hence, hypothesis 2 is confirmed with lagged firm performance as well. Even though the market-based measure is insignificant, it still shows a positive sign as expected. As far as my knowledge extends, there aren't any previous studies that analyze the relation between CEO compensation, economic growth and firm performance based on market-based measures. The explanation can be found in paragraph 4.2.1.

Table 4
Regression results from fixed effects with and without lagged firm performance for hypothesis 2.

The data sample consists of 568 total observations of 71 firms between 2009 and 2016. The firm performance and control variables data have been retrieved from Orbis and Thomson Reuters. The compensation data have been acquired from the BoardEx database. The economic growth data have been taken from the international monetary fund (IMF) world economic outlook reports. A full description of all variables can be found in Table B1.

The expected sign is predicted in accordance to economic theory and prior research. Cash and equity compensation is predicted as positive, since it is expected that the compensation is positively influencing the firm performance. GDP growth EU is expected to have a positive sign, because firms can profit from economic growth. According to Reichstein & Dahl (2004), it is important to add control variables that may influence the relation. In this case, that would be adding firm size and firm age. It is expected that a large firm can enhance their firm performance, hence, a positive sign is expected. The expected sign of firm age is negative, since an older firm does not have to be more profitable. However, firm age2 is expected to have a positive sign, since it is more likely that an older firm will have better firm performance. T-statistics can be found in the parentheses under the coefficient. * P<0.10, ** P<0.05, *** P<0.01.

		Fixed effects without lag				Arellano-Bond linear dynamic panel-data with lag		
Variables	Expected sign	ROE	ROA	Tobin		ROE	ROA	Tobin
Cash	+	1.562 ***	0.495 ***	0.022		1.038 *	0.432 **	0.0113
		(3.23)	(3.35)	(1.18)		(1.65)	(2.53)	(0.51)
Equity	+	0.123	0.143 **	0.013		0.253	0.109 *	0.0126
		(0.60)	(2.29)	(1.62)		(1.02)	(1.65)	(1.45)
GDP Growth EU	+	79.56 ***	42.81 ***	0.232		111.5 **	24.92 *	-2.942
		(2.67)	(4.69)	(0.20)		(2.14)	(1.74)	(-1.55)
Firm size	+	10.45 ***	-4.271 ***	-0.997 ***		7.468 **	-8.564 ***	-1.938 ***
		(4.14)	(-5.53)	(-10.33)		(2.01)	(-8.63)	(-16.12)
Firm age	-	-2.138 ***	-0.316 **	0.0721 ***		-1.711 ***	0.0231	0.134 ***
		(-5.27)	(-2.55)	(4.64)		(-3.35)	(0.17)	(7.37)
Firm age2	+	0.00305 *	0.000648	0.0000130		0.00154	-0.000219	0.0000088
		(1.66)	(1.15)	(0.18)		(0.64)	(-0.33)	(0.10)

The differences between the different regressions for ROE are the level of significance for the significant variables. Cash compensation went from the 1%-level to the 10%-level. Furthermore, GDP growth EU and firm size went from the 1%-level to the 5%-level. Another interesting result is that firm age2 turned insignificant, which would indicate that the effect of firm age will not improve the older it gets. The results of ROA are somewhat similar, cash compensation, equity-based compensation, and GDP growth EU all have a lower significance level. Moreover, firm age has turned insignificant, which would suggest that firm age does not influence firm performance.

The only real difference regarding Tobin is the change of sign in GDP growth EU. Even though the variable is insignificant, it is near the 10% significance level, while being negative. A significant negative result would have meant that an increase in GDP growth would decrease firm performance. Perhaps, this is due to the fact that Tobin already captures the effect of GDP growth.

According to the results CEO compensation and firm performance are linked to GDP growth. Critics of the controversy argue that compensation is too weakly linked to firm performance. The relation to GDP growth enhances that argument, since it can show that an increase in CEO compensation is not only a due to firm performance, but also because of GDP growth.

5. Conclusion

This study analyzes the impact of CEO compensation on firm performance and its relation to economic growth for non-financial firms on the EuroNext 100. This paper has two purposes: (1) to examine whether the compensation paid to a CEO has an effect on firm performance, and (2) its relation to economic growth. Previous studies regarding the influence of CEO compensation on firm performance show mixed results. There have been studies that find a positive relationship between CEO compensation and firm performance (Cheng & Farber, 2008; Ozkan, 2011), others conclude there is a negative relationship (Core, Holthausen, & Larcker, 1999; Newton, 2015). And several other studies find a non-significant relationship between CEO compensation and firm performance (Gomez-Mejia, Larraza-Kintana, & Makri, 2003; Parthasarathy, Menon, & Bhattacharjee, 2006). The papers that have researched the link between CEO compensation on firm performance and its relation to economic growth have found a positive relation, which has also been found in this paper (Brito & Vieira, 2013; Campbell, et al., 2016; Galván, Martinez, & Rahman, 2017).

The relevant theories for this analysis are the agency theory, optimal contracting theory, and the managerial power theory. The agency theory suggests that the alignment of interests between the principals and agents is very important. One of the ways to align the interests is to design a compensation scheme that rewards performance. This is where the optimal contracting theory comes into place. The optimal contracting theory has the assumption that the board designs the contract for the manager, which provides incentives to maximize shareholder value, while minimizing agency costs. However, the managerial power theory suggests that CEO's have power over the board, so they can arrange their own compensation scheme. CEO's are attracted to the firm by the 'perfect[5]' compensation scheme but they can negotiate a better deal due to their power over the board, which means that the agency costs rise and could influence firm performance. Thus, these theories show that there is a relationship between CEO compensation and firm performance.

The controversy on the level of CEO compensation has defenders and critics. I do not agree with the current level of CEO compensation, hence I agree with the statement of Kuhn (2010). Even though a large group of people disagrees with the current level of compensation, the pay gap between typical workers and executives continues to rise. I firmly believe that managing a firm is a difficult task that deserves compensation. However, I also believe that the compensation should be linked to firm performance, however, that is not the case regarding some firms. Moreover, I believe that the managerial power theory plays a major role in this discussion. The managerial power theory recognizes that CEO's and other executives have more power than they should. The current situation

[5] There is no such thing as a perfect compensation scheme. In this context, it would be 'perfect' for the firm if the CEO accepts the offer which would minimize agency costs for the firm. However, the CEO can always try to negotiate a deal that is better for him/her, but not necessarily better for the firm.

regarding the power of CEO's has escalated too far and I believe that it should come to an end. The board of directors should be fully independent of the CEO and other executives to stay objective, so they can keep the shareholders' interests as their main focus.

The analysis provides an answer to the hypotheses and also the research question. I use two different models to estimate the relationship between CEO compensation and firm performance and its relation to economic growth, namely fixed effects and Arellano-Bond linear dynamic panel-data with lagged firm performance. In both models I control for firm risk (leverage & volatility), firm size, firm age, and CEO-specific variables (tenure & age). The results show a positive sign and is significant for accounting-based measures in both models. The market-based measure is also positive but not significant. Hence hypothesis 1 has been verified. Perhaps, Tobin's Q is insignificant because the compensation is linked to financial targets within a firm that directly relate to accounting-based measures and not market-based measures. Furthermore, GDP growth is related significantly to CEO compensation and firm performance for the accounting-based measures in both models. However, the market-based measure is insignificant again. This might be because Tobin's Q already captures the effect of GDP growth. The second hypothesis is still confirmed regarding the accounting-based measures. The research question of this study is as follows: "What is the influence of CEO compensation on firm performance and its relation to economic growth on non-financial firms listed on the EuroNext 100?" The results show that CEO compensation significantly positively influences firm performance for accounting-based measures. It also shows a positive relation with economic growth. The market-based measures are unfortunately insignificant.

The results are in accordance with previous studies on the positive influence of accounting-based measures (Huang & Chen, 2010; Ozkan, 2011; Cambini, Rondi, & Masi, 2015; Smirnova & Zavertiaeva, 2017) and market-based measures (Cambini, Rondi, & Masi, 2015; Raithatha & Komera, 2016; Smirnova & Zavertiaeva, 2017). However, the insignificant results of equity-based compensation and market-based firm performance were unexpected. I believe that the equity-based compensation was insignificant because the firms do not link it directly to financial targets. Furthermore, I think the market-based firm performance needs a different measure to fully capture the relationship between CEO compensation and firm performance. Even though Tobin's Q is generally accepted as a market-based measure, I believe that a different one[6] (e.g. Sharpe Index) would have been more appropriate.

Some limitations of this study can be mentioned so that these issues can be addressed in future research. For example, this study only uses 71 firms that are listed on the EuroNext 100, but it would be interesting to see if the same results come up with a larger sample size. Additionally, the

[6] The realization that I might have used the wrong measure only came after the research was done. Even though previous studies have used Tobin's Q, there were also studies that used different market-based measures, such as the Sharpe Index.

data on compensation was limited for some included firms. The BoardEx database has an ample amount of data but there are some missing values that might have influenced the regression results. Another limitation of this study is that it is impossible to tell if CEO compensation is truly the only influencer regarding firm performance. According to Selvam et. al. (2016), firm performance can be determined by multiple dimensions. This study only explores one, so it does not include other dimensions that could have a potential influence on the relation. Potentially, future research should include corporate governance control variables, since it is believed to have an influence on the relationship between CEO compensation and firm performance. The use of corporate governance variables in previous research shows that it can definitely influence the relation between CEO compensation and firm performance (Core, Holthausen, & Larcker, 1999; Ozkan, 2011; Gregg, Jewell, & Tonks, 2012; Cambini, Rondi, & Masi, 2015; Cooper, Gulen, & Rau, 2016). Moreover, as far as my knowledge extends, there aren't any previous studies that analyze the relation between CEO compensation, economic growth and firm performance based on market-based measures.

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Appendices

Appendix A - Companies

Name	Country	Industry
ABB Ltd	Switzerland	Electrical equipment
Accor SA	France	Tourism
Adidas AG	Germany	Sportswear
Air Liquide SA	France	Chemicals
Airbus SE	Netherlands	Aerospace
Allianz SE	Germany	Insurance
Alstom SA	France	Rail transportation
Anheuser-Busch InBev SA/NV	Belgium	Food and beverage
ASML Holding	Netherlands	Technology
AstraZeneca PLC	United Kingdom	Pharmaceutical
AXA SA	France	Insurance
BASF SE	Germany	Chemicals
Bayer AG	Germany	Chemicals
BMW AG	Germany	Automotive
Bouygues SA	France	Conglomerate
Capgemini SE	France	Goods and services
Carrefour SA	France	Retail
Compagnie de Saint-Gobain SA	France	Construction and materials
CRH PLC	Ireland	Construction and materials
Daimler AG	Germany	Automotive
Danone SA	Spain	Food and beverage
Deutsche Post AG	Germany	Logistics
Deutsche Telekom AG	Germany	Telecommunication
E.ON SE	Germany	Electric utility
Electricite de France SA	France	Electric utility
Enel SPA	Italy	Electric utility
Engie SA	France	Electric utility
Eni SPA	Italy	Petroleum
Essilor International SA	Germany	Pharmaceutical
Fresenius SE & CO. KGAA	Germany	Health care equipment
Glencore PLC	Switzerland	Commodities
Heineken NV	Netherlands	Food and beverage
Iberdrola SA	Spain	Electric utility
Inditex SA	Spain	Retail
Kering SA	France	Retail
Koninklijke KPN NV	Netherlands	Telecommunication
Koninklijke Philips NV	Netherlands	Personal and household goods
Legrand SA	France	Electrical equipment
L'Oréal SA	France	Personal and household goods
Michelin SA	France	Automotive
Munchener Ruckversicherungs AG	Germany	Insurance
Nestle SA	Switzerland	Food and beverage
Nokia OYJ	Finland	Telecommunication
Novartis AG	Switzerland	Pharmaceutical

Name	Country	Industry
Novo Nordisk A/S	Denmark	Pharmaceutical
Orange S.A.	France	Telecommunication
Pernod Ricard SA	France	Food and beverage
Peugeot SA	France	Automotive
Publicis Groupe SA	France	Media
Relx PLC	United Kingdom	Information and analytics
Groupe Renault SA	France	Automotive
Roche Holding AG	Switzerland	Pharmaceutical
Royal Dutch Shell	Netherlands	Petroleum
Safran SA	France	Aerospace
Sanofi SA	France	Pharmaceutical
SAP SE	Germany	Technology
Schneider Electric SE	France	Goods and services
Siemens AG	Germany	Goods and services
Sodexo SE	France	Conglomerate
Solvay SA	Belgium	Chemicals
STMicroelectronics NV	Netherlands	Semiconductors
Suez SA	France	Electric utility
Telefónica SA	Spain	Telecommunication
Total SA	France	Petroleum
Unibail-Rodamco SE	France	Real estate
Unilever NV	Netherlands	Goods and services
Valeo SA	France	Automotive
Veolia Environnement SA	France	Goods and services
Vinci SA	France	Construction and materials
Vivendi SA	France	Media
Volkswagen AG	Germany	Automotive

Table A1
Summarized table of number of firms and observations per country

Country	Firms	Observations
France	30	240
Germany	15	120
Netherlands	8	64
Switzerland	5	40
Spain	4	32
Belgium	2	16
Italy	2	16
United Kingdom	2	16
Denmark	1	8
Finland	1	8
Ireland	1	8
Total	71	568

Appendix B - Description variables & tests

Table B1

Description of variables included in the research

Variables	Description
Performance	Firm performance measured in accounting-based measures (ROE & ROA) and market-based measure (Tobin's Q)
ROE	Ratio of profit before taxes to book value of equity
ROA	Ratio of profit before taxes to total assets
Tobin's Q	Ratio of market capitalization to book value of total assets
Cash	Cash compensation
Equity	Equity-based compensation
Total	Total compensation
Firm size	Natural logarithm of total assets
Leverage	Ratio of book value of total debt to book value of total equity
Volatility	Annualized by monthly closing prices
CEO tenure	Amount of years the CEO has worked in the same company
CEO age	The age of the current CEO
CEO age2	CEO age squared
Firm age	Age of the firm
Firm age2	Firm age squared
GDP EU	GDP growth of Europe

Table B2

Hausman test results using ROE as dependent variable

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
cash	.0016601	.0016022	.0000579	.0001127
equity	.0001466	.0002005	-.0000539	.
lev	-1.531298	-1.486441	-.0448564	.0532275
vola	-20.07383	-12.70962	-7.364213	1.515551
size	10.35136	.6198444	9.731515	2.081357
ceoten	.1865815	.2063008	-.0197193	.1181408
ceoage	-.1398831	-.2746979	.1348148	.0988755
firmage	-1.391641	-.0156055	-1.376036	.2460746

```
                b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       79.45
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

Table B3

Hausman test results using ROA as dependent variable

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
cash	.0005506	.0006074	-.0000568	.0000354
equity	.0001508	.0001509	-1.51e-07	8.46e-06
lev	-.193689	-.1984188	.0047298	.0173123
vola	-3.290749	-2.243461	-1.047288	.5535923
size	-4.163975	-3.079947	-1.084028	.6270763
ceoten	.0660173	.1002026	-.0341853	.0325012
ceoage	.0569939	-.021765	.0787589	.02678
firmage	-.0581672	-.0041822	-.053985	.0793638

```
                b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       18.81
                Prob>chi2 =      0.0045
```

Table B4
Hausman test results using Tobin as dependent variable

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
cash	.0000209	.0000401	-.0000193	.
equity	.0000128	.0000117	1.10e-06	.
lev	-.0286766	-.024165	-.0045116	.
vola	.0671226	-.2884376	.3555602	.
size	-1.040174	-.6179757	-.4221987	.0671641
ceoten	-.0088486	.0066138	-.0154625	.0013698
ceoage	.019223	.0114609	.0077621	.0006369
firmage	.0749258	.0008948	.074031	.0095949

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 119.84
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)

Appendix C - Robustness check results

Table C1
Regression results from robustness check.

The data sample consists of 568 total observations of 71 firms between 2009 and 2016. The firm performance and control variables data have been retrieved from Orbis and Thomson Reuters. The compensation data have been acquired from the BoardEx database. The economic growth data have been taken from the international monetary fund (IMF) world economic outlook reports. A full description of all variables can be found in Table B1.

The expected sign is predicted in accordance to economic theory and prior research. Total compensation is predicted as positive, since it is expected that the compensation is positively influencing the firm performance. GDP growth EU is expected to have a positive sign, because firms can profit from economic growth. According to the study of De Jong (2002), leverage does not increase firm performance, thus resulting in a negative sign. Volatility is measured with monthly stock prices, so a volatile stock is expected to have a negative influence on firm performance (Dutt & Humphery-Jenner, 2013). It is expected that a large firm can enhance their firm performance, hence, a positive sign is expected. As CEO tenure becomes larger, the CEO has worked longer at the same firm, which will have a positive influence on firm performance. CEO age is expected to have a positive influence, since it represents the experience the CEO has over his/her lifetime. CEO age2 is expected to have a negative influence, because as people get older the effect of age is lessoned. The expected sign of firm age is negative, since an older firm does not have to be more profitable. However, firm age2 is expected to have a positive sign, since it is more likely that an older firm will have better firm performance. T-statistics can be found in the parentheses under the coefficient. * P<0.10, ** P<0.05, *** P<0.01.

	Expected	Fixed effects without lag				Arellano-Bond linear dynamic panel-data with lag		
Variables	sign	ROE	ROA	Tobin		ROE	ROA	Tobin
Total	+	0.341 *	0.193 ***	0.0139 *		0.359 *	0.148 **	0.0114
		(1.88)	(3.35)	(1.95)		(1.65)	(2.40)	(1.43)
GDP growth EU	+	63.32 **	42.84 ***	0.390		106.30 **	24.45 *	-3.133
		(2.16)	(4.61)	(0.34)		(2.15)	(1.69)	(-1.64)
Leverage	-	-1.493 ***	-0.181 **	-0.030 ***		-1.892 ***	-0.191 **	-0.0354 ***
		(-6.51)	(-2.58)	(-3.29)		(-7.18)	(-2.51)	(-3.53)
Ann. Volatility	-	-17.94 ***	-1.465	0.065		-17.53 **	-0.854	0.0666
		(-2.71)	(-0.70)	(0.25)		(-2.20)	(-0.37)	(0.23)
Firm size	+	10.43 ***	-4.375 ***	-1.049 ***		7.240 **	-8.727 ***	-2.013 ***
		(4.25)	(-5.62)	(-10.90)		(2.04)	(-8.72)	(-16.77)
CEO tenure	+	0.163	0.0515	-0.00732		-0.0410	-0.0251	-0.0143
		(0.67)	(0.71)	(-0.77)		(-0.11)	(-0.24)	(-1.09)
CEO age	+	-0.193	0.236	0.117		-2.743	-0.534	0.218 *
		(-0.10)	-0.390	(1.56)		(-0.87)	(-0.59)	(1.87)
CEO age2	-	0.001	-0.00136	-0.000879		0.0243	0.00517	-0.00173 *
		(0.06)	(-0.25)	(-1.30)		(0.86)	(0.64)	(-1.66)
Firm age	-	-1.915 ***	-0.338 ***	0.0729 ***		-1.276 **	0.0546	0.139 ***
		(-4.79)	(-2.66)	(4.65)		(-2.56)	(0.39)	(7.53)
Firm age2	+	0.00189	0.000626	-0.00000150		-0.00084	-0.000269	-0.0000523
		(1.06)	(1.11)	(-0.02)		(-0.37)	(-0.41)	(-0.62)