What is the effect of CEO overconfidence on firm value?

Master Thesis P.H. Van der Velde

Erasmus School of Economics

Program: **Financial Economics**
Author: **Pieter van der Velde**
Supervisor: **Dr. Maurizio Montone**
Final version: **7th of October**

ERASMUS UNIVERSITEIT ROTTERDAM

Colofon

Erasmus University Rotterdam
Erasmus School of Economics
Burgemeester Oudlaan 50
3062 PA Rotterdam, The Netherlands
E: info@ese.eur.nl

Author
P.H. Van der Velde (Pieter Hendrik)
Master Financial Economics
Student number: 457842
E: p.h.vandervelde@gmail.com

Supervisor
Dr. M. Montone (Maurizio)
Assistant professor of finance at the Erasmus School of Economics and Tinbergen Institute

Abstract

This study analyses the overall effect of CEO overconfidence on firm value and also documents how it impacts different corporate policies. The separate effects of CEO overconfidence on leverage, investment, and innovation are assessed and incorporated into one framework to determine the overall effect on firm value. The focus of this study is on U.S. firms in the period from 2006 to 2016. The methodology of Malmendier and Tate (2005) is adopted to construct four overconfidence measures based on option exercise behavior; Holder 67, Low overconfidence, High overconfidence, and Net buyer. The results indicate that moderate and high overconfidence levels have a positive effect on firm performance. Furthermore, low overconfidence harms firm value. The interaction of CEO overconfidence with leverage has a negative but negligible effect on firm value. Overconfident managers have a positive effect on firm value by moving investment levels closer to its optimal level. Particularly the interaction of CEO overconfidence with innovation has a positive effect on firm value. The implications of this study are that firms should focus on hiring overconfident managers. Furthermore, alternative mechanisms or more monitoring towards leverage decisions could possibly help to reach more optimal debt levels.

Preface

Hereby I would like to briefly reflect on completing the final project of my Master Financial Economics at the Erasmus School of Economics. Throughout the past months I have been gradually progressing towards the final product that you are currently reading. I enjoyed writing my thesis and still, after all this time, consider CEO overconfidence as a highly interesting topic.

I would like to thank my supervisor Dr. M. Montone for not only assisting me in finding this specific topic and providing useful advice throughout the entire process, but also for teaching the seminar Behavioral Finance that confirmed my original plan to write my thesis on a topic in the field of Behavioral Finance. I am very thankful for this as it was the major reason for me to choose this particular subject. Furthermore, I would of course like to thank my family; my parents and little brother for letting me finish this final project in the relaxing environment of their home. Lastly, I would like to thank my girlfriend for working with me in the library throughout the entire summer, a perfect holiday.

Pieter van der Velde

October, 2017

Haren

Table of contents

1. Introduction

In his book, Thinking, Fast and Slow, Daniel Kahnemann states: "The illusion that we understand the past fosters overconfidence in our ability to predict the future." In this statement he implies we do not yet fully understand the mechanisms of how people make decisions under uncertainty. Indeed, there are many cognitive biases that cause the decisions of agents to deviate from what is expected. The most dangerous is overconfidence. It has been blamed for overinvestment, stock market crashes, strikes, and even wars (Howard, 1983; Neale and Bazerman, 1985; Dominic, 2004; Johnson, 2004). This paper examines the effect of overconfidence on CEO decision-making, and thus how it affects corporate policies, and subsequently firm value.

The line of thought by Kahnemann opposes classical finance models, which assumes investors and managers are generally *rational*, and that asset prices incorporate all available information. The assumption of rationality is essential. According to classical models rational agents make choices consistent with the expected utility framework. In this framework choices are based on their rational outlook, available information and past experiences. Furthermore, as described by Bayes law, agents update their expectations correctly when they receive new information. By assuming rationality, the expected utility for choices under uncertainty should equal the weighted average of all possible levels of utility, and agents are expected to choose whatever maximizes their utility. In classical economics expected utility theory is often used as a descriptive theory, that is, a theory of how people *do* make decisions.

However, predictions of these models have received mixed empirical support, and the assumption of rationality is being challenged more and more (Ye and Yuan, 2008). In some cases classical theory makes faulty predictions about the decisions of agents in real-life situations. Allais (1953) and Ellsberg (1961) proposed examples of preferences that cannot be represented by the expected utility framework, but that nonetheless seem rational. The Allais paradox proved that different framing of the exact same question has an effect on the desirability of one gamble over another.[1] After Kahneman and Tversky (1979) tested this paradox a new line of thought originated with the development of the prospect theory, what

[1] See Appendix 1 for additional information regarding the Allais paradox.

[2] The certainty effect, reflection effect, and framing effect. For more extensive reading on behavioral biases see for example Ramirez and Levine (2013).

has laid the foundation for their groudbreaking economic theory; behavioral finance.

Behavioral finance stresses that psychology and emotion prompt investors to behave in ways that are inconsistent with what is considered rational in classical models. It focuses on the idea that agents are not rational. As this model better reflects how agents act under uncertainty, it is a better predictor of their choices in the real world. Prospect theory for example offers insights into why agents make non-optimizing decisions under uncertainty. It states agents are not universally risk-averse. Following Kahneman and Tversky (1979) loss aversion principle: "Losses loom larger than gains", which shows agents are risk averse for gains, but risk seeking for losses. The growing amount of research into the field of behavioral finance of the last decades has led to numerous behavioral biases where assumptions of the expected utility theory framework are violated. [2] Indicating this theory potentially could be used as a normative theory, a theory of how people *should* behave.

Regardless of the discussion outcome, and as Malmendier and Tate (2005, p.649) report: "The ultimate purpose within behavioral finance, one may argue, is predicting economic outcomes rather than the correct description of decision-making processes". Indeed, this relatively new field of finance could hold an explanation for stock market anomalies that have yet to be explained by classical finance models (Baker, Ruback, and Wurgler, 2007). Furthermore, it can have great implications to a wide variety of topics ranging from asset pricing to investor behavior and corporate finance decisions.

Behavioral finance studies the irrationality of investors and managers in two ways. One assumes the irrationality of investors, the other the irrationality of managers, this paper will focus on the latter. This approach, not to be confused with rational moral hazard behavior (empire building), assumes the manager believes he is maximizing firm value, while actually he is not (Baker, Ruback, and Wurgler, 2007). The main bias of the irrational manager approach is overconfidence, and psychology literature suggests that executives are particularly prone to exhibit this bias (Larwood and Whittaker, (1977), Kidd (1970), and Moore (1977)). Overconfident CEOs tend to overestimate their knowledge and underestimate risks. It is therefore interesting to analyse how overconfidence influences their decisions regarding corporate policies and evaluate how it subsequently impacts firm performance.

One of the first papers to link overconfidence to corporate decision making is the hubris hypothesis by Roll (1986). Acquisitions occur frequently while there is little evidence that they create value. Roll argues that excessive takeover activity is due to overconfident CEOs

overestimating the expected returns of mergers. Malmendier and Tate (2008) also find that overconfident CEOs undertake value-destroying mergers. Overconfidence can also lead to both over- and underinvestment (Malmendier and Tate, 2005). CEOs overinvest if they overestimate the returns of their projects and have access to sufficient internal funds. However, in the absence of sufficient internal funds an overconfident CEO may even underinvest due to a misperception of the cost of external financing. Overconfident CEOs are reluctant to take on risky debt or issue new equity since they perceive the stock of their company to be undervalued by the market. However, Hirshleifer, Low and Tech (2012) suggest there is also a bright side to overconfidence. They find that CEO overconfidence is associated with riskier projects, and consequently greater innovative output. Extensive research has focussed mainly on the separate effects of overconfidence on separate corporate policies. However, research on the overall effect of overconfidence on firm performance is scarce and has received mixed empirical results. This paper tries to combine all overconfidence effects and analyse how it impacts different corporate policies and how this subsequently affects firm performance. The research question of this paper is as follows:

What is the effect of CEO overconfidence on firm value?

I follow the methodology of Malmendier and Tate (2005) and construct their overconfidence measures based on option exercise behavior of CEOs to answer this research question. More specifically, their exposure to idiosyncratic risk is analysed in order to determine whether a CEO is overconfident or not. The option-based overconfidence measures are: Holder 67, Low Overconfidence and High Overconfidence. The fourth overconfidence measure Net Buyer is based on the same principle but focusses on the option purchasing behavior of CEOs. Tobin's Q is used as a proxy for firm value. The panel data is extracted from the database ExecuComp and Compustat and ranges from the years of 2006 until 2016 and contains 1683 U.S. firms and 2522 CEOs. I find that moderate *and* high overconfidence levels have a positive effect on firm performance. Furthermore, low overconfidence harms firm value. The results indicate overconfidence can account for corporate investment distortions.

This study contributes to existing literature linking biased managerial beliefs to corporate decisions. Moreover, it incorporates the different effects overconfidence has on corporate policies into one framework to determine the overall effect on firm value. Also, this study considers the difference between overconfident and non-overconfident CEOs, and also

distinguishes between the effects of low, moderate, and high levels of overconfidence. Lastly, the option-based overconfidence measures of Malmendier and Tate (2005, 2008) are constructed to measure the overall effect on firm value. However, they focus on explaining merger activity. Hirshleifer et al., (2012) also uses both overconfidence measures to analyse the effect of overconfidence on investments in risky projects. To the best of my knowledge these measures have yet been used to measure the effect of overconfidence on overall firm value.

This study is structured as follows. Section 2 reviews the literature on the implications of overconfidence for different corporate policies. Section 3 gives a description of the model and dataset that is used and specifies the variables for the regression models. Section 4 describes the methodology of this study. Section 5 will cover the empirical results and robustness tests and section 6 concludes with implications for corporate policies and limitations of this study. Lastly, the limitations of this study will be covered in the Discussion.

2. Theoretical background

This section starts with a general review of the literature on overconfidence, and proceeds by presenting a breakdown of the existing literature on the separate effects of overconfidence on corporate policies. Each subsection will conclude by presenting the hypothesis for each corporate policy accompanied by a prediction as to how overconfidence affects that particular policy, and subsequently firm performance.

2.1. Overconfidence

So what exactly is overconfidence? The existence of this well established cognitive bias has been known for centuries, and to this day still influences the decision making behavior of many agents. Overconfidence can have great implications, with sometimes detrimental consequences. According to Plous (1993, p.186): "No problem in judgment and decision making is more prevalent and more potentially catastrophic than overconfidence". An extreme example of overconfidence is the explosion of the space shuttle Challenger. According to the Commission's report of NASA (1986) a booster rocket failure occurs approximately every 100 launches. One year before the crash, NASA set the chances of an accident at 1 in 100,000. Overconfidence leads people to overestimate their knowledge and underestimate risks. Cooper, Woo and Dunkelberg (1988) conduct a survey under U.S. entrepreneurs and find that 68 percent feel they have better odds to succeed than other similar businesses. A similar research by Landier and Thesmar (2009) considers French entrepreneurs, and find that only 6 percent expects difficulties in the year the business was started. While Scarpetta, Hemmings, Tressel and Woo (2002) report that only half of all startups survive more than three years. Overconfidence is offered as an explanation to rationalize entrepreneurial activity, despite the frequency of entrepreneurial failure (Camerer and Lovallo, 1999). Due to its generality overconfidence is believed to hold explanations not just for entrepreneurial activity, but also for a much broader spectrum outside of economical topics.

Many behavioral biases are linked to overconfidence. A disadvantage of its generality is that there is no clear consensus regarding terminology or associated biases of overconfidence. The two most common biases associated with overconfidence are overoptimism and

overprecision.[3] In most studies overconfidence is referred to as overoptimism (Campbell et al., 2010). Agents can be overoptimistic about the outcome of exogenous variables or their own abilities (Clayson, 2005). Hence, optimistic investors exhibit an upward bias in their assessment of future outcomes (Malmendier and Tate, 2005a). The bulk of the literature focuses on agents that are too optimistic about their own abilities, and thus tend to overestimate them (Lichtenstein et al., 1982; De Bondt and Thaler, 1995; Daniel et al., 2001). For example, Christensen-Szalanski and Bushyhead (1981) find that physicians overestimate the accuracy of their diagnoses. Furthermore, Buehler, Griffin, and Ross (1994) report people also tend to overestimate how fast they can get work done. In economics, overconfident CEOs are described to systematically overestimate the mean returns to their investment projects (Malmendier and Tate, 2005). Heaton (2002) was one of the first studies to link this overestimation to investment distortions. What follows logically from the overestimation of individual abilities is another well-documented behavioral bias: the better-than-average effect (Larwood and Whittaker, 1977; Svenson, 1981; Alicke, 1985).

When agents assess their relative skill, they tend to overestimate their own abilities relative to the average. Most people believe they have above average driving skills (Svenson, 1981), and ability to remember details (Moore and Cain, 2007). The better-than-average effect potentially holds an explanation for stock market bubbles. Graham (1999) conducts a survey of CFOs, and finds that two-thirds believe their stock is undervalued. For the technology sector almost half of CFOs thought in a similar fashion. This result is especially striking considering the survey was taken shortly before the Internet crash. Other bahavioral biases commonly linked to overoptimism are illusion of control and self-attribution bias. When agents have no control over an event, they often exaggerate their ability to control outcomes (Presson and Benassi, 1996; Thompson, Armstrong, and Thomas; 1998). Furthermore, they attribute good outcomes to their own, and bad outcomes to luck (Miller and Ross, 1975). This self-attribution bias is perfectly described by the title of Langer and Roth's paper (1975): "Heads I Win, Tails It's Chance".

The other well-documented bias associated with overconfidence is overprecision; in the literature most commonly referred to as miscalibration. Most studies confound overestimation with overprecision, and use both terms interchangeably (Moore and Healy, 2008). Instead of overestimating the *mean*, miscalibrated investors underestimate the *variance* of investment projects. (Ben-David, Graham, and Harvey, 2013). In other words, miscalibrated investors

[3] Other associated biases are illusion of control, better-than-average effect, self-attribution bias and hindsight bias. See for example Miller and Ross (1975) and Roese and Vohs (2012), who propose a model of how hindsight bias leads to overconfidence.

underestimate the volatility of their firm future cash flows. Ben-David et al., (2013) also show that CFOs are severely miscalibrated, which has severe implications for corporate decision-making. When estimating the returns of investment projects executives set their confidence interval too narrowly, indicating they are too confident in their own prediction of uncertain future returns. As Teigen and Jorgenson (2005) report: 90% confidence intervals contain the answer less than 50% of the time. Also, an experiment conducted by Oskamp (1965) that compared confidence against accuracy showed that the confidence of subjects in their forecasts increased more rapidly than the actual accuracy of the forecast.

Existing literature also report that overconfidence is generally higher for executives than the average population (Heaton, 2002). Overconfidence is mainly triggered by three factors: illusion of control, high degree of commitment to good outcomes, and abstract reference points (Weinstein, 1980; Alicke et al., 1995; Hirshleifer et al., 2011). According to Malmendier and Tate (2005a) all these factors are pertinent to most executives and thus make them particularly prone to exhibit overconfidence. Moreover, overconfidence occurs more frequently among highly skilled individuals (Camerer and Lovallo, 1999), for difficult tasks (Griffin and Tversky, 1992) and when the power of an individual increases (Weinstein and Klein, 2002).

As mentioned above, overoptimism is often treated as equivalent of miscalibration. Hirshleifer's et al., (2012) main focus is on the miscalibration aspect of overconfidence, whereas Malmendier and Tate (2005, 2008) main focus is on the overoptimism aspect of overconfidence. In finance research the focus is generally on the overestimation of one's own abilities and not on the perceived outcome of exogenous variables or the underestimation of variance. Although some studies stress the importance of distinguishing between the two (Kwan, John, Kenny, Bond, and Robins, 2004); the setup of this study does not allow to adequately do so. However, Hackbarth (2009) suggests that both optimism and miscalibration are expected to occur in conjunction. Therefore this study will refer to both biases as overconfidence, and thus defines overconfidence as an overestimation of the mean returns to investment projects and an underestimation of the risks.

2.2. The effect of CEO overconfidence on corporate policies

Now that we have established the prevalence of overconfidence and its general implications, this section considers the theoretical effects of CEO overconfidence on four

different corporate policies and how it subsequently affects firm value. Each subsection concludes with the hypothesis for the corresponding corporate policy. All four hypotheses are refinements of the main research question. There are a multitude of variables influencing the different corporate policies in various ways. This section provides a simplified approach in assessing the different effects of CEO overconfidence on different corporate policies.

2.2.1. Leverage

The optimal capital structure of a firm has been researched extensively over the past decades. How do firms decide their optimal debt and equity levels? The most traditional theory is the Modigliani and Miller theorem (1958), which states that the value of a firm remains the same, irrelevant of its capital structure. However, strong assumptions are needed in order for this theorem to hold. Other traditional theories are the pecking order theory and static trade off theory. Donaldson (1961) started the beginning of the pecking order theory, which was further developed by Myers and Majluf (1984) that base this theory upon the asymmetry of information between internal and external stakeholders. Pecking order theory states that firms prefer a sequential choice with regards to funding sources: firms prefer internal financing, and prefer debt financing to equity financing if firms have to engage in external financing (Shyam-Sunder and Myers, 1999). Reasons for this hierarchy are transaction costs of raising capital and a firm's debt capacity. Static trade off theory challenges the former theory and suggests firms pursue an optimal debt ratio. It states the cost of equity is higher than the cost of debt, and that the optimal capital structure of firms is a trade-off between tax shields and the cost of financial distress (Myers, 1984). Both theories have received mixed empirical results.

Recent studies argue there are large unexplained time-invariant effects in leverage, and that overconfidence could potentially explain these differences across firms (Lemmon, Roberts, and Zender, 2008). Overconfidence generally implies higher firm leverage (Hirshleifer, Low, and Teoh (2012); Ben-David, Graham, and Harvey (2013). Malmendier and Tate (2005) find that overconfident CEOs raise roughly 33 cents more debt for one dollar of external financing than non-overconfident CEOs. According to Hackbarth (2006), overconfident CEOs underestimate the volatility of their firms' cash flows and thus underestimate the probability of bankruptcy. This results in overconfident CEOs pursuing aggressive financial policies and higher firm debt levels, which increases financial cost of distress (Fairchild, 2005b). Also, many studies report that the underestimation of volatility leads to lower discount rates (Roll, 1986; Hackbarth, 2006). As Ben-David et al., (2007, p.3) state: "overconfident managers value risky

cash flows with discount rates that are too low." The combination of the underestimation of risk and thus the lower discount rates and the overestimation of their own future cash flows leads overconfident CEOs to believe their firm is undervalued by the market. As a result, they view external financing as too costly (Malmendier, Tate, and Yan, 2011). Internal financing is preferred, and in the case of external financing they prefer debt to equity, which is consistent with the pecking order theory. Overconfident CEOs are reluctant to issue equity as they believe it dilutes the claims of existing shareholders. However, they are also reluctant to issue debt as they perceive the corresponding interest rate to be too high. According to Malmendier et al., (2013) overconfident CEOs will always prefer debt to equity since they consider equity issuance to be more costly as it is more sensitive to market expectations. Furthermore, issuing debt allows the current shareholders to keep their claim on future cash flows. Malmendier et al., (2013) find that overconfident CEOs are 37% to 49% less likely to issue equity than non-overconfident CEOs.

The preference for internal financing and aversion to external financing, and particularly equity, contrasts studies that state overconfidence leads to higher leveraged firms. Instead, these studies suggest the opposite. The manifestation of overconfidence could potentially help explain the important empirical puzzle of debt conservatism; which states that firms in general do not issue enough debt. Malmendier et al., (2013) find that managerial overconfidence is positively related to debt conservatism. Graham (2000) uses the kink methodology to show that debt conservative policies lead firms away from their optimal capital structure. The kink variable measures the extend to which firms can further increase debt and thereby reap additional tax benefits. However, low levels of debt do not necessarily imply low leverage, since overconfident CEOs are even more reluctant to issue equity than debt.

Most studies find that overconfident CEOs lead to significantly higher leveraged firms. Hackbarth (2008) for example shows that overconfident CEOs underestimate financial costs of distress and thus tend to issue more debt. This in turns leads to higher default thresholds and a higher probability of defaults. Furthermore, Oliver (2005) finds that managerial overconfidence explains a significant part of a firms' financing decisions and that overconfident CEOs are associated with higher debt levels. Lastly, Gombola and Marciukaityte (2007) find that the higher debt levels due to overconfidence is followed by worse stock performance compared to equity financing. It has to be noted that it can be difficult to assess causality for leverage and overconfident CEOs. Firms with higher debt levels or lower debt capacity might attract overconfident CEOs. Selection effects might bias the true effect of individual CEOs (Malmendier et al., 2013).

Overall, overconfident CEOs underestimate the costs of financial distress, leading to them adopting higher firm debt levels. The second manifestation of overconfidence is that they perceive their firm to be undervalued since they both underestimate the volatility of future cash flows to their own firm as well as overestimate these cash flows. As a result, they are reluctant to issue debt, but even more reluctant to issue equity. This moves the firm away from their optimal capital structure and harms firm value in the long run. I test the following hypothesis to study the effect of leverage on firm value:

Hypothesis 1: The interaction of CEO overconfidence and leverage has a negative effect on firm value.

2.2.2. Investment

Classical theories provide two traditional explanations for investment distortions (Ye and Yuan, 2008). The agency view links the misalignment of managerial and shareholders objectives to overinvestment (Jensen, 1986). In this framework the manager does not act in the interest of the shareholders. Instead, he overinvests to reap private benefits. Contrary to this overinvestment theory, asymmetric information between insiders and the capital market is proposed as an explanation for underinvestment (Myers and Majluf, 1984). The manager who acts in the interest of the shareholders restricts external financing in order to avoid diluting shares. This reluctance to issue external financing leads to underinvestment. However, both theories assume the manager is rational. CEO overconfidence can possibly explain investment distortions as it can lead to heightened cash flow sensitivity. This can in turn lead to both over- and underinvestment. In both cases the manager believes he is acting in the best interests of shareholders. This could have policy implications as the incentives of manager and shareholders are then perfectly aligned, but the manager may still invest sub optimally.

2.2.2.1. Investment cash-flow sensitivity

Most of the literature relates investment-cash flow sensitivity to capital market imperfections or misaligned incentives. However, Malmendier and Tate (2005a) state this interpretation is controversial (Kaplan and Zingales 1977; Fazzari, Hubbard, and Petersen,

2000). Overconfidence can link investment behavior and its dependence on cash flows (Roll, 1986; Heaton, 2002).

As discussed in the above section, overconfidence manifests itself mainly in two ways. Firstly, overconfident CEOs underestimate costs of financial distress, which leads to higher debt levels. Second, they systematically overestimate the returns of investment projects and simultaneously underestimate the variance of future cash flows, leading them to believe their firm is undervalued. Due to this perceived undervaluation they prefer internal over external financing, are reluctant to issue debt, and even more reluctant to issue equity. Considering their aversion to external financing, the literature studies the investment behavior of overconfident CEOs in case of insufficient internal funds. Most studies find a positive relation between overconfidence and investment cash flow sensitivity (Fazzari, Hubbard, and Petersen 1988; Ye and Yuan, 2008).

For example, Malmendier and Tate (2005) find that the investments of overconfident CEOs are more sensitive to cash flows than investments of their non-overconfident peers. Moreover, they also find that the effects are strongest for equity-dependent firms. Their findings confirm the aversion of overconfident CEOs to external financing, as well as their preference of issuing debt over equity. In case of abundant internal resources this results in overinvestment. Overconfident CEOs overestimate the returns of their investment projects and undertake projects with negative net present value. On the other hand, in case of serious financial constraints, it can also lead to underinvestment. Overconfident CEOs believe their firm is undervalued and do not undertake positive net present value projects since they are reluctant to issue debt and equity (Heaton, 2002). The presence or absence of internal resources is the deciding factor for their investment behavior. This is confirmed by Hovakimian and Hovakimian (2009) who find that overconfident CEOs with high cash flow sensitivity underinvest in years with low cash flows, and overinvest in years with high cash flows.

2.2.2.2. Overinvestment

In general, there are two reasons why overconfident CEOs overinvest. First, if overconfident CEOs have sufficient internal resources they overinvest since they overestimate the returns of their investment projects. As a result they undertake projects with negative net present value. Malmendier and Tate (2005a) confirm this finding and show that overconfident CEOs overinvest for all levels of investment as they overestimate future returns. The second reason why overconfidence may lead to overinvestment is studied by Ben-David et al., (2007).

Instead of focusing on overestimation they study how miscalibration impacts investment behavior. Miscalibrated CEOs underestimate the volatility of their firm future cash flows. As a result they attribute discount rates to risky cash flows that are too low. These lower discount rates overstate the net present value of investment projects, and thus also lead to overinvestment.

Roll (1986) was one of the first to pose overconfidence as an explanation for excessive takeover activity. Acquisitions occur frequently while there is little evidence that they create value. Roll argues that mergers occur so often because overconfident CEOs overestimate the expected returns of those mergers.[3] This overestimation increases the range of bids made by other bidders leading to larger losses for the winning bidder. Roll describes this phenomenon as the winners curse: the highest bidder will most likely overpay, which harms firm value.

Malmendier and Tate (2005) extend on the study by Roll by stating overconfidence has more implications than solely overbidding. Overconfident CEOs also overestimate their own ability to create synergies, which is another incentive for them to engage in mergers. Malmendier and Tate (2005) find that overconfident CEOs are 65% more likely to engage in acquisitions. Moreover, they find that mergers performed by overconfident CEOs are value destroying. The market reaction to merger announcements confirms their results. They find that the market reaction is significantly more negative for mergers conducted by overconfident CEOs. Furthermore, highly overconfident CEOs always trigger a negative market reaction.

However, there is also a positive side to CEO overconfidence as is demonstrated by Gervais, Heaton, and Odean (2003). First, they find that a rational risk averse manager is reluctant to undertakes projects with incomplete information. This agency problem leads to higher agency costs. Secondly, they suggest that the willingness of overconfident CEOs to engage in new projects overcomes the risk aversion behavior of rational managers. Hence, the tendency to overinvest aligns the incentives of managers and shareholders thereby decreasing agency costs, and benefiting firm value. These findings are confirmed by Goel and Thakor (2008); they find that rational risk averse managers underinvest compared to the optimal investment level. Overconfident managers on the other hand alleviate this underinvestment problem as they have a tendency to overestimate returns to future cash flows. In this way they move investment closer to the optimal investment level.

[3] It has to be noted that rational CEOs can also perform value-destroying acquisitions due to other frictions such as misaligned incentives or asymmetric information between insiders and capital markets.

2.2.2.3. Underinvestment

The above sections state that overconfident CEOs underestimate risks and overestimate future cash. Hence, they believe their firm is undervalued, which leads to a misperception of the cost of external financing. Overconfident CEOs simply believe creditors demand too high interest rates for providing debt and that shareholders demand too much compensation for providing equity (Malmendier, Tate, Yan, 2011). Hence, they view external financing as too costly and are therefore reluctant to issue debt or equity. Malmendier et al., (2001) also show that overconfident CEOs exhibit a preference of issuing debt over equity since they believe equity is more mispriced than debt.

Overconfident CEOs are financially constraint due to this misperception of actual firm value and reluctance to address external financing. As a result, if internal resources are scarce, they will not undertake positive net present value projects which leads to underinvestment (Heaton, 2002). Overconfident CEOs will only resort to external financing if the overestimated returns are larger than the perceived financing costs (Malmendier et al., 2011). Fazzari, Hubbard, and Peterson (1988) construct the financial constraint theory and find that reluctance to address external financing leads to underinvestment and could subsequently harm firm value. Lastly, Ye and Yuan (2008) confirm these findings as they state that overconfident CEOs are more likely to destroy value through suboptimal investment behavior.

The literature reports that overconfident CEOs have a significant influence on firm investment. Overconfident CEOs tend to exhibit heightened cash flow sensitivity that could serve as an explanation for investment distortions. Both over- and underinvestment are consequences of this high cash flow sensitivity. The empirical findings show that particularly overinvestment with respect to mergers can harm firm value. On the other hand, CEO overconfidence may move investments closer to the optimal level. Underinvestment might alleviate some of the overinvestment concerns, but can also have a negative influence on firm value. Therefore, the overall effect of CEO overconfidence on investment and consequently firm value remains ambiguous. I test the following hypothesis to shed more light on the relation between CEO overconfidence and investments:

Hypothesis 2: The interaction of CEO overconfidence and investment has a negative effect on firm value.

2.2.3. Innovation

Existing literature has established that managers are likely to be overconfident. This finding poses an empirical puzzle (Hirshleifer, Low, and Teoh, 2012). Why do firms hire overconfident managers? One can reasonably assume firms prefer unbiased managers. Instead, Graham, Harvey, and Puri (2010) provide evidence that developing firms employ more confident managers.[4] They also report that these are exactly the kind of firms where overconfidence effects are greatest. The literature provides a possible solution to this overconfident manager puzzle by stating that overconfident CEOs are better innovators.

There are several papers that study the effect of CEO overconfidence on innovation. Most studies report that the willingness of overconfident CEOs to engage in greater exploration and more risky projects may create value (Bernardo and Welch, 2001; Goel and Thakor, 2008). Innovative projects develop new technologies, products or services. Innovation is inevitably associated with risk; it is always pushing the limits and expanding the boundaries of the known, trying to explore and develop something new. Overconfident CEOs engage in more risky projects as they both overestimate future cash flows as well as underestimate the associated risks. Furthermore, it can take some time before the outcome of innovative projects is known plus the corresponding feedback can be ambiguous, which makes managers even more prone to overconfidence (Einhorn, 1980).

Due to their willingness to engage in risky projects Hirshleifer et al., (2012) state that overconfident CEOs are particularly important for innovative projects. They show that CEO overconfidence is associated with riskier projects, greater investment in innovation, and consequently also greater innovative output in the form of a 9% to 28% higher patent count. This higher innovative output however is only obtained in innovative industries. Overconfident CEOs can achieve higher innovative output by accepting good but risky projects, avoided by rational managers. Hirshleifer et al., (2012) propose a solution to the overconfident manager puzzle: overconfident CEOs are better innovators and can translate growth opportunities into firm value, but only for innovative industries. Their findings suggest that overconfident CEOs do not necessarily harm firm value.

[4] Many other papers find that firms often employ overconfident managers. See for example Malmendier and Tate (2005a, 2005b, 2008); and Ben-David, Graham, and Harvey (2010)).

Most literature report CEO overconfidence leads to riskier projects and greater innovative output. Overconfident CEOs undertake risky projects that rational managers avoid, and are able to translate growth opportunities into firm value only in innovative industries. In contrast, they might also undertake projects with low expected payoff. Most evidence however suggests overconfident CEOs might actually benefit firm value. I will therefore test the following hypothesis:

Hypothesis 3: The interaction of CEO overconfidence and innovation has a positive effect on firm value.

2.3. The overall effect of CEO overconfidence on firm value

The above sections addressed the separate effects of CEO overconfidence on corporate policies. This section will review the literature that studies the overall effect of CEO overconfidence on firm value. It will conclude with a prediction of how the separate effects of CEO overconfidence on corporate policies influence total firm value.

Existing literature that studies the effect of CEO overconfidence on firm value empirically is rather scarce since behavioral finance is a relatively new field of study still in the developing phase. In a model of Fairchild (2005b) including asymmetric information he suggests CEO overconfidence always leads to higher firm debt levels and thus also higher financial cost of distress. Consequently, this will harm firm value. When this model is extended and moral hazard is included he finds CEO overconfidence can both benefit, as well as harm firm value. There is trade-off between the CEOs taking on more projects and higher cost of financial distress associated with higher debt levels. He concludes that a moderately high confidence level is optimal for maximizing firm value. Other studies reach similar conclusions. Gervais et al., (2003) for example states that moderate overconfidence levels are optimal since it alleviates concerns of underinvestment while also avoiding cost of distress that are too high. Another study by Hackbarth (2009) documents two effects of CEO overconfidence. The first is the reluctance of overconfident CEOs to issue debt and particularly equity since they believe their firm is undervalued. As a result, they tend to underinvest since they avoid external financing. The second refers to the willingness of overconfident CEOs to engage in more projects since they overestimate future projects returns and underestimate risk. The timing effect alleviates the underinvestment problem. Similar as other studies Hackbarth (2009) suggest there is a trade-off between both effects. He reports that moderate levels of

overconfidence benefit firm value. Goel and Thakor (2008) also suggest there is an optimal point of overconfidence. Moderately overconfident CEOs are more willing to engage in risky projects alleviating the underinvestment problem and benefiting firm value. However, too high levels of overconfidence result in them taking on too many projects with low or perhaps negative net present value.

Ye and Yuan (2008) are one of the few papers to study the effects of CEO overconfidence on firm value empirically. They test how Chinese managerial confidence impacts Chinese firm value through investment decisions. Ye and Yuan (2008) argue that CEO overconfidence has an effect on firm value mainly through investments while at the same time firm value also has an effect on the overconfidence level. Therefore they treat firm value, investments and CEO overconfidence as endogenous variables. They find a positive relation between firm value and CEO overconfidence. If a firm is performing well overconfident CEOs attribute this success to their own performance and also become more confident about future success. Furthermore, they find that the effect of CEO overconfidence on firm value is positive at first, and turns negative after a certain point. These findings confirm previous studies as the authors suggest there exists a U-shaped relationship between CEO overconfidence and firm value. Thus, there may be an optimal level of CEO overconfidence that maximizes firm value.

We can conclude that there exists a theoretical relation between CEO overconfidence and firm value. Studies suggest this can have both positive and negative consequences for firm value. Despite contrasting results, it has also proven difficult to provide empirical evidence for this relation. There are a multitude of variables influencing firm value in various ways. It can therefore be difficult to assess the exact role that CEO overconfidence plays. Following the literature I briefly summarize how CEO overconfidence impacts different corporate policies, and subsequently what the expected effect on firm value is. First, CEO overconfidence leads to higher debt levels and subsequently higher financial cost of distress. Furthermore they are reluctant to address external financing. The effect of CEO overconfidence on leverage is therefore expected to harm firm value. Second, overconfident CEOs display heightened cash flow sensitivity, which can lead to both over- and underinvestment. Particularly overinvestment with regards to mergers and acquisitions severely harms firm value. In case of insufficient internal funds however overconfident CEOs may also underinvest. The effect of underinvestment on firm value remains ambiguous. Lastly, CEO overconfidence leads to riskier projects, greater innovation investment and subsequently greater innovative output, but only in innovative industries. To summarize, the overall effect of CEO overconfidence on firm value

remains controversial. It influences some policies positively, while negatively influencing others. However, most evidence suggests CEO overconfidence does more good than harm. Some studies show that there might be an optimal level of managerial overconfidence that maximizes firm value. Ye and Yuan (2008) proposed a U-shaped relation between CEO overconfidence and firm value. I will therefore test the following hypothesis:

Hypothesis 4: Moderate levels of CEO overconfidence have a positive effect on firm value, while both low- and high CEO overconfidence negatively affect firm value.

All four constructed hypotheses are refinements of the main research question of this study. I will accept or reject all hypotheses in order to answer the following research question:

What is the effect of CEO overconfidence on firm value?

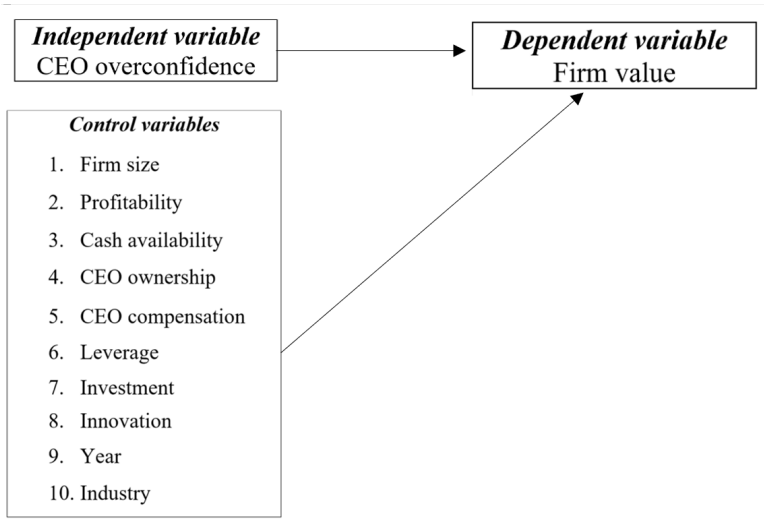
3. Research design

In this section the model, all independent, dependent, and control variables will be described.[5] A predictive validity framework will be constructed to present the model in a clear overview. Furthermore, the data collection process and the motives for the sample data and time period selection are explained.

3.1. Model

The framework of this study is shown below in figure 1. Table 1 provides an overview of the variables used in this study. This framework specifies all variables and predicts how they will influence each other. The purpose of this study is to answer the research question: *What is the effect of CEO overconfidence on firm value?* Consequently, the dependent variable in the model is firm value and the independent variable CEO overconfidence. As mentioned in the above section there exist many variables that influence firm value. The model will therefore control for them.

Figure 1: Conceptual model



The described model will answer the research question and hypothesis 4. Furthermore, hypotheses 1 until 3 are refinements of the research question, and allow for studying the individual effects of CEO overconfidence on leverage, investment, and innovation respectively.

[5] See Appendix 2 for an overview of all variables used from Compustat and ExecuComp. Table 1 depicts a detailed overview of all variables.

In order to answer hypotheses 1 until 3, a second independent variable will be added to the model to study the effect of CEO overconfidence on different corporate policies, and how it subsequently affects firm value. Moreover, the interaction effect of CEO overconfidence with each respective corporate policy is assessed.

3.2. CEO overconfidence measures

The greatest challenge for this study is to construct a plausible measure of overconfidence. Overconfidence is notoriously hard to measure. As Malmendier and Tate (2005, p.652) state: "Biased beliefs naturally defy direct and precise measurement." Multiple authors use surveys as a proxy for CEO overconfidence to overcome direct measurement problems. Ben-David, Graham, and Harvey (2013) study if CFOs are miscalibrated by asking them to predict future performance of a stock index. After assessing the survey results they measure the narrowness of the distribution of their predictions to detect miscalibration. If CEOs set the confidence intervals too narrowly they are classified as overconfident. Grinblatt and Keloharju (2009) construct another survey-based proxy for overconfidence by assessing the outcome of psychological and aptitude tests of military service recruits in Finland. One of the scales from the tests measures their confidence levels. The overconfidence measure is their self-reported confidence level minus how confident they should be based on the outcome of the test results. However, a more direct measure of overconfidence independent of the proclaimed opinions of individuals would be more robust.

Other papers use firm characteristics as a proxy for overconfidence. Considering that many studies show that overconfidence leads to more acquisitive CEOs, Doukas and Petmezas (2007) use the high frequency of acquisitions deals as a measure of overconfidence. Another proxy proposed by Lin, Hu, and Chen (2005) is based on corporate earnings forecasts. They label CEOs as overconfident when earnings forecasts are higher than what can realistically be assumed. A disadvantage of both proxies is that many other variables other than overconfidence determine firm characteristics.

The most influential overconfidence proxies are constructed by Malmendier and Tate (2005a, 2005b, 2008). Multiple other studies adopted their proxies to conduct further research into overconfidence.[6] The first three proxies of overconfidence are all based on management shareholding status. More specifically, Malmendier and Tate (2005a) infer CEO beliefs on

6 See for example Hirshleifer, Low and Tech (2012); and Ye and Yuan (2008).

future firm performance by measuring their exposure to idiosyncratic risk. In order to align the incentives of managers and shareholders, top tier managers generally receive a substantial equity-based compensation in the form of stocks and options. In this way the compensation of managers is tied to firm performance. To maximize the incentive effects CEOs are not allowed to trade their options or short sell company stock, and so they are unable to hedge the risk. As a result CEOs are under-diversified and thus overexposed to idiosyncratic risk as their human capital, stock, and options all bear the risk of the same company. CEOs must trade off the option value of holding the stock against the costs of exposure to idiosyncratic risk. Given the under-diversification, an optimizing risk-averse CEO is expected to exercise their options early in order to diversify and thereby decreasing their exposure to idiosyncratic risk.[7] According to Hall and Murphy (2002) this is particularly true if their options are sufficiently in the money due to a high stock price.[8]

However, some CEOs do not act accordingly. Instead of exercising early and diversifying as soon as possible, they choose to hold in the money options. Malmendier and Tate (2005a) argue they can infer CEO beliefs if they do not exercise their options above a certain threshold.[9] They classify a CEO as overconfident when they systematically expose themselves to high idiosyncratic risk despite having strong incentives to diversify their portfolios. Following their line of argument, the reason for holding options is that they are confident about the firm's prospects. They overestimate the firm's future performance and therefore expect stock prices to rise. As a result, overconfident CEOs are willing to be exposed to idiosyncratic risk and hold their option as they hope to benefit from these expected higher stock prices, sometimes even purchasing additional company stocks.

Malmendier and Tate (2005) translate this logic into three overconfidence measures. The first two measures are based on the option exercise behavior of CEOs: "Holder 67" and "Longholder", which classify CEOs as overconfident if they exercise later than optimal, or hold their options until expiration, respectively. The third measure is based on purchasing behavior of CEOs and is called "Net Buyer", which classifies CEOs as overconfident if they purchase their own company stock. Literature suggests that overconfidence varies significantly among

7 CEOs can exercise early only after the vesting period. The vesting period ends when selling restrictions on executive stock options expires and option exercise becomes permissible.

8 A call option is in the money whenever the share price exceeds the strike price for which the CEO can buy. A put option is in the money whenever the strike price exceeds the share price for which the CEO can sell. Employee stock options (ESO's) are generally call options and so this paper treats CEO compensation as call options whenever it refers to options.

9 Following Hall and Murphy (2002), the exact threshold for rational exercise depends on individual wealth, risk aversion, and diversification.

individuals and also tends to be stable for these individuals over time (Klayman et al., 1999). Both assumptions are essential for this study as the overconfidence measure rely heavily on them. Malmendier and Tate (2005) use data on CEO exercise and holding behavior of Forbes 500 firms collected by Yermack (1995) and Hall and Liebman (1987). Unfortunately, it is not possible to reconstruct the exact overconfidence measures constructed by Malmendier and Tate (2005), as use of their dataset is proprietary. However, Campbell et al., (2011) and Hirshleifer et al., (2012) construct similar measures to "Holder 67" by using data from Compustat and ExecuComp. Moreover, they construct another proxy that distinguishes between low and high CEO overconfidence. This study follows their approach in constructing both the "Holder 67" and "Low versus High" overconfidence proxies. Lastly, "Net Buyer" is also constructed by using data from Compustat and ExecuComp. The measure "Longholder" cannot be reconstructed from these two datasets.

A final measure of overconfidence proposed by Malmendier and Tate (2005a) is called "perception of outsiders", and is a measure based on press portrayal. This measure ought to capture if outsiders believe CEOs to be overconfident or not by assessing how CEOs are portrayed in the media. The press portrayal measure considers the level of media coverage by counting how often words relating to overconfidence are mentioned in correspondence with a specific CEO. Although the press-based measure overcomes potential endogeneity problems of the option-based measures, it is also a noisier measure due to inconsistent press coverage for all CEOs. This study will therefore only consider the option-based overconfidence measures.

3.2.1. Overconfidence measure: "Holder 67"

The first overconfidence measure in this study follows the option-based measure "Holder 67" or "OC67" in short, constructed by Hirshleifer et al., (2012). They follow Hall and Murphy (2002) and state that it is optimal for a risk-averse CEO to exercise their options early in order to diversify and thereby decrease their exposure to idiosyncratic risk if the option is sufficiently in the money. The exercise benchmark in the Hall-Murphy framework is set at 67% in the money. Hirshleifer et al., (2012) classify CEOs as overconfident if they hold vested options that are at least 67% in the money once.[10]

10 Originally Malmendier and Tate (2005) require a CEO to hold options that are at least 67% in the money *twice*. However, Hirshleifer et al., (2012) perform robustness tests and find that results are unchanged if CEOs hold 67% or more in the money options just *once* in the sample. This study follows this approach.

The average moneyness of options has to be calculated in order to determine if CEOs hold options of at least 67% in the money:

$$Average\ option\ moneyness = \frac{stock\ price\ at\ fiscal\ year\ end}{stock\ price\ at\ fiscal\ year\ end - \left(\frac{estimated\ value\ of\ unexercised\ exercisable\ options}{number\ of\ unexercised\ exercisable\ options}\right)} - 1$$

As previously stated, if the average moneyness of held options is at least 67%, CEOs are classified as overconfident. Consequently, the dummy variable OC67 takes a value of one, and zero otherwise. Klayman et al., (1999) state overconfidence is a persistent trait. Therefore, if CEOs are classified as overconfident once, the dummy variable OC67 remains one for the entire sample period.[11] The line of thought is that CEOs do not suddenly become overconfident if the average moneyness of held options is above the 67% threshold. Rather, they were already overconfident prior to the option crossing the threshold; the actual crossing simply reveals their already formed beliefs. Negative and zero values for option moneyness are excluded. Furthermore, CEOs who never hold options with a positive value are also excluded. Following hypothesis 4, OC67 is expected to have a negative effect on firm value.

3.2.2. Overconfidence measure: "Low versus High" overconfidence

The second option-based overconfidence measure follows Campbell et al., (2013), who construct two dummy variables for low and high overconfidence: Low_OC and High_OC respectively. CEOs are classified as high overconfident if they hold vested options that are more than 100% in the money at least once. Consequently, the dummy variable High_OC takes a value of one, and zero otherwise. The option moneyness is calculated in the exact same matter as the variable OC67. Again, CEOs who never hold options with a positive value are excluded. Following hypothesis 4, High_OC is expected to have a negative effect on firm value.

A CEO is classified as having low overconfidence upon two conditions. First, if CEOs do not *hold* exercisable options of 30% in the money or higher. And secondly, if CEOs *exercise* stocks that are 30% in the money or lower. The former condition also relies on the option moneyness calculation as above. The value of exercised options is calculated as follows:

[11] In case of missing data the CEO is still classified as overconfident if he is overconfident at least once for the years in which he is CEO.

$$Value\ exercised\ options = \frac{\left(\frac{value\ of\ exercised\ options}{number\ of\ exercised\ options}\right)}{\left(stock\ price\ at\ fiscal\ year\ end - \frac{estimated\ value\ of\ unexercised\ exercisable\ options}{number\ of\ unexercised\ exercisable\ options}\right)}$$

CEOs are classified as low overconfident if the value of exercised stocks are 30% in the money or lower *or* if they do not hold options with average option moneyness of 30% or higher at least once in the sample. Consequently, the dummy variable Low_OC takes a value of one, and zero otherwise. Missing values for the value of exercised options cannot be excluded since CEOs who did not exercise yet cannot be classified as having low overconfidence. Following hypothesis 4, Low_OC is expected to have a negative effect on firm value.

3.2.3. Overconfidence measure: "Net Buyer"

The third overconfidence measure follows Malmendier and Tate (2005) who construct the variable Net_Buyer.[12] The dummy variable Net_Buyer takes a value of one if CEOs buy additional stocks of their own firm, and zero otherwise. The percentage change increase or decrease in shares owned by the CEO is used to determine if CEOs classify as net buyer or not. The increase or decrease in shares owned is interpreted as the net amount the CEO buys or sells. Following Malmendier and Tate (2005) CEOs can only classify as a net buyer if there are more years where they buy company stocks than where they sell company stock. This study uses a dataset with a time period of 11 years. Therefore, CEOs are only classified as a net buyer if they buy company stocks for more than half of the observations, which is 6 out of 11 years. Malmendier and Tate (2005) also construct an alternative variable to Net_Buyer where they classify CEOs as net buyers only if they buy stock for all years in the sample. Unfortunately, there does not exist a CEO in the sample for which this is true. Therefore, I change the alternative measure and classify CEOs as a net buyer if they buy company stocks for all years while being CEO but one.[13] For both measures of Net_Buyer, CEOs in the sample for only one or two years are excluded and treated as missing as these observations could potentially cause an upward bias. Following Hypothesis 4; Net_Buyer is expected to have a negative effect on firm value.

[12] Due to the use of different datasets the construction of Net_Buyer in this study is not an exact replicate of the measure of Malmendier and Tate (2005).

[13] The results of Net_Buyer are robust to the use of the alternative proxy of Net_Buyer.

3.3. Alternative explanations of option-based overconfidence measures

An important assumption of the option-based overconfidence measures is that CEOs are under-diversified and thus overexposed to idiosyncratic risk and therefore have strong incentives to exercise their options early. Consequently, CEOs must be overconfident about the firm's prospects if they hold options above a certain threshold. However, Malmendier and Tate (2005) acknowledge there are many other reasons why CEOs may choose to hold options. They consider alternative interpretations for CEOs holding options including inside information, signaling and board pressure and risk tolerance. Moreover, this study will also consider some factors that influence optimal exercise decisions that have been excluded by Malmendier and Tate (2005), under which tax incentives and procrastination.

3.3.1. Inside information

One possible alternative explanation for CEOs to hold sufficiently in the money options is inside information. Overconfident CEOs anticipate a stock price increase and therefore hold their options to benefit from the increase in value. With positive inside information the CEO knows for certain the stock price will increase instead of only believing it will, and consequently will hold his options. If CEOs would indeed have positive inside information one would expect they also earn abnormal returns from holding options. However, Malmendier and Tate (2005) do not find evidence for abnormal returns earned by CEOs who hold in the money options. Carpenter and Remmers (2001) also find little evidence that managers hold or exercise options based on inside information. They conclude that CEOs do not have positive inside information that may induce them to hold options.

3.3.2. Signaling and board pressure

Signaling is based on a similar mechanism as inside information and can also serve as an alternative explanation for CEOs to hold options. The signaling theory states that insider trades reveal private information of CEOs to the market (John and Lang, 1991). Outsiders perceive insider trades as a valuable source of information that leads to prices that better reflect a firm's fundamental value (Manne, 1966; Leland, 1992). Fidrmuc et al., (2006) show empirically that stock prices change after insider trades. For example, the early exercise of

CEOs is often viewed as negative news and is therefore accompanied by a stock price decrease. This might induce CEOs to hold options. Board pressure may also induce CEOs to hold in the money options. If CEOs don't exercise they signal positive information to the market about the quality of a possible merger deal. Malmendier and Tate (2005) argue there is little evidence for both explanations, as they do not find positive abnormal returns for CEOs who hold their options to avoid a negative price reaction. They do state the possibility that the market could have reacted even worse if the CEOs had exercised their options, but have no evidence for this matter. I will consider some papers that study how market reactions may influence CEO exercise behavior and present alternative explanations for both early and late options exercises in the Discussion.

3.3.3. Risk tolerance

Personal preferences of CEOs may have a significant effect on their exercise behavior. As stated in previous sections Malmendier and Tate (2005) consider two manifestations of overconfidence namely overestimation and miscalibration. CEOs may hold options due to a higher willingness to take risk, not because they are overconfident. However, they argue that risk tolerance does not explain reluctance to address external financing. High risk tolerant CEOs should be more willing to increase firm's debt levels to finance projects. Malmendier and Tate (2005) results suggest the opposite.

Another possible concern about the option-based measures is that it could possibly measure the underestimation of stock volatility instead of the overestimation of future returns. According to the no-arbitrage option pricing theory the option increases in value as volatility increases. Empirical analysis shows that high variance is associated with earlier exercise of options (Bettis, Bizjak, and Lemmon, 2005; Carpenter, Stanton, and Wallace, 2009). This suggests that underestimating variance should favour later exercise. In that case the option-based proxy would actually measure underconfidence instead of overconfidence (Malmendier, Tate, and Yan, 2011).

3.3.4. Optimal exercise decisions

It can be difficult to estimate the optimal time to exercise options. The optimal time to exercise depends on the stock price forecast, which in turn is dependent on interest rates, tax rates, and dividend pay-outs. Tax rate for example, although not considered by Malmendier and

Tate (2005), can be important in explaining both early exercises and the holding of options. If CEOs want to exercise early they need money to exercise. If they choose to borrow they owe interest, if they use their own they forego the interest they would have otherwise earned on that money. Moreover early exercise comes with a big tax event. CEOs are taxed at ordinary rates on the intrinsic value "gain", which is the difference between the strike and stock price. This tax is due in the same tax year and has to be paid upon early exercise. The above-mentioned reasons might induce CEOs to hold their options. In contrast, CEOs might also exercise early due to tax incentives. If CEOs believe a stock will appreciate considerably they will exercise today and pay the ordinary income tax. After holding the option for twelve months future gains would then be subject to a lower long-term capital gains rate.

Other factors such as the strike price and the time value of the option can also influence the optimal time to exercise. CEOs forego the time value of options by exercising early. The time value of options can be substantial, and might pose a reason for CEOs to hold their options. Lastly, Malmendier and Tate (2005) also suggest CEOs may hold their options because of procrastination. I will discuss other papers that study portfolio effects and also behavioral explanations to gain more insight into the incentives of CEOs to either exercise early or hold their options in the Discussion.

3.4. Firm value measure

This study employs Tobin's Q as a proxy for firm performance, and thus firm value. There is consensus in existing finance literature in that Tobin's Q is generally used as a market-based measure for firm performance. Prior studies on the relationship between CEO overconfidence and firm performance all employ this proxy (Yermack, 1995; Malmendier and Tate, 2005; Hirshleifer et al., 2012). Brainard and Tobin (1968) define Tobin's Q as the market value of equities divided by the replacement costs of physical assets. It can be difficult to precisely estimate replacement costs of assets, as it requires many assumptions. Moreover, all necessary data is not always available. Most studies therefore use a simplified version of Tobin's Q and substitute replacement costs by book value of assets. Malmendier and Tate (2005) compute the market value of assets as total assets plus market value of equity minus book value of equity. Market value of equity is calculated by multiplying the number of common shares outstanding by the stock price at fiscal year end. Book value of equity is calculated as stockholder's equity minus preferred stock at liquidating value plus balance sheet

deferred taxes and investment tax credit.[14] Lastly, market value of assets is estimated as total assets.

An alternative measure of Tobin's Q by Chung and Pruit (1994) is used as a robustness check. Their approach differs in how they estimate the market value of assets. They define the market value of assets as market value of equity (number of common shares outstanding multiplied by the stock price at fiscal year end) plus preferred stock at liquidating value plus debt. Debt is defined as total current liabilities minus total current assets plus total inventories plus total long-term debt.[15] Lastly, they also divide by total assets.

3.5. Control variables

There exist many variables that influence firm value. The model in this study will therefore control for these variables accordingly. Alternative proxies for different control variables will be constructed to ensure robustness. Moreover, besides controlling for them, the variables leverage, investment, and innovation will also be included as independent variables in hypotheses 1, 2, and 3 respectively, in order to measure interaction effects with CEO overconfidence.

Firm size

There is a general consensus in existing literature that firm size influences firm value (Yermack, 1995). Although the evidence is ambiguous, most papers include firm size as a control variable by taking the log of Total Assets. Moreover, this study also considers the log of Net Sales as an alternative proxy for firm size.[16]

---

[14] In case of missing values for preferred stock at liquidating value, they use preferred stock at redemption value or par value, in that specific order respectively. Daniel and Titman (1997) and Baker et al., (2003) compute Tobin's Q in a similar fashion. Although Daniel and Titman (1997) use a different order for preferred stock: they first use redemption value, then liquidating value, followed by carrying value. The results for the first measure of Tobin's Q are similar when stockholder's equity is substituted by total assets minus total liabilities. Lastly, book value of equity can be replaced by the variable book value per share from Compustat, multiplied by the number of common shares outstanding. This also produces similar values for the first measure of Tobin's Q.

[15] This study follows Hirshleifer et al., (2012) and assumes all missing variables for debt as zero since they are considered as non-material. In robustness checks all missing values are treated as missing which does not significantly alter the empirical results.

[16] Both proxies produce qualitatively similar results.

Profitability

Yermack (1995) finds that profitability positively affects firm value. Return on assets (ROA) is often used as a proxy for profitability. Malmendier, Tate, and Yan (2005) for example measure profitability as operating income before depreciation and normalize this variable by the book value of assets to compute ROA. To simplify, this study instead normalizes by using Total Assets. An alternative proxy of ROA is computed by dividing Net Income by Total Assets.[17] Profitability is expected to have a positive effect on firm value.

Cash availability

The availability of cash is an important determinant for firm's investment decisions. Without sufficient internal funds firms are forced to resort to the costlier external financing. Hence, in the absence of internal funds firms may choose not to undertake investment projects with positive net present value, which harms firm value. On the other hand, in case of abundant internal resources, firms tend to undertake too many projects, which also harms firm value (Roll, Schwartz, and Subrahmanyam, 2009). Following these authors this study constructs a dummy variable as a proxy for capital constraints. The dummy variable takes a value of one in case a firm pays dividend, and zero otherwise. Roll et al., (2009) argue that firms that pay dividends could have more cash flow, which in turn may potentially be used to overinvest. Therefore, the dummy for cash availability is expected to negatively affect firm value. This study uses Cash Dividends (Cash Flow) as a proxy for cash availability since there are no observations for the preferred variable Cash Dividends Paid.

CEO ownership

The proxy for CEO ownership is the percentage of company stock that is owned by the CEO, excluding options. ExecuComp does not display negative percentages, and so they are treated as missing. Both Malmendier and Tate (2005b) and Hirshleifer et al., (2012) control for CEO ownership as it could lead to incentive misalignment. The incentives of CEOs increase if CEOs hold more company shares, since their own human capital is then more heavily dependent on firm performance. Chung and Pruitt (1996) study the relationship between CEO ownership and Tobin's Q and find that CEO ownership induces CEOs to act in the best interest of the shareholders. Consequently, CEO ownership is expected to have a positive effect on firm value.

[17] Both proxies produce qualitatively similar results although the alternative proxy generally leads to higher coefficients for all overconfidence measures and higher positive coefficients for Investment, which are significant at the 1% level.

CEO compensation

This study measures CEO compensation as Total Compensation Including Option Grants. Chung and Pritt (1996) find a strong and positive correlation between compensation and Tobin's Q. As a result, CEO compensation is expected to have a positive effect on firm value.

Leverage

Static trade-off theory suggests firms pursue optimal firm value by trading the benefits of tax shields against the costs of financial distress (Myers, 1984). The effect of leverage on firm value has received mixed empirical results. This study measures leverage as the debt-to-equity ratio: the sum of Total Long Term Debt and Total Debt in Current Liabilities normalized by Total Stockholder's Equity. This variable will also be included as an independent variable in Hypothesis 1 to measure the interaction effect of CEO overconfidence with leverage. An alternative proxy for leverage is also constructed by normalizing solely Total Long Term Debt by Stockholder's Equity.[18] A final alternative measure proposed by other studies is the financial leverage ratio, also referred to as the equity multiplier: divide average Total Assets by average Stockholder's Equity. However, this alternative proxy produces significantly higher levels of leverage compared to the first two proxies, and is therefore excluded. The interaction variable is expected to have a negative coefficient as the combined effect of leverage and CEO overconfidence is expected to have a negative effect on firm value.

Investment

Ye and Yuan (2008) test the impact of CEO overconfidence on firm value through investment decisions and find a significant positive relation between firm value and investment, but an insignificant positive relation the other way around. The evidence of the relation between investments and firm value is generally ambiguous. Malmendier, Tate, and Yan, (2011) use the following formula as a proxy for investment: Capital Expenditures plus Increase in Investments plus Acquisitions minus Sale of Property minus Sale of Investments. Subsequently they normalize investment with beginning of the year capital. For simplicity, this study normalizes investments with total assets. As an alternative measure they use the exact same formula but

[18] The Leverage and Alternative Leverage measure produce qualitatively similar results.

also subtract the change in Short-Term Investments and Other Investing Activities.[19] The variable Uses of Other Funds is excluded, as there is no available data for this variable. A third possible proxy for investment is constructed by Malmendier and Tate (2008) who normalize Capital Expenditures by Total Assets. They also use an alternative proxy by substituting Total Assets with Beginning Balance of Property, Plant, and Equipment. Unfortunately there is no available data for the latter variable. This study follows the more detailed proxy for investment proposed by Malmendier, Tate, and Yan (2011) to construct two investment proxies. The proposed proxy by Malmendier and Tate (2008) will also be used to construct a third proxy for investment. These variables will also be included as an independent variable in Hypothesis 2 to measure the interaction effect of CEO overconfidence with investment. The interaction variable is expected to have a negative coefficient as the combined effect of investment and CEO overconfidence is expected to have a negative effect on firm value.

Innovation

There is generally more evidence in existing literature that suggests CEO overconfidence may benefit firm value. Following Hirshleifer et al., (2012) this study constructs a proxy for innovation by dividing Research and Development Expense by Book Assets.[20] Again to simplify, this study uses Total Assets instead of Book Assets. Malmendier, Tate, and Yan (2011) propose an alternative measure of innovation by dividing Capital Expenditures with Net Sales. Malmendier et al., (2011) also construct a final proxy for innovation by dividing Advertising Expense with Net Sales.[21] This study will construct all three proxies for innovation. These variables will also be included as an independent variable in Hypothesis 3 to measure the interaction effect of CEO overconfidence with innovation. The interaction variable is expected to have a positive coefficient as the combined effect of innovation and CEO overconfidence is expected to have a positive effect on firm value.

Year and Industry fixed-effects

Following Yermack (1995) it is common practise to introduce year and industry fixed-effects. This study therefore constructs a dummy variable for each year in the sample to control

[19] The Investment and two alternative Investment proxies produce qualitatively similar results.

[20] This study follows Hirshleifer et al., (2012) and assumes all missing variables for Research and Development Expense as zero since they are considered as non-material. In robustness checks all missing values are treated as missing which does not significantly alter the empirical results.

[21] The three proxies for Innovation all produce qualitatively similar results.

for time effects. Moreover, this study also follows Yermack (1995) in constructing dummy variables based on two-digit SIC codes to control for industry effects. SIC codes in the sample all consist of four-digit codes, and are thus transformed into two-digit SIC codes before constructing a dummy variable for each industry in the sample. In total, this study creates 58 industry dummies based on two-digit SIC codes.

3.6. Data source and sample

The panel data is extracted from Compustat and ExecuComp available at Wharton Research Data Services. The dataset is unbalanced as not all firms have an equal number of observations. Compustat is used to extract firm financial data for the dependent and control variables, and ExecuComp to extract data on the compensation of executives for the independent variables. The sample ranges from 2006 until 2017 and includes only North American firms. Only data from 2006 and onwards is included since ExecuComp provides more detailed information on the compensation of executives. More specifically, from 2006 onwards the difference between the option's exercise price and close price of company's stock is available. Also, prior to 2006 ExecuComp provided information of in the money unvested options. Information on unvested options is irrelevant considering the overconfidence measures of this study are based on executives that choose to hold in the money exercisable options. With unvested options however, executives are not allowed to exercise their options, therefore unvested options are excluded from the sample. Furthermore, since this study analyses the effect of CEO overconfidence on firm value, only CEOs are included in the sample. This study aims to maximise the number of observations rather than to immediately drop observations with missing data. Only missing values for the overconfidence measures are excluded, as they are essential to the analysis. Missing values for the dependent or control variables are assumed to be zero. Also, CEOs who never hold valuable options are excluded. Lastly, following previous research I exclude SIC codes 4900-4999 of specific financing firms and 6000-6999 of regulated utilities. With these alterations the final sample of panel data consists of 1683 firms, 2572 CEOs, and 11935 CEO years.

4. Methodology

4.1. Data alterations

All variables in the model are systematically checked for errors. First, for each variable negative, missing, or extreme values are evaluated and possibly removed if they contain errors or if they contain inappropriate values for the research of this study. To ensure that all variables are normally distributed I construct histograms to identify possible outliers. Any extreme values will be winsorised at the 1% level in both tails to ensure robustness. The literature on robustness generally finds percentages of gross errors higher than 1% in each tail; percentages around 10% are not uncommon (Hampel, Ronchetti, Rousseeuw, Stahel, 1986). This study adopts the conservative approach by only winsorizing the dependent and control variables at the 1% level in both tails. This study compares conventional standard errors and robust standard errors to alleviate hetereoskedasticity concerns. The two sets of standard errors are similar and therefore the results are based on homoskedasticity. Besides the standard errors being robust, they are also clustered at the firm level, further alleviating heteroskedasticity and autocorrelation concerns. Second, the correlation between control variables cannot be too high in order to avoid multicollinearity problems. A correlation matrix is constructed to measure correlation between variables. High correlation may be an indication of spurious regression. Hence, if control variables are too strongly correlated one of these variables will be excluded from the regression.[22] The correlation matrix shows no concerns of too high correlation between control variables. This study performs all data alterations and regressions with the statistical program Stata.

4.2. Regression analysis

Only the dependent variable Tobin's Q is a continuous variable, all other variables in the model are either quantitative or dummy variables. Following Malmendier and Tate (2005b) and Hirshleifer et al., (2012) this study uses OLS regression to estimate the parameters of the model. Also, year and industry fixed-effects are added to the model to alleviate concerns with a high probability of endogeneity.[23] By including fixed-effects the effect of overconfidence can

22 Correlation between variables of 0.7 or higher is undesirable (Pallant, 2011).

23 In the fixed-effects model α is permitted to be correlated with the regressors X_{it} which limits endogeneity concerns. Endogeneity concerns will be covered more extensively in the Discussion.

be analysed separately from the impact of time-invariant firm characteristics. However, in this study CEO overconfidence is assumed to be stable for CEOs over time. CEOs are overconfident for all firm years in the sample or none. Consequently, firm fixed-effects may not be suitable regressions for this study. For now they are included in the model. The base regression model for this study is specified as follows:

$$\text{Tobin's } Q_{it} = \beta_0 + \beta_1(OC67_{it}) + \beta_2(Year_{it}) + \beta_3(Industry) + \varepsilon_{it} \quad (1)$$

Where β_0 is the intercept, β_1 measures the coefficient of the first overconfidence measure OC67, Year and Industry are the year and industry dummies, and lastly ε_{it} is the error term. The other two overconfidence measures Low vs High overconfidence and Net Buyer will also be tested in this regression. The overconfidence measures will be substituted with each other to separately test the measures. For clarity, Low_OC and High_OC are simultaneously used in the base regression model in order to compare both effects to moderate levels of overconfidence. All measures are expected to have a negative effect on firm value. Consequently, the coefficient of OC67, Low_OC, High_OC and Net_Buyer is expected to be negative. The model will control for other variables that are likely to influence firm value. These control variables are added to the base regression to ensure robustness of the results. The extended regression model is specified as follows:

$$\text{Tobin's } Q_{it} = \beta_0 + \beta_1(OC67_{it}) + \beta_2(\text{Firm Size}_{it}) + \beta_3(\text{Profitability}_{it}) + \beta_4(\text{Cash Availability}_{it}) + \beta_5(\text{CEO ownership}_{it}) + \beta_6(\text{CEO compensation}_{it}) + \beta_7(Leverage_{it}) + \beta_8(Investment_{it}) + \beta_9(Innovation_{it}) + \beta_{10}(Year_{it}) + \beta_{11}(Industry) + \varepsilon_{it} \quad (2)$$

Regression (2) will test Hypothesis 4 by measuring coefficient β_1. In order to answer Hypotheses 1-3 a different regression is used. The variables leverage, investment, and innovation will also be included as independent variables to measure the interaction effects with CEO overconfidence for Hypotheses 1, 2, and 3 respectively. The general regression model is specified as follows:

$$\text{Tobin's } Q_{it} = \beta_0 + \beta_1(OC67_{it}) + \beta_2(Leverage_{it}) + \beta_3(OC67_{it}) * (Leverage_{it}) + \beta_4(Year_{it}) + \beta_5(Industry) + \varepsilon_{it} \quad (3)$$

Regression (3) will test Hypothesis 1 by measuring coefficient β_3, which is the interaction variable with of the overconfidence measure with the independent variable Leverage. OC67 will be substituted with High_OC and Net_Buyer to test the separate effects of different overconfidence levels on leverage. The coefficients of the independent variables in regression (3) OC67 and Leverage, are not analysed as they are difficult to interpret due to the inclusion of interaction effects. Subsequently, Hypotheses 2 and 3 are tested separately in similar fashion as regression (3) by substituting Leverage with Investment and Innovation respectively. Again, for both Hypotheses OC67 will be substituted with High_OC and Net_Buyer to consider the effects of different overconfidence levels on Investment and Innovation. Lastly, regression (3) is extended with the same control variables used in regression (2).

4.3. Robustness tests

After running the above-mentioned regressions this study performs various robustness tests to assess the reliability of the results. First, four CEO overconfidence measures are employed, one alternative proxy for Leverage, and two alternative proxies for both Investment and Innovation to determine if the regressions produce qualitatively similar results. Also, alternative proxies for the control variables Firm size and Profitability are employed. The outcome of robustness tests will only be discussed if the substitution of the various proxies produces qualitatively different results. Second, scatterplots are used to examine if the assumed relationship between the independent and dependent variables is correct. Third, a substantial number of variables included in the regressions consider missing data as non-material and therefore assume missing values as zero (Hirshleifer et al., (2012). To ensure robustness of results these assumptions are lifted, and missing values are instead treated as missing.[24] Fourth, the control variables can significantly affect the outcome of the performed regressions. To analyse how the controls may influence results they are excluded from the regressions one by one. Fifth, the regression models include a substantial number of control variables. To ensure these controls do not significantly influence results the regressions are performed with only the controls variables Firm size and Profitability. Sixth, as mentioned this paper uses a different dataset than Malmendier and Tate (2005a) and as such also uses different overconfidence measures. Although the applied measures are less precise due to less amount of available

[24] Stata performs listwise deletion by default; missing values are excluded from regressions.

information, Malmendier, Tate, and Yan (2011) show that they can produce similar results by including past stock performance as a control variable. This is confirmed by Campbell et al., (2011) as they show that the alternative confidence measures produce similar results to those in Malmendier and Tate (2005a). This study will therefore include past stock performance as a control variable.[25] Lastly, this study follows Hirshleifer et al., (2012), who use one year lagged variables with respect to the dependent variable. Hence, the overconfidence measures are lagged to test if the effect of CEO overconfidence only influences Tobin's Q one year later. Hirshleifer et al., (2012) argue this may alleviate endogeneity concerns, which will be further covered in the Discussion.

[25] Past stock performance is computed as the increase in stock price at fiscal year end divided by the stock price of the of that particular fiscal year: $\left(\frac{\text{Stock price}_t - \text{Stock price}_{t-1}}{\text{Stock price}_{t-1}}\right)$

5. Results

First, this section provides an overview of the descriptive statistics, followed by the results of the correlation matrix, the results of the performed regressions, and will conclude with some robustness tests. All corresponding tables can be found in Appendix 3.

5.1. Descriptive statistics

Please see table 2 in Appendix 3 for an overview of the descriptive statistics for the dependent, independent and control variables of this study. The averages of the dependent variable Tobin's Q and the control variables are similar compared to other studies on overconfidence. The first overconfidence measure OC67 classifies 68.8% of the CEOs in the entire sample as overconfident, which is slightly higher compared to previous studies.[26] OC67 classifies CEOs as overconfident roughly 69% per year. This value is fairly constant over the years. The observations for the OC67 dummy variable with value one and zero start to annually decline slowly from 2011 onwards. However, so do the number of observations per year which explains why the percentage of CEOs classified as overconfident remains fairly stable around 69% over the years.[27] The second overconfidence measures classify 16.4%, 55.2%, and 28.4% of CEOs as low, medium, and high overconfidence respectively. These values differ slightly from previous studies.[28] Particularly the percentage of low overconfident CEOs is higher. This can be explained by a slightly different assumption compared to previous studies. The dummy for either low of high overconfidence in those studies becomes one from the first moment a CEO exhibits low or high overconfidence behavior. After that moment the CEO remains classified as low or high overconfident as overconfidence is seen as a persistent trait (Klayman et al., 1999). However, this study questions their approach. Considering the assumption of persistence; this study argues CEOs were also low or high overconfident prior to when they first revealed their beliefs, and not solely after. Following this line of thought this study assumes CEOs are low, medium, or high overconfidence for all their CEO years. In this way, this study

[26] The Holder 67 measure of Malmendier and Tate (2005b) and comparable measure of Hirshleifer et al., (2012) classify 51.3% and 61.1% respectively, as overconfident.

[27] There are roughly 1100 annual observations for all overconfidence measures. The number of observations remains relatively constant from 2006 until 2011 and start to gradually decline from 2011 and onwards. The number of observations for the years 2014, 2015, and 2016 is significantly lower compared to previous years.

[28] Campbell et al., (2011) overconfidence measure classify 8.9%, 57%, and 34.1% of CEOs as low, medium, and high overconfidence, respectively.

pursues to truly follow the assumption of persistency. In line with this reasoning this also explains the slightly higher percentage for the OC67 overconfidence measure compared to previous studies. The dummy values of Low_OC and High_OC follow a similar pattern as OC67; they are fairly stable from 2006 until 2011, and start to gradually decline from 2011 onwards. An advantage of the slightly different assumption is that the percentage of CEOs classified as low overconfident is significantly higher compared to previous studies, which could potentially alleviate robustness concerns resulting from a low number of observations for this overconfidence measure. Lastly, Net_Buyer classifies CEOs as overconfident on average 48.4% over the entire sample.[29] However, contrary to OC67 and High_OC, the percentage where the dummy variable Net_Buyer takes a value of one is not constant. Rather, it increases over time. In 2006 Net_Buyer classifies 33.9% of CEOs as overconfident, which increases up to 55.2% in 2014. The reason for this lies in the construction of Net_Buyer. CEOs are classified as overconfident from the first moment they buy company stock for more than half the observations of CEO years. Overconfidence is assumed to be a persistent trait. Hence, CEOs will remain classified as overconfident for the entire sample after the first time they exhibit behavior associated with overconfidence. This explains the increasing percentage of CEOs classified by Net_Buyer over the years in the sample.

Table 3 depicts the differences in the descriptive statistics of the mean and median of the three overconfidence measures and also distinguishes between the dummy variables taking a value of one and a value of zero. Table 3 gives a first indication of the relationship between CEO overconfidence and Tobin's Q. Following OC67; overconfident managers have a significantly higher mean and median for Tobin's Q. Furthermore, they operate in smaller and more profitable firms, receive more compensation, own a higher percentage of firm shares, invest more, but spend less on innovation. The effect of CEO overconfidence on leverage is insignificant.[30] The second overconfidence measure High overconfidence shows similar results; highly confident CEOs are again associated with a significantly higher mean and median for Tobin's Q. However, the two measures differ with respect to CEO ownership and leverage. Highly confident CEOs own a significantly higher percentage of firm shares and employ higher debt levels compared to moderately overconfident CEOs. This is in line with expectations following from the Literature Review; highly overconfident CEOs are more

[29] The Net_Buyer overconfidence measure constructed by Campbell et al., (2011) classifies 40.8% of CEOs as overconfident. Whereas the alternative measure of this study Net_Buyer classifies only 14.49% of CEOs as overconfident.

[30] These results are also found in previous studies (Hirshleifer et al., 2012).

willing to be exposed to idiosyncratic risk as they are positive about the future prospects of the company. Unexpected is however that High overconfidence is associated with a significantly higher mean and median for Tobin's Q. Lastly, the third overconfidence measure Net_Buyer also displays some irregularities; CEOs classified as overconfident are associated with significantly lower mean and median of Tobin's Q and Profitability while they earn significantly more than non-overconfident CEOs. This seems contradicting as overconfident CEOs should be more willing to receive performance based compensation as they overestimate their ability to generate future returns (Ben-David et al., 2007). Moreover, CEOs own a significantly lower percentage of company stock, which is also unexpected.[31] Overconfident CEOs overestimate a firm's future prospects and thus expect stock prices to rise. Consequently, they are expected to buy additional company stock to benefit from these expected stock price increase, not hold a significantly lower number of company stock. Section 5.3 will discuss if the indications of a possible relationship actually hold after the regression results.

5.2. Correlation matrix

Table 4 in Appendix 3 depicts a correlation matrix for the dependent and independent variables in this study. The pairwise correlation between these variables is measured to alleviate multicollinearity concerns. The correlation between OC67 and High_OC of 0.748 is fairly high, indicating the two overconfidence measures are strongly correlated. However, although the correlation between the two variables is above the 0.7 threshold specified by Pallant (2011), it does not raise multicollinearity concerns as both overconfidence proxies measure the same effect. Hence, it is expected that the two measures correlate strongly. What can further explain the strong correlation is the significant overlap of the two variables in the sample; OC67 and High_OC both classify a CEO as overconfident 55.19% of the time. Furthermore, both variables classify a CEO as non-overconfident 31.22% of the time. None of the other dependent and independent variables are too strongly correlated. Particularly the low correlation between Net_Buyer with OC67 and High_OC is unexpected. Some degree of correlation is expected as they should all measure the level of overconfidence. The substitution of the alternative measure of Net_Buyer in the correlation matrix leads to a stronger but negative correlation between Net_Buyer and the other overconfidence measures. These unexpected results for both Net_Buyer measures will be covered in Section 5.4.

[31] The alternative measure of Net_Buyer produces similar results.

From table 4 another indication of the relation between CEO overconfidence and firm value can be extracted. OC67 and Tobin's Q are positively correlated, which may indicate a positive relationship. Furthermore, High_OC is also positively correlated, while Low_OC and Net_Buyer are negatively correlated with Tobin's Q, indicating a possible negative relationship of those measures with firm value. Only the positive correlation between High_OC and Tobin's Q is unexpected, as they are expected to have a negative relation. To summarize, multicollinearity issues due to too strongly correlated variables is not a concern.

5.3. Regression results

Table 5 depicts the result of the OLS regressions which will be used to test Hypothesis 4: *Moderate levels of CEO overconfidence have a positive effect on firm value, while both low- and high CEO overconfidence negatively affect firm value.* The first three regression specifications consist of solely the three overconfidence measures plus the year and industry fixed-effects. [32] The last three regression specifications consist again of the three overconfidence measures and now also include the additional control variables. In the first three regressions both OC67 and High_OC have a positive coefficient, while Low_OC has a negative coefficient. Lastly, Net_Buyer also has a negative coefficient. All coefficients of the overconfidence measures are significant at the 1% level. These findings provide partial support for Hypothesis 4; it confirms that low CEO overconfidence has a negative effect on Tobin's Q, while moderate levels of CEO overconfidence have a positive effect. However, the positive coefficient for the effect of highly overconfident CEO on Tobin's Q does not support Hypothesis 4 as highly overconfident CEOs are expected to have a negative effect on Tobin's Q. The negative coefficient of Net_Buyer does support Hypothesis 4. The inclusion of control variables in regressions 4-6 to control for other variables that potentially influence Tobin's Q does not lead to significantly different results than in regressions 1-3. The coefficient of OC67 is still positive and significant, although it is lower compared to the coefficient without control variables. The effect of OC67 on firm value is also economically significant: CEO overconfidence leads to a 22.41% higher base level of Tobins_Q.[33] The result for High_OC is also consistent: highly overconfident CEOs have a positive and significant effect on Tobins_Q

[32] For clarity; whenever is referred to year and industry fixed-effects this study adds the self-constructed year dummies and industry dummies based on 2-digit SIC codes to the regression.

[33] Computed as the ratio of the OC67 coefficient divided by the median value when the dummy variable OC67 takes a value of zero.

compared to moderate levels of CEO overconfidence. The effect of High_OC on firm value is also economically significant: high CEO overconfidence leads to an increase of the base level of Tobins_Q by 20.88%.[34] The effect of Low_OC on Tobins_Q is also consistent compared to the regression excluding the control variables: Low_OC has a negative effect and significant effect on Tobins_Q. The magnitude of economic significance is significantly lower compared to OC67 and High_OC: low CEO overconfidence leads to a 4.99% decrease in the base level of Tobins_Q.[35] Furthermore, a Wald test shows that the difference in the coefficients between the variables Low_OC and High_OC is significant. This indicates that High_OC has a greater positive effect on Tobins_Q in comparison with Low_OC. Lastly, the effect of Net_Buyer on Tobins_Q is also consistent: it has a negative and significant effect on Tobins_Q.[36] The economic significance of Net_Buyer is similar to Low_OC: CEOs who are classified as Net_Buyer lead to a 6.26% lower base level of Tobins_Q compared to non-buyers of company stock.[37] A possible concern of the regression outcomes is the contradicting signs of High_OC and Net_Buyer; High_OC predicts overconfidence has a positive effect on Tobin's Q, whereas Net_Buyer suggests the opposite. Which of the two overconfidence measures is correct will be discussed in section 5.4.

Most control variables in the regressions have the predicted signs and are significant except for Cash_availability and CEO_ownership. For Cash_availability a negative coefficient was predicted, and for CEO_ownership a positive coefficient. The coefficients of both variables however only have a very small but significant effect on Tobins_Q. All other controls are significant at the 1% level except for the coefficients of Leverage and Investment which are insignificant for all three overconfidence measures.[38] Firm size has a significant negative coefficient indicating it has a significantly negative effect on Tobins_Q. On the other hand, both Profitability and Innovation have a significantly positive effect on Tobins_Q. Lastly, CEO compensation has a significant but negligible positive effect on Tobins_Q.

---

[34] Computed as the ratio of the High_OC coefficient divided by the median value when the dummy variable High_OC takes a value of zero.

[35] Computed as the ratio of the Low_OC coefficient divided by the median value when the dummy variable Low_OC takes a value of zero.

[36] The alternative measure of Net_Buyer produces qualitatively similar results.

[37] Computed as the ratio of the Net_Buyer coefficient divided by the median value when the dummy variable Net_Buyer takes a value of zero.

[38] The substitution of the alternative measure of Profitability leads to higher coefficients for all overconfidence measures and higher positive coefficients for Investment, which are now also significant at the 1% level. However, the substitution of the alternative measure of Innovation turns the positive coefficient of Investment into a negative one, and the results are significant at the 5% level. These contradicting results will be discussed in Section 5.4.

When the alternative proxy Profitability1 is substituted in the regressions for Profitability the coefficients for all overconfidence measures increase. Furthermore, the positive coefficients for Investment are now higher and significant at the 1% level for all three overconfidence measures. This indicates that more investments have a positive effect on Tobin's Q, which is not in line with the prediction based on existing literature. When the proxy Investment1 is substituted for Investment in the regressions this leads to slightly lower coefficients for all three overconfidence measures. More importantly, the substitution also results in higher positive coefficients for Investment1 compared to Investment which are significant at the 1% level for all three overconfidence measures.[39] The R-squared values of approximately 0.41 when the control variables are included is slightly lower than wat other studies find, and is an indication that the applied model is appropriate for the sample data.[40]

A fixed-effects (FE) model is also applied to ensure that the overconfidence measures are robust to the inclusion of firm fixed-effects. FE regressions allow to explore the relationship between the overconfidence measures and Tobin's Q within firms. That is, each firm has its own individual characteristics that may influence Tobin's Q. With the FE model this study assumes these individual characteristics may impact or bias Tobin's Q, and therefore controls for this. The basic assumption of the FE model is that the effect of time-invariant characteristics on Tobin's Q are excluded so that the net effect of CEO overconfidence on Tobin's Q can be assessed. The results of the FE regressions are depicted in Table 6. From this table can be concluded that the overconfidence measures OC67, High_OC, and Low_OC are robust to the inclusion of firm fixed-effects. The coefficients for OC67 and High_OC are both positive and slightly lower compared to the OLS regressions. The inclusion of control variables does not alter the regression results. The negative coefficient of the Low_OC overconfidence measure is also slightly lower than the OLS regression coefficient, but is more negative when control variables are included. The overconfidence measures OC67, High_OC, and Low_OC are significant at the 1% level. These findings confirm the OLS regression results in that both OC67 and High_OC have a positive and significant effect on Tobin's Q. Whereas Low_OC has a negative and significant effect on Tobin's Q. The results for Net_Buyer still have the predicted

[39] Unless stated otherwise all proxies produces qualitatively similar results and do not significantly alter the regression results.

[40] Yermack (1995) reports an R-squared value of 0.55 when performing OLS regression.

negative sign but are now insignificant due to the inclusion of firm fixed-effects.[41] This will be further covered in section 5.4 where the robustness of these results is discussed. All control variables except CEO_ownership have the same influence on Tobin's Q compared to the OLS regressions. The unpredicted negative sign of the coefficient for CEO_ownership remains negative in the FE regressions; however, the results are now insignificant. The inclusion of firm fixed-effects leads to significantly higher R-squared values of approximately 0.74 when the control variables are included, indicating that the FE regression model explains 74% of the variation in Tobin's Q, which is higher than the 41% of the OLS regressions.[42] The R-squared values for panel data however are computed in a cross-sectional manner, in contrast to the time-series manner of OLS regressions. Therefore, the R-squares of both models cannot be compared, and solely the separate values of R-squared will be assessed.

To summarise, based on the regression results from Table 5 and 6 can be concluded that the first part of Hypothesis 4 is accepted; low levels of CEO overconfidence have a negative effect on Tobin's Q, while moderate levels of CEO overconfidence have a positive effect. Both overconfidence measures are robust to the inclusion of firm fixed-effects. However, the second part of Hypothesis 4 cannot be accepted, as highly overconfident CEO have a positive relation with Tobin's Q instead of the suggested negative relation in the Hypothesis. Hence, Hypothesis 4 is partially accepted.

Table 7 depicts the results of the OLS regressions used to test Hypothesis 1: *The interaction of CEO overconfidence and leverage has a negative effect on firm value.* The variable of interest is the interaction variable of the overconfidence measures with the independent variable Leverage. Unfortunately, only the interaction of High_OC and Leverage including control variables produces a negative coefficient significant at the 5% level, indicating the interaction variable has a negative effect on Tobin's Q. The interaction variables of the overconfidence measures OC67 with Leverage and Net_Buyer with Leverage never produce significant results, independent of the inclusion of control variables.[43] The only exception is the alternative measure of Net_Buyer; when control variables are included the

[41] Based on the now insignificant results for the overconfidence measure Net_Buyer due to the inclusion of fixed-effects, this study assumes High_OC is the appropriate overconfidence measures and thus follows the coefficient of High_OC in determining the effect on Tobin's Q.

[42] Stata provides inaccurate R-squared values of FE regressions whenever xtreg commands are involved. Instead, this study uses the cross-sectional areg command in combination with absorb to find appropriate R-squared values of FE regressions.

[43] The alternative proxy of Leverage produces qualitatively similar results.

interaction of this measure and Leverage produces a positive coefficient significant at the 1% level. This result poses a possible concern as it contrasts the significant negative coefficient of the interaction variable High_OC and Leverage that indicates that the interaction of highly overconfident CEOs and leverage has a negative effect on Tobin's Q. This opposing result of the interaction variables of the two overconfidence measures with Leverage will be discussed more elaborately in Section 5.4. It has to be noted that the interaction of High_OC with Leverage has a very small negative effect as the coefficient is almost zero. Hence, the economic effect of the interaction of high overconfidence and leverage on Tobin's Q is negligible. Due to the inclusion of firm fixed-effects the results of the OLS regressions are confirmed; the negative coefficient of the interaction between High_OC and Leverage becomes significant at the 10% level excluding control variables and significant at 5% including controls. The inclusion of firm fixed-effects raises concerns for the interaction between Net_Buyer and Leverage. Excluding controls the interaction of Net_Buyer and Leverage produces a negative coefficient significant at the 10% level, while this result turns insignificant due to the inclusion of control variables. The interaction of the alternative measure of the Net_Buyer and Leverage also produce contradicting and insignificant results; excluding controls the coefficient for the interaction variable is insignificant, while inclusion of the controls leads to a *positive* coefficient significant at the 1% level. This result is particularly worrisome as the original Net_Buyer interaction with Leverage resulted in a negative coefficient. The results indicate that the interaction of Net_Buyer and Leverage is not robust to the inclusion of firm fixed-effects, while the interaction of High_OC and Leverage is. Furthermore, the original and alternative Net_Buyer measures lead to opposing results, which will be covered more extensively in Section 5.4. [44] Although the evidence is not strong and the economic significance is low, the negative coefficient of the interaction variable of High_OC and Leverage is significant and robust to the inclusion of firm fixed-effects. This indicates that the interaction of highly overconfident CEOs with leverage has a negative effect on Tobin's Q. Hence, Hypothesis 1 is accepted.

Table 8 depicts the results of the OLS regressions used to test Hypothesis 2: *The interaction of CEO overconfidence and investment has a negative effect on firm value.* Again, the variable of interest is the interaction variable of the overconfidence measures with the

[44] Following the line of thought in Hypothesis 4; considering the inclusion of firm-fixed effects lead to insignificant or contradicting results for Net_Buyer, this study assumes the overconfidence measures of High_OC to be correct.

independent variable Investment. The interaction of OC67 and Investment excluding control variables has a positive coefficient significant at the 10% level, indicating that the interaction variable has a positive effect on Tobin's Q. Both the interaction variables of High_OC and Investment and Net_Buyer and Investment excluding control variables are insignificant. The significance of the coefficient of the interaction variable OC67 and Investment disappears due to the inclusion of control variables. In contrast, the interaction variable between High_OC and Investment is now significant at the 10% level. The interaction variable of Net_Buyer and Investment is again insignificant.[45]

Different results are obtained when the alternative proxy for Investment is substituted in the regressions.[46] The interaction variables of the overconfidence measures OC67 and High_OC with Investment are positive and significant at the 5% level. The results are robust to the inclusion of control variables. Net_Buyer without controls is negative and significant at the 5% level, while adding control variables produces insignificant results.[47] The significant results for the interaction variables High_OC and Net_Buyer with Investment are a possible concern as their signs are opposing. One would expect to find similar signs of the coefficients as both overconfidence measures should in theory measure the same effect. However, when firm fixed-effects are included it leads to similar coefficients for OC67 and High_OC with Investment, while the coefficient of Net_Buyer and Investment turns insignificant for both with and without control variables.[48] The results for OC67 and High_OC are again significant at the 5% level independent of the inclusion of control variables. Considering the insignificant effect for Net_Buyer and Investment when fixed-effects are included this study assumes the predicted sign of High_OC and Investment to be correct.

The alternative proxy for Investment is more extensive and allows for testing Hypothesis 2 with more certainty. Therefore, Hypothesis 2 will be tested based on the regressions results where the alternative proxy, instead of the original proxy for Investment, is included. The economic significance of the regression results is significant: if a CEO is overconfident, an increase in Investment of one standard deviation increases Tobin's Q by 0.08, whereas one standard deviation increase for the interaction variable of a non-overconfident

---

45 The alternative measure of Net_Buyer produces qualitatively similar results.

46 For clarity; this study uses the more extensive of the two proxies offered by Malmendier, Tate, and Yan (2011) as the alternative proxy for Investment.

47 The alternative measure of Net_Buyer produces similar results.

48 The alternative measure of Net_Buyer in FE regressions produces similar results compared to the alternative measure in the OLS regressions; a significant negative coefficient at the 1% level excluding controls. This opposes the positive coefficient of the interaction of High_OC and Investment. However, when controls are included the significance disappears.

CEO leads to a decrease in Tobin's Q of 0.05.[49] Thus, one standard deviation increase in Investment leads to a 6.50% higher increase of Tobin's Q for overconfident CEOs compared to non-overconfident CEOs.[50] The regression results indicate that both interaction variables of OC67 and High_OC with Investment lead to a significant increase in Tobin's q; Hypothesis 2 is therefore rejected.

Table 9 depicts the OLS regression results that are used to test the final Hypothesis 3: *The interaction of CEO overconfidence and innovation has a positive effect on firm value.* The positive coefficients of both interaction variables OC67 and Innovation and High_OC and Innovation are positive and significant at the 1% level. This indicates that the interaction of overconfident and highly overconfident CEOs with Innovation lead to significantly higher values of Tobin's Q. The inclusion of control variables does not alter these results. The interaction variable Net_Buyer and Innovation is insignificant independent of the inclusion of control variables. However, the interaction of the alternative proxy of Net_Buyer and Innovation does produce a negative coefficient significant at the 1% level independent of the inclusion of control variables. This contradicts the regression results of the High_OC with Innovation, which also leads to a coefficient that is significant at the 1% level, but has a positive sign. The contradiction of the interaction variables High_OC and Investment and Net_Buyer and Investment as well as the contradicting results of Net_Buyer and Investment and the alternative measure of Net_Buyer will be discussed in Section 5.4.

The substitution of both alternative proxies for Innovation produce insignificant results for the interaction variables of all overconfidence measures and Innovation. The only exception for both proxies is that the negative coefficient of the interaction variable Net_Buyer and Innovation without control variables is now significant at the 5% level.[51] Again, fixed-effects are introduced to determine which of the two opposing signs from High_OC and Innovation and the alternative proxy of Net_Buyer and Innovation is correct. From the FE regressions can be concluded that the original negative coefficient of the interaction variable Net_Buyer and Innovation now has a positive coefficient significant at the 1% level without the inclusion of controls, which turns insignificant after the inclusion of control variables. On the other hand,

[49] Computed by multiplying the interaction variable coefficient with the standard deviation from regression specification (5) in Table 8.

[50] Computed by dividing the change in Tobin's Q by the overall mean of Tobin's Q of 1.960.

[51] The alternative proxy for Net_Buyer produces qualitatively similar results independent of the inclusion of control variables.

the inclusion of firm fixed-effects do not change the coefficient of the interaction variable High_OC and Innovation: the positive coefficient is significant at the 1% level independent of the inclusion of control variables. Considering the fixed-effects regressions changed the sign for the interaction variable Net_Buyer and Innovation and leads to insignificant results when controls are included this study follows the positive sign of the interaction between High_OC and Innovation. The economic significance of the regression results is quite large: if a CEO is overconfident, an increase in Innovation of one standard deviation increases Tobin's Q by 1.14, whereas one standard deviation increase for the interaction variable of a non-overconfident CEO leads to a decrease in Tobin's Q of 1.01.[52] Thus, one standard deviation increase in Innovation leads to a 110% higher increase of Tobin's Q for overconfident CEOs compared to non-overconfident CEOs.[53] All regression results indicate that the interaction between CEO overconfidence and innovation has a positive effect on Tobin's Q and therefore Hypothesis 3 is accepted.

5.4. Robustness tests

As discussed in section 4.3 this study performs a number of robustness tests to determine the validity of the regression results. First, different proxies of overconfidence measures and control variables are substituted in the regression specifications to determine if this leads to qualitatively similar results. In most cases the substitution of an alternative proxy does not significantly alter the results.[54] Second, all scatterplots show the predicted mostly linear relationships of Tobin's Q with all independent and control variables. The only exceptions are the third proxy for Investment and the second proxy for Innovation; scatterplots indicate a negative relationship between these variables and Tobin's Q, while the other proxies all indicate a positive relationship.[55] As a third robustness test this study will exclude missing values from the regressions instead of considering data as non-material and therefore assuming these missing values to be to be zero to test if this significantly alters results. This results mainly in higher coefficients for the overconfidence measures. However, it also more frequently produces

[52] Computed by multiplying the interaction variable coefficient with the standard deviation from regression specification (5) in Table 9.

[53] Computed by dividing the change in Tobin's Q by the overall mean of Tobin's Q of 1.960.

[54] Section 5.3 discuss whether this substitution leads to significant changes and only reports cases of substitutions that lead to different outcomes compared to the original regression variables.

[55] None of the obtained regression results are computed with either of these proxies, therefore this robustness test does not affect the robustness of the results.

insignificant results. Particularly the results for the coefficient variables to test Hypotheses 1-3 are almost always insignificant. This indicates the assumption to treat missing values as non-material and therefore assume them to be zero instead of excluding them is appropriate. Fourth, the control variables are excluded from the regression one by one to determine their individual regression effects and to ensure none have a too great influence on the regression results. In all four Hypotheses, the control variable Profitability has a relatively large effect on the coefficients of the overconfidence measures; when Profitability is excluded from the regressions the coefficients of the overconfidence measures significantly increase. Furthermore, the coefficient for the control variable Investment turns significant at the 1% level. However, in regression specification (4) and (6) for Hypothesis 1, 2, and 4 the exclusion of Profitability in turn also leads to insignificant results of CEO_ownership. The results for CEO_ownership remain significant in regression specification (5). It could therefore be considered to substitute the original for the alternative proxy of Profitability. None of the other control variables have a significantly large effect on the regression outcomes. Fifth, the regression results are assessed with only the two control variables Firm_size and Profitability to assess if this significantly changes the regression results. This produces qualitatively similar results for all regressions that test Hypotheses 1-4, except for Net_buyer in Hypotheses 2 and 3. In these regressions the interaction variable of Net_Buyer with Investment and Innovation respectively, turn significant at the 5% and 1%
level. This is a contradicting result, as in these regressions the interaction variable of High_OC with Investment and Innovation is also significant at the 10% and 1% level respectively. Both overconfidence measures should measure the same effect of overconfidence, and therefore equal signs are expected. In section 5.3 there also were several incidents where the coefficients of the overconfidence measures High_OC and Net_Buyer showed opposing signs. This will be further covered after all robustness tests are discussed. Sixth, following Malmendier, Tate, and Yan (2011) and Campbell et al., (2011) the control variable past stock performance is included in the regressions as it could potentially have a significant influence on Tobin's Q.[56] The positive coefficient of past stock performance is small and significant at the 1% level for all Hypotheses. This indicates that past stock performance does not lead to a significantly higher value of Tobin's Q. Furthermore, the inclusion of past stock performance as a control variable does not lead affect the results for any of the four Hypotheses. Seventh, this study follows

[56] Past stock performance is computed as the increase in stock price at fiscal year end divided by the stock price of the of that particular fiscal year: $\left(\frac{\text{Stock price}_t - \text{Stock price}_{t-1}}{\text{Stock price}_{t-1}}\right)$

Hirshleifer et al., (2012) who lag the independent and control variables with one year to assess if CEO overconfidence impacts Tobin's Q directly, or with a lag. The main hypothesis to be tested with this particular robustness test is Hypothesis 4.[57] Overall, the inclusion of lagged independent and control variables produces similar results for all overconfidence measures in comparison to the OLS regressions excluding lagged variables. The only difference is that the lagged regressions produce significantly lower coefficients for the overconfidence measures OC67, High_OC and Low_OC, while the coefficient of Net_Buyer is higher. Furthermore, the R-squared values for the model including lagged variables is significantly lower, indicating it does not take a year before the effect of CEO overconfidence on Tobin's Q can be observed. Rather, the variables directly impact Tobin's Q. The fixed-effects model however produces inconsistent results; OC67 and High_OC are similar but Low_OC and Net_Buyer are now insignificant independent of the inclusion of control variables. The R-squared values are low, indicating the FE model is not appropriate to use whenever lagged variables are included. The low R-squared values can possibly be explained as the unobserved panel-level effects are likely to be correlated with the lagged dependent variables. As a result, the standard estimators are inconsistent. A generalized least squares model is applied which confirms the results of the OLS regression including lagged variables, only difference is that Net_Buyer is now insignificant. To summarize, the low R-squared values of the regression model with lagged independent and control variables indicate CEO overconfidence directly impacts Tobin's Q and not start to manifest itself after a time lag of one year. However, after one year CEO overconfidence still has a positive, although slightly lower and less significant effect on Tobin's Q.[58] As a final robustness test the distribution of the error variable is checked for normality. A histogram of the residuals indicates a normal distribution.

To conclude, the inconsistencies of the opposing and significant signs of the measures High_OC and Net_Buyer needs to be addressed. Furthermore, Net_Buyer and its alternative proxy produces contradicting results in several regression specifications.

The first indication Net_Buyer might not be an appropriate overconfidence measure is discussed in Section 5.1; CEOs classified as overconfident by Net_Buyer are associated with significantly lower mean and median of Tobin's Q while they earn substantially more than non-

[57] The inclusion of lagged independent and control variables does not significantly alter the results of Hypothesis 1, 2, and 3; it also produces a lower coefficient for all overconfidence measures and a higher coefficient for Net_Buyer.

[58] The results are unchanged if only the independent variables and not the control variables are lagged.

overconfident CEOs. This results contrasts OC67 and High_OC that both predict CEO overconfidence is associated with a higher mean and median of Tobin's Q. Furthermore, Net_Buyer not only contradicts the other overconfidence measures, it also seems inconsistent as it predicts CEOs of firms with lower Tobin's Q receive more compensation. Net_Buyer also contradicts the other two overconfidence measures regarding the number of company stock owned by the CEO; following Net_Buyer overconfident CEOs hold a significantly lower number of company stock, while a higher percentage of CEO ownership is expected. Overconfident CEOs overestimate a firm's future prospects and hence are expected to own more company stock to benefit from rising stock prices. Section 5.2 reports another conflicting result; the very low and even negative correlation between Net_Buyer and the alternative measure of Net_Buyer with the other overconfidence measures is unexpected as they are expected to measure the same overconfidence effect.[59] This result implies that Net_Buyer might not capture the same effect as the other overconfidence measures.

Furthermore, the main indication that Net_Buyer significantly differs from the other overconfidence measures is provided by the regression results. In all four hypotheses there are occurrences where the regression results of Net_Buyer are significant and indicate the exact opposite effect as the other overconfidence measure High_OC. In most cases, the inclusion of either control variables or a FE model leads to insignificant results for the Net_Buyer measure, whereas the results for High_OC are consistent in almost all regression specifications. The evidence suggests the overconfidence measure Net_Buyer could potentially not be suitable to measure CEO overconfidence. It may capture possible alternative explanations of exercise behavior such as inside information, signaling and board pressure, and risk tolerance instead of overconfidence incentives. As such, the results for the overconfidence measure Net_Buyer and the alternative measure of Net_Buyer are not reliable and therefore not considered to accurately predict the relation between CEO overconfidence and firm value. Section 3.3 covers alternative explanations of all overconfidence measures. Particularly signaling will be more elaborately covered in the Discussion, which will also present alternative explanations for both early and late options exercise.

Lastly, it can be difficult to explain the inconsistent results of Net_Buyer and its alternative measure. A potential explanation lies in the construction of both measures; the original Net_Buyer classifies CEOs as overconfident if they are a net buyer of company stock for more than half of their CEO years. While the alternative Net_Buyer requires CEOs to be a

[59] Malmendier and Tate (2005b) report a correlation between Longholder and Net_Buyer of 0.06.

net buyer of company stock for all CEO years but one in order to qualify as overconfident. Hence, the alternative measure of Net_Buyer is based on significantly less observations as the original measure; 14.79% of CEOs are classified as overconfident for the alternative measure versus 48.35% for the original one. The low number of observations could potentially explain the inconsistency between the two measures.

6. Conclusion

The goal of this study is to shed light on the effect of CEO overconfidence on firm value, and aims to do so by examining the following research question:

What is the effect of CEO overconfidence on firm value?

The research question is complemented with three additional Hypotheses that serve as further refinements of the main research question. Existing literature has documented how CEO overconfidence impacts different corporate policies. The goal of the additional Hypotheses therefore is to examine the separate effects of CEO overconfidence on Leverage, Investment, and Innovation respectively, and incorporate those effects into one framework to determine the overall effect on firm value.

The focus of this study is on U.S. firms; panel data is extracted from ExecuComp and Compustat and contains 1683 firms and 2522 CEOs in the period from 2006 to 2016. This study defines CEO overconfidence as an overestimation of the mean returns to investment projects and an underestimation of the associated risks. The methodology of Malmendier and Tate (2005) is adopted to construct three overconfidence measures that qualify CEOs as overconfident based on their option exercise behavior; Holder 67, Low Overconfidence and High Overconfidence. A fourth overconfidence measure Net Buyer is constructed based on the same principle but focusses on the option purchasing behavior of CEOs. Following the line of reasoning by Malmendier and Tate (2005); CEOs are under-diversified and must therefore trade off the option value of holding the stock against the costs of exposure to idiosyncratic risk. CEOs are classified as overconfident if they, despite having strong incentives to exercise their options and diversify, choose to hold their options above a certain threshold and systematically expose themselves to idiosyncratic risk. The overconfidence measure Net Buyer classifies CEOs as overconfident if they purchase company stock and thereby also expose themselves to idiosyncratic risk. Malmendier and Tate (2005) argue CEOs are overconfident in the firm's future prospects and hold (or purchase) their options to benefit from an expected stock price increase. This study follows Hirshleifer et al., (2012) in constructing the overconfidence measure Holder 67 and Campbell et al., (2013) in constructing the Low and High overconfidence measures as Malmendier and Tate (2005) use proprietary data. Holder 67 classifies CEOs as overconfident if they hold vested options that are at least 67% in the money

once. CEOs are classified as highly overconfident if they hold vested options that are more than 100% in the money at least once. CEOs have low overconfidence if they either do not hold exercisable options of 30% in the money or higher, or if they exercise stocks that are 30% in the money or lower. CEOs are classified as Net Buyer if they are a net buyer of company stock in more than half of their CEO years. The alternative measure of Net Buyer classifies CEOs as overconfident if they are a net buyer of company stock for all their CEO years but one. Tobin's Q is used as a proxy for firm value. This study starts with a general literature review on CEO overconfidence and proceeds with a breakdown of the existing literature on how CEO overconfidence is expected to impact the corporate policies of interest; Leverage, Investment, and Innovation, and how each separate effect in turn impacts Tobin's Q. Subsequently, the predictions are transformed into Hypotheses 1-3 and empirically tested to determine if they hold. More specifically, the variable of interest in the regression models is the interaction variable of the overconfidence measures with the corresponding independent variable; Leverage, Investment or Innovation. Hypothesis 4 will be empirically tested to determine the overall effect of CEO overconfidence on firm value.[60]

Hypothesis 1 states: *The interaction of CEO overconfidence and leverage has a negative effect on firm value.* On the one hand the literature predicts overconfident CEOs underestimate the cost of financial distress, and therefore pursue higher debt levels. However, overconfident CEOs on the other hand tend to underestimate the volatility of future cash flows and simultaneously overestimate the cash flows. As a result, they perceive their firm to be undervalued and therefore display debt conservatism; they are reluctant to issue debt, but even more reluctant to issue equity. Both effects may harm firm value. Hypothesis 2 is as follows: *The interaction of CEO overconfidence and investment has a negative effect on firm value.* Following from Hypothesis 1, overconfident CEOs are reluctant to address external financing and therefore display a heightened cash flow sensitivity. As a result, the presence of sufficient internal funds is decisive for their investment behavior. Overconfident CEOs overinvest in years with high cash flows, and underinvest in absence of internal resources. Particularly overinvestment with respect to mergers is believed to harm firm value. However, other studies suggest overconfidence can move investment closer to its optimal level as overconfident managers overcome the risk averse behavior of rational managers. Underinvestment might alleviate some of the overinvestment concerns but can also negatively affect firm value. The

[60] For clarity, the Hypotheses will be tested in the following order: Hypothesis 4, 1, 2, 3. Thus, this study will first analyse the overall effect of CEO overconfidence on firm value, and continue by assessing the individual effects of the interaction variable of CEO overconfidence and the independent variables on Tobin's Q.

overall effect of CEO overconfidence on investment and consequently firm value is ambiguous. Hypothesis 3 states: *The interaction of CEO overconfidence and innovation has a positive effect on firm value.* According to existing literature CEO overconfidence is generally believed to positively influence innovation as overconfident managers undertake risky projects that rational managers would normally avoid. On the contrary, they might also undertake projects with low expected payoff, but most studies show this is not the case. Hypothesis 4 tests the overall effect of CEO overconfidence on firm value and states: *Moderate levels of CEO overconfidence have a positive effect on firm value, while both low- and high CEO overconfidence negatively affect firm value.* There is no clear consensus in existing literature on how CEO overconfidence affects firm value as few studies focus on the overall effect of CEO overconfidence. However, most studies believe moderate levels of overconfidence benefit firm value, and regard this as the optimal level of CEO overconfidence.

All four Hypotheses are empirically tested in order to answer the main research question of this study. The regression results for Hypothesis 4 indicate that both overconfidence measures OC67 and High_OC have a positive and highly significant effect on Tobin's Q in all regression specifications independent of the inclusion of control variables. Whereas Low_OC has a negative and highly significant effect on Tobin's Q for both with and without controls.[61] The results for OC67, High_OC and Low_OC are robust to the inclusion of a fixed-effects model. The results indicate the first part of Hypothesis 4 is accepted; low levels of CEO overconfidence have a negative effect on Tobin's Q, while moderate levels of CEO overconfidence have a positive effect. However, highly overconfident CEOs have a positive and highly significant effect on Tobin's Q, which implies that moderate levels of CEO overconfidence are not optimal to benefit firm value. This particular finding is unexpected as most existing literature predicts highly overconfident CEOs harm firm value. All control variables except Cash_availability and CEO_ownership have the predicted signs and are significant. Cash_availability was expected to negatively influence Tobin's Q, whereas a positive effect was expected for CEO_ownership. This indicates that a heightened dependence on cash may move investments levels closer to its optimum, which benefits firm value. All considered, Hypothesis 4 is partially accepted. The effects of OC67 and High_OC on firm value are economically significant: CEO overconfidence leads to a 22.41% higher base level of Tobin's Q whereas High_OC leads to a 20.88% higher base level. Hypotheses 1-3 are

[61] Section 5.4 indicates inconsistencies for the overconfidence measure Net_Buyer and the alternative measure of Net_Buyer. As such, the results for both measures are excluded.

empirically tested to see how CEO overconfidence interacts with corporate policies and how this interaction subsequently affects firm value. Unfortunately, the only regression specification for Hypothesis 1 that produces significant results is the interaction variable of High_OC and Leverage including control variables. The effect on Tobin's Q is negative and very small. Although the evidence is not strong and the economic significance is low, Hypothesis 1 is accepted. The regression results for Hypothesis 2 indicate that both interaction variables of OC67 and High_OC with Investment have a positive and significant effect on Tobin's Q.[62] The regression results for Hypothesis 3 are strongest; for all overconfidence measures the interaction with Innovation produces positive and highly significant results independent of the inclusion of control variables, which indicates it positively impacts Tobin's Q. Hypothesis 3 is therefore accepted.

The results for the overconfidence measure Net_Buyer are excluded as this overconfidence measures displays inconsistencies throughout this study. This follows mainly from the regression results where Net_Buyer produces significant results that indicate the exact opposite as the other overconfidence measure High_OC. The evidence suggests Net_Buyer could potentially capture alternative explanations of exercise behavior, and therefore it is not a suitable measure to predict the relationship between CEO overconfidence and Tobin's Q. It is difficult to provide evidence as to which alternative explanations might drive the contradicting results of Net_Buyer. Other studies should carefully consider the applicability of this overconfidence measure.

This study concludes by answering the main research question:

What is the effect of CEO overconfidence on firm value?

From the results can be concluded that both moderate and high levels of overconfidence have a positive effect on firm value. CEOs with low overconfidence harm firm value. Although the interaction of CEO overconfidence and leverage is negative and very small, overconfident managers positively impact firm value by moving investment levels closer to its optimal level. Lastly, overconfident CEOs particularly contribute to firm value through the interaction with innovation.

[62] The inclusion of the alternative proxy for Investment produces even more significant results for all overconfidence measures independent of the inclusion of control variables.

The results have important implications for contracting practices and hiring incentives. First, it proposes another explanation for the overconfidence puzzle documented by various other studies: "Why do firms employ overconfident managers?" Hirshleifer et al., (2012) state this could be due the fact that overconfident CEOs are better innovators and can more effectively translate growth opportunities into firm value, but only in innovative industries. The results of this study suggest that the interaction of overconfident CEOs with innovation also positively influences firm value in other industry segments than solely innovative ones. Moreover, they indicate overconfident CEOs are also able to contribute to firm value through their investment behavior. Second, if moderate and high overconfidence levels have a positive effect on firm value firms might be more inclined to focus their hiring efforts specifically on attracting overconfident managers. Third, many studies advocate to align the incentives of (overconfident) managers and shareholders through for example option-based compensation to mitigate the so believed detrimental effects of CEO overconfidence on corporate policies. As a result, they are in favour of introducing additional mechanisms to constrain overconfident CEOs. Considering the positive effects of the interactions of CEO overconfidence with investment and innovation, introducing additional mechanisms does not seem necessary. However, concerning the negative interaction of CEO overconfidence with leverage, for example debt overhang or more monitoring towards leverage decisions could possibly help to reach more optimal levels debt levels.

7. Discussion

First, the assumption of Malmendier and Tate (2005) that one can infer CEO beliefs by analysing their exercise behavior is crucial in this study. They argue CEOs can be classified as overconfident if they hold vested options above a certain threshold, as economic laws predict they should exercise their options and diversify as they are exposed to idiosyncratic risk. However, the option exercise behavior for CEOs is influenced by many other factors than solely exposure to idiosyncratic risk that are not addressed in their study. And although Malmendier and Tate (2005) consider some alternative explanations of holding options, since it is such a vital determinant of this study, I will briefly discuss cases when there exist strong enough incentives to induce CEOs (overconfident or not) to either hold their options or exercise early. Unfortunately, empirical evidence on the exercise behavior of CEOs is scarce. To briefly summarize the existing literature on the incentives of CEOs; the main advantages of exercising early are tax advantages and decreased exposure to idiosyncratic risk. Malmendier and Tate (2005) argue the decrease of exposure to idiosyncratic risk is the main incentive for rational CEOs to exercise early. However, there are also disadvantages of exercising early that cannot be overlooked; the intrinsic value of the option is sacrificed, and in some cases a substantial amount of resources is required to exercise the option. Although you risk the possibility of paying more taxes, there is a general consensus that it is optimal to hold options until expiration as the time value of the option can be quite substantial. This opposes the view of Malmendier and Tate as it indicates rational managers have valid incentives not to exercise their options.

There are other alternative reasons as to why CEOs exercise early; Klein and Maug (2011) show that particularly institutional constraints and to a lesser extent behavioral explanations are important in explaining early exercise behavior. Examples of institutional constraints are blackout- and vesting periods; trade restrictions lead to a significant decline in trading activity whereas expiration of a vesting period leads to significantly higher exercise rates. Other examples are dividend payments, employment termination, or specific share ownership targets. Examples of behavioral explanations that can explain early exercise behavior are anchoring and investor sentiment. Heath, Huddart, and Lang (1999) for example show the importance of stock prices fluctuations for CEO exercise behavior. CEOs perceptions are anchored to the 52-week maximum and minimum stock price and are therefore more likely to exercise if the stock price of their company stock trades above the 52-week maximum, and less likely if the stock trades below the 52-week minimum. An example of investor sentiment is proposed by Hemmer, Matsunga and Shevlin (1996) who show that CEO exercise decisions

are positively related to stock volatility. Managers seem to take advantage of investor sentiment as they are more likely to exercise if investor sentiment is high. Due to the many alternative explanations that influence CEOs exercise behavior, the overconfidence measure of Malmendier and Tate (2005) can classify CEOs as overconfident if they hold their options, while their actual incentive of holding options is nonrelated to overconfidence. This line of thought can also be applied the other way around; CEOs can exercise early while still being overconfident. This is a possible concern for the validity of the applied overconfidence measures.

Second, Malmendier and Tate (2005) argue that inside information is not an alternative explanation for CEOs that hold in the money options as they do not earn abnormal returns. However, in their line of thought they do not account for negative inside information. If CEOs know the stock price will decrease they will exercise early. As a result, overconfident CEOs with access to negative inside information can be classified as non-overconfident. Moreover, Bartoy and Mohanram (2004) provide evidence that CEOs do have access to positive inside information as they find that the exercise behavior of CEOs can predict future stock price performance. This indicates that CEOs who hold sufficiently in the money options are not necessarily overconfident; inside information can also be a reasonable explanation for them to hold their options.

Third, Malmendier and Tate (2005) consider signaling as an alternative explanation for CEOs to hold their options, but find no evidence for this. The exercise behavior of insiders is considered a valuable source of information, and early exercise is often interpreted as negative news. Empirical evidence indicates that stock prices adjust after CEOs exercise options (Ravina and Sapienze, 2010). A negative stock price reaction is therefore expected around unusually early exercises. The higher the loss in intrinsic option value due to early exercise, the stronger is the conveyed signal to outsiders about the CEOs negative inside information. This might induce CEOs to hold options. Indeed, studies provide evidence that there is a negative market reaction to insider trading. Fidrmuc, Goergen, and Renneboog (2006) show that this negative market reaction is particularly true for poorly performing firms. The exercise of CEOs then leads to a stronger negative market reaction. Therefore, CEOs that hold sufficiently money in the options again do not necessarily have to be overconfident, it could also be that they want to avoid a negative stock price reaction. In light of this argument it is also possible that CEOs holding options is not due to overconfidence, but due to CEO underconfidence; insecure CEOs do not exercise as they fear the negative price reaction. CEO underconfidence could also possibly explain the reluctance to address external financing due to aversion of the associated

risks. Furthermore, underconfidence can also explain underinvestment as CEOs do not want to engage in too risky projects. Considering the various alternative explanations of late option exercise behavior, more research has to be conducted on the incentives of CEOs to exercise or hold their options. More research regarding this topic could further strengthen the option-based overconfidence measures of Malmendier and Tate (2005) and could provide further insights into the mechanisms as to how firms can optimally align the incentives of managers and shareholders. Further research could also implement a complementary overconfidence measure by Malmendier and Tate (2008) that is based on press portrayal to verify the results of the option-based overconfidence measures. The press portrayal measure ought to capture if outsiders believe CEOs to be overconfident or not by assessing how CEOs are portrayed in the media.

Fourth, a limitation of this study are the endogeneity concerns reported by Malmendier and Tate (2005) and Hirshleifer et al., (2012). It could be that firms hire CEOs based on overconfidence criteria. If that is the case, CEO overconfidence is not an exogenous variable. However, both studies state the inclusion of control variables alleviates some of the endogeneity concerns. Moreover, the inclusion of firm fixed-effects controls for unobserved firm characteristics further reduces these concerns.

Fifth, another limitation is stated by Graham et al., (2009) and concerns the direction of causality. There is a possibility that firms focus specifically on hiring overconfident CEOs, or that overconfident CEOs prefer to work at firms with a high Tobin's Q. Lastly, it could also be that CEOs become overconfident as Tobin's Q increases in their CEO years. This would imply a positive relation between CEO overconfidence and Tobin's Q. The use of lagged variables partly alleviates some causality concerns, as the effect of CEO overconfidence on Tobin's Q is still present when the independent and control variables are lagged. This indicates the causality flow; overconfident CEOs lead to a better performing firm.

Table 1: Overview of variables

Table 1 depicts an overview of the dependent, independent and control variables used in this study.

Variable name	Description	Expected influence
Dependent variable		
Tobins_Q	(total assets + (common shares outstanding * stock price at fiscal year end) - (stockholders equity - preferred stock at liquidating value + deferred taxes and investment tax credit)) / total assets	
Overconfidence measures		
OC67	Dummy is 1 if (stock price at fiscal year end / (stock price at fiscal year end - (realisable value of exercisable options / number of exercisable options))) - 1 > 0.67 once in the entire sample, and 0 otherwise	Positive
Low_OC	Dummy is 1 if (value realised from exercising options / number of exercised options) / (stock price at fiscal year end - (realisable value of exercisable options / number of exercisable options)) < 0.3 and OC67 < 0.3 once in the entire sample, and 0 otherwise	Negative
High_OC	Dummy is 1 if (stock price at fiscal year end / (stock price at fiscal year end - (realisable value of exercisable options / number of exercisable options))) - 1 > 1 once in the entire sample, and 0 otherwise	Negative
Net_Buyer	Dummy is 1 if the net percentage change in shares owned options excluded > 0 for 6 out of 11 years	Negative
Control variables		
Firm_size	log(total assets)	Ambiguous
Profitability	Operating income before depreciation / total assets	Positive
Cash_availability	Dummy is 1 if cash dividends (cash flow) > 0, and 0 otherwise	Negative
CEO_ownership	Percentage of shares owned by the CEO excluding options	Positive
CEO_compensation	Total compensation of CEO including option grants	Positive
Year	Dummy for every year in the sample	-
Industry	Dummy for every two-digit SIC industry	-
Control and Interaction variables		
Leverage	(Total long term debt + total debt in current liabilities) / stockholders equity	Negative
Investment	(Capital expenditures + increase in investments + acquisitions - sale of property - minus sale of investments) / total assets	Negative
Innovation	Research and development expense / total assets	Positive

Table 2: Overview of variables

Table 2 depicts the number of observations, means, standard deviations, and minimum and maximum values of the dependent, independent, and control variables of this study. A variable name followed with the abbreviation alt. Indicates an alternative proxy of that variable.

Variable name	Number of observations	Mean	Standard deviation	Minimum value	Maximum value
Dependent variable					
Tobins_Q	11935	1.960	1.233	0.328	20.923
Tobins_Q alt.	11935	1.546	1.179	-0.203	20.040
Overconfidence measures					
OC67	11935	0.688	0.463	0	1
Low_OC	11935	0.164	0.370	0	1
High_OC	11935	0.552	0.497	0	1
Net_Buyer	11935	0.484	0.500	0	1
Net_Buyer alt.	11935	0.148	0.355	0	1
Control variables					
Firm_size	11935	7.529	1.617	4.036	11.639
Firm_size alt.	11935	7.409	1.646	3.402	11.512
Profitability	11935	0.136	0.109	-1.068	1.250
Profitability alt.	11935	0.041	0.128	-3.058	0.902
Cash_availability	11935	0.492	0.500	0	1
CEO_ownership	11935	1.567	3.965	0	30.093
CEO_compensation	11935	5711.007	5367.824	176.464	28564.970
Control and Interaction variables					
Leverage	11934	1.064	36.708	-610.266	3569.374
Leverage alt.	11934	0.977	35.983	-605.351	3526.545
Investment	11935	0.076	0.099	-0.701	3.514
Investment alt.	11935	0.073	0.108	-1.180	2.063
Investment alt. 2	11935	0.048	0.054	0	0.715
Innovation	11935	0.037	0.070	0	0.958
Innovation alt.	11935	0.075	0.179	0	3.954
Innovation alt. 2	11935	0.013	0.032	0	0.371

Table 3: Differences in descriptive statistics

Table 3 depicts the means, medians, and their differences for the three overconfidence measures in four separate tables. It also distinguishes between the dummy variables taking a value of 1 or zero. The Wilcoxon rank-sum test is used to determine if two selected independent samples of unmatched data are drawn from populations that follow the same distribution. Subsequently, a nonparametric test is used to determine if the selected samples are drawn from populations with the same median. The significance of the differences is indicated by; *, **, and ***, which stand for the 10%, 5%, and 1% level, respectively.

Table 3.1 Overconfidence measure: OC67

	OC67 = 0		OC67 = 1		Difference	
Variable name	Mean	Median	Mean	Median	Mean	Median
Tobins_Q	1.631	1.397	2.110	1.726	0.479***	0.329***
Firm_size	7.595	7.505	7.499	7.434	-0.096***	-0.071*
Profitability	0.114	0.117	0.145	0.139	0.031***	0.022***
Cash_availability	0.534	1	0.473	0	-0.061***	-1***
CEO_ownership	1.033	0.184	1.809	0.362	0.776***	0.178***
CEO_compensation	5506.423	3899.869	5803.865	4132.301	297.442***	232.432**
Leverage	0.650	0.374	1.251	0.374	0.601	0
Investment	0.067	0.046	0.081	0.057	0.014***	0.011***
Innovation	0.042	0.007	0.035	0.006	-0.007***	-0.001

Table 3.2 Overconfidence measure: Low overconfidence

	Low_OC = 0		Low_OC = 1		Difference	
Variable name	Mean	Median	Mean	Median	Mean	Median
Tobins_Q	2.011	1.643	1.7	1.455	-0.311***	-0.188***
Firm_size	7.456	7.402	7.899	7.678	0.443***	0.276***
Profitability	0.137	0.134	0.131	0.128	-0.006***	-0.006***
Cash_availability	0.467	0	0.617	1	0.15***	1***
CEO_ownership	1.550	0.283	1.653	0.336	0.103*	0.053***
CEO_compensation	5600.767	3979.865	6272.731	4517.581	671.964***	537.716***
Leverage	1.108	0.367	0.838	0.403	-0.27***	0.036**
Investment	0.078	0.055	0.069	0.050	-0.009***	-0.005***
Innovation	0.038	0.007	0.031	0.003	-0.007**	-0.004***

Table 3.3 Overconfidence measure: High overconfidence

	High_OC = 0		High_OC = 1		Difference	
Variable name	Mean	Median	Mean	Median	Mean	Median
Tobins_Q	1.705	1.451	2.167	1.761	0.462***	0.310***
Firm_size	7.655	7.565	7.427	7.370	-0.228***	-0.195***
Profitability	0.122	0.122	0.147	0.141	0.025***	0.019***
Cash_availability	0.551	1	0.443	0	-0.108***	-1***
CEO_ownership	1.033	0.192	2.000	0.418	0.967***	0.226***
CEO_compensation	5703.791	4079.216	5716.865	4043.140	13.074	-36.076
Leverage	0.824	0.390	1.258	0.357	0.434***	-0.033**
Investment	0.068	0.048	0.083	0.058	0.015***	0.010***
Innovation	0.039	0.007	0.035	0.006	-0.004	-0.001

Table 3.4 Overconfidence measure: Net Buyer

	Net_Buyer = 0		Net_Buyer = 1		Difference	
Variable name	Mean	Median	Mean	Median	Mean	Median
Tobins_Q	2.049	1.662	1.866	1.565	-0.183***	-0.097***
Firm_size	7.352	7.279	7.719	7.640	0.367***	0.361***
Profitability	0.139	0.134	0.132	0.132	-0.007***	-0.002*
Cash_availability	0.450	0	0.536	1	0.086***	1***
CEO_ownership	2.308	0.334	0.775	0.263	-1.533***	-0.071***
CEO_compensation	5280.118	3581.683	6171.238	4524.989	891.12***	943.306***
Leverage	0.776	0.324	1.371	0.431	0.595***	0.107***
Investment	0.077	0.053	0.076	0.053	-0.001	0.000
Innovation	0.036	0.005	0.038	0.008	0.002***	0.003***

Table 4: Correlation matrix

Table 4 depicts the pairwise correlation matrix for the dependent and independent variables.

	Tobins_Q	OC67	High_OC	Low_OC	Net_Buyer
Tobins_Q	1.000				
OC67	0.180	1.000			
High_OC	0.187	0.748	1.000		
Low_OC	-0.094	-0.142	-0.149	1.000	
Net_Buyer	-0.074	0.023	0.014	0.090	1.000

Table 5: Base regression CEO overconfidence and firm value – OLS

Table 5 depicts the OLS regression results for six regressions where the dependent variable is Tobins_Q, and the independent variables are the three overconfidence measures; OC67, High_OC and Low_OC, and Net_Buyer. The robust standard errors are clustered at firm level. The coefficients are reported with *, **, and *** which stand for the significance levels of 10%, 5%, and 1% respectively. The corresponding t-statistics are displayed in parentheses below the reported coefficient. The outcome of the regressions are used to test Hypothesis 4.

	Dependent variable: Tobins_Q					
Independent and Control variables	(1)	(2)	(3)	(4)	(5)	(6)
OC67	0.479***			0.313***		
	(24.64)			(18.32)		
High_OC		0.449***			0.303***	
		(22.11)			(17.29)	
Low_OC		-0.189***			-0.082***	
		(-8.46)			(-4.42)	
Net_Buyer			-0.136***			-0.104***
			(-6.41)			(-5.76)
Firm_size				-0.219***	-0.212***	-0.223***
				(-19.99)	(-19.48)	(-20.18)
Profitability				5.112***	5.105***	5.294***
				(24.12)	(24.12)	(24.96)
Cash_availability				0.066***	0.082***	0.050***
				(3.50)	(4.37)	(2.63)
CEO_ownership				-0.007***	-0.008***	-0.007**
				(-2.82)	(-3.04)	(-2.59)
CEO_compensation				0.000***	0.000***	0.000***
				(14.05)	(13.89)	(14.53)
Leverage				0.000	0.000	0.000
				(0.31)	(0.32)	(0.55)
Investment				0.023	0.021	0.104
				(0.20)	(0.22)	(0.90)
Innovation				6.837***	6.847***	6.888***
				(18.63)	(18.60)	(18.32)
Constant	2.322***	2.369***	2.704***	2.796***	2.752***	3.044***
	(11.07)	(10.66)	(10.06)	(17.57)	(17.03)	(17.11)
Number of observations	11935	11935	11935	11934	11934	11934
R-squared	0.167	0.175	0.141	0.414	0.416	0.403
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 6: Base regression CEO overconfidence and firm value - FE

Table 6 depicts the Fixed Effect (FE) regression results for six regressions where the dependent variable is Tobins_Q, and the independent variables are the three overconfidence measures; OC67, High_OC and Low_OC, and Net_Buyer. The robust standard errors are clustered at firm level. The coefficients are reported with *, **, and *** which stand for the significance levels of 10%, 5%, and 1% respectively. The corresponding t-statistics are displayed in parentheses below the reported coefficient.

	Dependent variable: Tobins_Q					
Independent and Control variables	(1)	(2)	(3)	(4)	(5)	(6)
OC67	0.306***			0.250***		
	(7.21)			(6.49)		
High_OC		0.241***			0.186***	
		(4.48)			(3.70)	
Low_OC		-0.133***			-0.139***	
		(-2.41)			(-2.94)	
Net_Buyer			-0.071			-0.062
			(-1.40)			(-1.43)
Firm_size				-0.307***	-0.306***	-0.307***
				(-6.80)	(-6.79)	(-6.78)
Profitability				3.764***	3.777***	3.805***
				(11.52)	(11.41)	(11.54)
Cash_availability				0.092**	0.085**	0.074*
				(2.30)	(2.09)	(1.84)
CEO_ownership				-0.006	-0.007	-0.006
				(-0.97)	(-1.04)	(-0.98)
CEO_compensation				0.000***	0.000***	0.000***
				(8.20)	(8.31)	(8.34)
Leverage				0.000	0.000	0.000
				(0.62)	(0.66)	(0.63)
Investment				0.165	0.173	0.181
				(1.48)	(1.53)	(1.62)
Innovation				3.225***	3.216***	3.221***
				(4.55)	(4.52)	(4.49)
Constant	1.750***	1.849***	1.994***	3.253***	3.338***	3.455***
	(59.92)	(55.99)	(81.77)	(8.72)	(9.14)	(9.37)
Number of observations	11935	11935	11935	11934	11934	11934
R-squared	0.698	0.697	0.695	0.745	0.744	0.743
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 7: General regression model CEO overconfidence, leverage and firm value - OLS

Table 7 depicts the OLS regression results for six regressions where the dependent variable is Tobins_Q, and the independent variables are the three overconfidence measures; OC67, High_OC, and Net_Buyer. The variable leverage is added to the regressions as an independent variable and the interaction variable of CEO overconfidence and leverage is added. The robust standard errors are clustered at firm level. The coefficients are reported with *, **, and *** which stand for the significance levels of 10%, 5%, and 1% respectively. The corresponding t-statistics are displayed in parentheses below the reported coefficient. The outcome of the regressions are used to test Hypothesis 1.

	Dependent variable: Tobins_Q					
Independent and Control variables	(1)	(2)	(3)	(4)	(5)	(6)
OC67	0.479***			0.313***		
	(24.67)			(18.34)		
High_OC		0.470***			0.311***	
		(23.13)			(17.90)	
Net_Buyer			-0.135***			-0.104***
			(-6.37)			(-5.73)
Leverage	0.001	0.001	0.001	0.001	0.001**	0.000
	(0.66)	(1.00)	(0.57)	(1.28)	(2.11)	(0.53)
OC67*Leverage	-0.001			-0.001		
	(-1.01)			(-1.26)		
High_OC*Leverage		-0.001			-0.001**	
		(-1.41)			(-2.13)	
Net_Buyer*Leverage			-0.001			0.000
			(-0.83)			(-0.44)
Firm_size				-0.219***	-0.214***	-0.223***
				(-19.99)	(-19.69)	(-20.18)
Profitability				5.113***	5.118***	5.294***
				(24.12)	(24.19)	(24.96)
Cash_availability				0.066***	0.077***	0.050***
				(3.49)	(4.12)	(2.62)
CEO_ownership				-0.007***	-0.008***	-0.007**
				(-2.82)	(-3.18)	(-2.59)
CEO_compensation				0.000***	0.000***	0.000***
				(14.05)	(13.91)	(14.53)
Investment				0.022	0.020	0.104
				(0.20)	(0.18)	(0.90)
Innovation				6.836***	6.851***	6.887***
				(18.63)	(18.62)	(18.42)
Constant	2.321***	2.359***	2.704***	2.796***	2.768***	3.044***
	(11.06)	(10.68)	(10.05)	(17.56)	(17.13)	(17.10)
Number of observations	11934	11934	11934	11934	11934	11934
R-squared	0.169	0.172	0.141	0.414	0.416	0.403
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 8: General regression model CEO overconfidence, investment and firm value – OLS

Table 8 depicts the OLS regression results for six regressions where the dependent variable is Tobins_Q, and the independent variables are the three overconfidence measures; OC67, High_OC, and Net_Buyer. The variable investment is added to the regressions as an independent variable and the interaction variable of CEO overconfidence and investment is added. The robust standard errors are clustered at firm level. The coefficients are reported with *, **, and *** which stand for the significance levels of 10%, 5%, and 1% respectively. The corresponding t-statistics are displayed in parentheses below the reported coefficient. The outcome of the regressions are used to test Hypothesis 2.

	Dependent variable: Tobins_Q					
Independent and Control variables	(1)	(2)	(3)	(4)	(5)	(6)
OC67	0.448***			0.298***		
	(17.16)			(12.88)		
High_OC		0.439***			0.282***	
		(15.41)			(11.39)	
Net_Buyer			-0.106***			-0.091***
			(-3.52)			(-3.73)
Investment	0.004	0.041	0.555**	-0.105	-0.171	0.174
	(0.03)	(0.32)	(2.48)	(-0.88)	(-1.57)	(1.06)
OC67*Investment	0.371*			0.207		
	(1.67)			(1.07)		
High_OC*Investment		0.361			0.380*	
		(1.49)			(1.81)	
Net_Buyer*Investment			-0.387			-0.168
			(-1.36)			(-0.77)
Firm_size				-0.219***	-0.214***	-0.223***
				(-19.99)	(-19.69)	(-20.16)
Profitability				5.112***	5.119***	5.294***
				(24.13)	(24.20)	(24.97)
Cash_availability				0.067***	0.079***	0.050***
				(3.54)	(4.19)	(2.60)
CEO_ownership				-0.007***	-0.008***	-0.007***
				(-2.81)	(-3.18)	(-2.60)
CEO_compensation				0.000***	0.000***	0.000***
				(14.05)	(13.92)	(14.52)
Leverage				0.000	0.000	0.000
				(0.32)	(0.39)	(0.54)
Innovation				6.835***	6.853***	6.884***
				(18.60)	(18.57)	(18.45)
Constant	2.323***	2.358***	2.666***	2.803***	2.780***	3.040***
	(11.09)	(10.71)	(9.98)	(17.60)	(17.24)	(17.02)
Number of observations	11935	11935	11935	11934	11934	11934
R-squared	0.169	0.172	0.142	0.414	0.416	0.403
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 9: General regression model CEO overconfidence, innovation and firm value – OLS

Table 9 depicts the OLS regression results for six regressions where the dependent variable is Tobins_Q, and the independent variables are the three overconfidence measures; OC67, High_OC, and Net_Buyer. The variable innovation is added to the regressions as an independent variable and the interaction variable of CEO overconfidence and innovation is added. The robust standard errors are clustered at firm level. The coefficients are reported with *, **, and *** which stand for the significance levels of 10%, 5%, and 1% respectively. The corresponding t-statistics are displayed in parentheses below the reported coefficient. The outcome of the regressions are used to test Hypothesis 3.

	Dependent variable: Tobins_Q					
Independent and Control variables	(1)	(2)	(3)	(4)	(5)	(6)
OC67	0.376***			0.229***		
	(16.51)			(10.60)		
High_OC		0.379***			0.237***	
		(15.96)			(11.35)	
Net_Buyer			-0.116***			-0.067***
			(-4.71)			(-2.99)
Innovation	3.091***	3.568***	4.949***	5.565***	5.925***	7.426***
	(11.12)	(9.12)	(10.02)	(13.94)	(12.86)	(14.69)
OC67*Innovation	2.772***			2.132***		
	(5.41)			(3.86)		
High_OC*Innovation		2.343***			1.967***	
		(4.12)			(3.38)	
Net_Buyer*Innovation			-0.521			-0.983
			(-0.89)			(-1.64)
Firm_size				-0.220***	-0.215***	-0.223***
				(-20.17)	(-19.79)	(-20.19)
Profitability				5.078***	5.094***	5.304***
				(23.96)	(24.02)	(24.96)
Cash_availability				0.067***	0.079***	0.050***
				(3.55)	(4.22)	(2.64)
CEO_ownership				-0.008***	-0.009***	-0.007***
				(-3.02)	(-3.51)	(-2.61)
CEO_compensation				0.000***	0.000***	0.000***
				(14.18)	(14.09)	(14.50)
Leverage				0.000	0.000	0.000
				(0.44)	(0.49)	(0.53)
Investment				0.021	0.023	0.105
				(0.19)	(0.21)	(0.90)
Constant	2.092***	2.126***	2.455***	2.825***	2.788***	3.036***
	(11.46)	(10.94)	(10.43)	(17.79)	(17.05)	(17.15)
Number of observations	11935	11935	11935	11934	11934	11934
R-squared	0.228	0.228	0.193	0.418	0.419	0.404
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes

Appendix 1: Allais paradox by Maurice Allais (1953)

Which gambles do you pick for the two experiments?

Experiment 1				Experiment 2			
Gamble 1a		Gamble 1b		Gamble 2a		Gamble 2b	
Winnings	Chance	Winnings	Chance	Winnings	Chance	Winnings	Chance
$1 million	100%	$1 million	89%	Nothing	89%	Nothing	90%
		Nothing	1%	$1 million	11%		
		$5 million	10%			$5 million	10%

Experiment 1				Experiment 2			
Gamble 1a		Gamble 1b		Gamble 2a		Gamble 2b	
Winnings	Chance	Winnings	Chance	Winnings	Chance	Winnings	Chance
$1 million	89%	$1 million	89%	Nothing	89%	Nothing	89%
$1 million	11%	Nothing	1%	$1 million	11%	Nothing	1%
		$5 million	10%			$5 million	10%

For most, rational choices in Appendix 1.1 seem to be 1A and 2B. However, a simple rewriting of Appendix 1.1 into Appendix 1.2 shows the gambles offer the exact same choice. As such, according to expected utility theory, agents should choose gambles 1A and 2A or gambles 1B and 2B. Agents who forego a chance of a very large gain to avoid a 1% chance of missing an otherwise certain large gain, but are less risk-averse when offering the chance of reducing 11% to 10% violate the independence axiom of the expected utility theory framework. The framing of the question should have no effect on the desirability of one gamble over another.

References

Alicke, M. D., (1985). Global self-evaluation as determined by the desirability and controllability of trait adjectives, *Journal of Personality and Social Psychology*, *49*, pp. 1621–30.

Alicke, M. D., Klotz, M. L., Breitenbecher, D. L., Yurak, T. J., Vredenburg, D. S. (1995). Personal contact, individuation, and the better-than-average effect, *Journal of Personality and Social Psychology*, *68*, pp. 804–25.

Allais, M. (1953). Le Comportement de l'Homme Rationnel devant le Risque: Critique des Postulats et Axiomes de l'Ecole Am´ericaine, *Econometrica, 21*, pp. 503–546.

Baker, M., & Wurgler, J. (2000). The equity share in new issues and aggregate stock returns, *Journal of Finance*, *55*, pp. 2219–57.

Baker, M., & Wurgler, J., (2002). Market timing and capital structure, *Journal of Finance*, *57*, pp. 1–32.

Baker, M., Ruback, R., & Wurgler, J. (2007). Behavioral corporate finance: a survey. In E. Eckbo (eds.), *The Handbook of Corporate Finance: Empirical Corporate Finance*, New York: Elsevier/ North Holland.

Bartov, E., & Mohanram, P. (2004). Private Information, Earnings Manipulations, and Executive Stock-Option Exercises, *The Accounting Review, 79*(4), pp. 889-920.

Becker, G., (1957). *The Economics of Discrimination*, Chicago: University of Chicago Press.

Ben-David, Graham, & Harvey (2013). Managerial miscalibiration, *The Quarterly Journal of Economics*, *60,* pp. 1547–1584.

Bernardo, A. E., & Welch, I. (2001). On the Evolution of Overconfidence and Entrepreneurs. *Journal of Economics & Management Strategy, 10*(3), pp. 301-330.

Bettis, J. C. Bizjak, J. M., & Lemmon, M. L. (2005). Exercise behavior, valuation, and the incentive effects of employee stock options, *Journal of Financial Economics*, *76(*2), pp. 445-470.

Brainard, W. C., & Tobin, J. (1968). Pitfalls in Financial Model Building. *The American Economic Review*, *58(*2), pp. 99-122.

Buehler, R., Griffin, D., & Ross, M. (1994). Exploring the "Planning Fallacy": Why People Underestimate Their Task Completion Times, *Journal of Personality and Social Psychology*, *67*(3), pp. 366-381.

Carpenter, J. N., & Remmers, B. (2001). Executive stock option exercises and inside information, *The Journal of Business,* pp. 1-23.

Carpenter, J. N., Stanton, R. & Wallace, N. (2009). Optimal exercise of executive stock options and implications for firm cost, *Journal of Financial Economics*, *98*, 315-337.

Camerer, C., & Lovallo, D., (1999). Overconfidence and excess entry: an experimental approach, *American Economic Review*, *89*(1), pp. 306–18.

Camerer, C., & Malmendier, U., (2012). Behavioral economics of organizations. In P. Diamond and H. Vartiainen (eds.), *Economic Institutions and Behavioral Economics*, Princeton NJ: Princeton University Press.

Campbell, T. C., Gallmeyer, M. F., Johnson, S. A., Rutherford, J., & Stanley, B. (2011). CEO Optimism and Forced Turnover, *Journal of Financial Economics*, *101*(3), pp. 695-712.

Chung, K. H., & Pruitt, S. W. (1994). A Simple Approximation of Tobin's Q. *Financial Management, 23*(3), pp. 70-74.

Christensen-Szalanski, J. J. & Bushyhead J. B. (1981). Feedback and the illusion of validity in a medical clinic, *Medical Decision Making, 1*(2), pp. 115-122.

Clayson, D.E. (2005). Performance overconfidence: metacognitive effects or misplaced student expectations? *Journal of Marketing Education, 27*(2), pp. 122-129.

Cooper, A. C., Woo, C. Y., & Dunkelberg, W. C. (1988). Entrepreneurs perceived chances for success, *Journal of Business Venturing, 3*, pp. 97–108.

Daniel, K., & Titman, S. (1997). Evidence on the characteristics of cross sectional variation in stock returns, *The Journal of Finance, 25*(1), pp. 1-33.

Daniel, K. D., Titman, S., & Wei, J., (2001). Explaining the cross-section of stock returns in Japan: Factors or characteristics*? Journal of Finance*, *56,* pp. 743–766.

De Bondt, F. M., & Thaler, R. H. (1994). Financial Decision Making in Markets and Firms: A Behavioral Perspective. *NBER working paper series, Working Paper No. 4777*.

Dominic, D.P. J., (2004). *Overconfidence and War: The Havoc and Glory of Positive Illusions*. Harvard: Harvard University Press.

Donaldson, G. (1961). *Corporate debt capacity: A study of corporate debt policy and the determination of corporate debt capacity.* Boston: Division of Research, Harvard School of Business Administration.

Einhorn, H. J. (1980). Learning from experience and suboptimal rules in decision making. In T. S. Wallsten (eds.), *Cognitive processes in choice and decision behavior*. Hillside, N.J: Erbaum.

Ellsberg, D. (1961). The crude analysis of strategy choices, *The American Economic Review, 51*(2), Papers and Proceedings of the Seventy-Third Annual Meeting of the American Economic Association, pp. 472-478.

Fairchild, R. J. (2005). The Effect of Managerial Overconfidence, Asymmetric Information, and Moral Hazard on Capital Structure Decisions. *The ICFAI Journal of Behavioral Finance, 2*(4), pp. 46-68.

Fazzari, S. M., Hubbard, R. G., & Petersen, B. C. (1988). Financing Constraints and Corporate investments, *Brooking Papers on Economic Activity, 1,* pp. 141-195.

Feather, N. T., & Simon, J. G., (1971). Attribution of responsibility and valence of outcome in relation to initial confidence and success and failure of self and other, *Journal of Personality & Social Psychology*, *18*(2), pp. 173–88.

Fidrmuc, Goergen, M. & Renneboog, L. (2006). Insider trading, news releases, and ownership concentration, *The Journal of Finance, 61(*6), pp. 2931-2973.

Gervais, S., Heaton, J. B. & Odean, T. (2003). *Overconfidence, investment policy and stock options*, Working Paper, Duke University.

Goel, A. M., & Thakor, A. V. (2008). Overconfidence, CEO Selection, and Corporate Governance. *Journal of Finance, 63*(6), pp. 2737-2784.

Gombola, M., & Marciukaityte, D. (2007). Managerial Overoptimism and the Choice Between Debt and Equity Financing, *Journal of Behavioral Finance 8*(4).

Griffin, D. & Tversky, A. (1992). The weighing of evidence and the determinants of confidence, *Cognitive Psychology*, 24, pp. 411-435.

Grinblatt, M & Keloharju, M. (2009). Sensation Seeking, Overconfidence, and Trading Activity, J*ournal of Finance, American Finance Association, 64*(2), pp. 549-578.

Graham, J. R. (1999). Do personal taxes affect corporate financing decisions? *Journal of Public Economics, 73*(2), pp. 147-185.

Graham, J. R. (2000). How Big Are the Tax Benefits of Debt? *Journal of Finance, 55*(5), pp. 1901-1941.

Graham, J. R., Harvey, C. R., & Puri, M. (2009). Managerial Attitudes and Corporate Actions. *Working Paper Fuqua School at Duke University, available at SSRN eLibrary*.

Hackbarth, D., (2006), *Managerial traits and capital structure decisions,* Working Paper.

Hall, B. J. & Liebman, J. B. (1987). Are CEOs really paid like bureaucrats? *The Quarterly Journal of Economics*, *113(3),* pp. 653-691.

Hall, B. J., & Murphy, K. J. (2002). Stock options for undiversified executives. *Journal of Accounting and Economics, 33*(1), pp. 3-42.

Hampel, F. R., Ronchetti, E. M., Rousseeuw, P. J. & Stahel, W. A. (1986). *Robust Statistics. The Approach Based on Influence Functions.* New York: John Wiley and Sons.

Heath, C., Huddart, S., & Lang (1999). Psychological Factors and Stock Option Exercise, *The Quarterly Journal of Economics,* 114, 2, pp. 601-627.

Heaton, J. B., (2002). Managerial optimism and corporate finance, *Financial Management*, *31*, pp. 33–45.

Hemmer, T., Matsunaga, S., & Shevlin, T. (1996). The influence of risk diversification on the early exercise of employee stock options by executive officers. *Journal of Accounting and Economics, 21*(1), pp. 45-68.

Hirshleifer, D., Low, A. & Teoh, S. H. (2012). Are overconfident CEOs better innovators? *The Journal of Finance, MPRA Paper No. 22425,* pp. 1-54.

Hovakimian, A., & Hovakimian, G. (2009). Cash Flow Sensitivity of Investment. *European Financial Management, 15*(1).

Howard, M. E. (1983). The causes of war and other essays. Cambridge, MA: Harvard University Press.

Jensen, M. C. (1986). Agency costs of free cash flow, corporate finance, and takeovers, *The American Economic Review, 76*(2), pp. 323-329.

Johnson, T. C. (2004). Forecast Dispersion and the Cross Section of Expected Returns, *The Journal of Finance, 59*(5), pp. 1957–1978.

John, K and Lang, L. H. P. (1991). Insider Trading around Dividend Announcements: Theory and Evidence, *The Journal of Finance, 46(*4), pp. 1361-1389.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decisions under risk. *Econometrica, 47*, pp. 313–327.

Kaplan, S., & Zingales, L. (1997). Do investment-cash flow sensitivities provide useful measures of financing constraints? *Quarterly Journal of Economics, 112*, pp. 169-216.

Kidd, J. B. (1970). The utilization of subjective probabilities in production planning, *Acta Psychologica, 33,* pp. 338-347.

Klayman, J., Soll, J., B, Gonzalez-Vallejo, C., & Barlas, S. (1999). Overconfidence: It depends on how, what, and whom you ask*, Organizational Behavior and Human Decision Processes, 79*(3), pp. 216-247.

Klein, D., & Maug, E. (2011). How Do Executives Exercise Their Stock Options? Working Paper, University of Mannheim.

Kruger, J., (1999). Lake Wobegon be gone! The 'below-average effect' and the egocentric nature of comparative ability judgments, *Journal of Personality and Social Psychology*, *77*(2), pp. 221–32.

Landier, A., & Thesmar, D., (2004). *Enterpreneurial optimism and financial contracting*, Working Paper, NYU.

Langer and Roth (1975):

Langer, E. J., & Roth, J. (1975). Heads I win, tails it's chance: The illusion of control as a function of the sequence of outcomes in a purely chance task. *Journal of Personality and Social Psychology, 32*, pp. 951-955.

Langer, E. J. (1975). The illusion of control, *Journal of Personality and Social Psychology*, *32*, pp. 311–28.

Lin, Y., Hu, S. & Chen, M. (2005). Managerial optimism and corporate investment: Some empirical evidence from Taiwan, Pacific-Basin, *Finance Journal*, *13,* 523-546.

Lichtenstein. S., Fischhoff, B., & Phillips. L. D. (1982). Calibration of probabilities: The state of the art to 1980. In D. Kahneman. P. Slovic & A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases* (pp. 306-334). New York: Cambridge University Press.

Landier, A., & Thesmar, D. (2009). Financial Contracting with Optimistic Entrepreneurs, *Review of Financial Studies,* 22(1), pp. 117-150.

Larwood, L. & Whittaker, W. (1977). Managerial myopia: self-serving biases in organizational planning, *Journal of Applied Psychology*, *62*, pp. 194–98.

Lemmon, M. L, Roberts, M., & Zender, J. F. (2008). Back to the Beginning: Persistence and the Cross-Section of Corporate Capital Structure, *Journal of Finance*, *63*(4), pp. 1575-1608.

Malmendier, U., & Tate, G. (2005). CEO Overconfidence and Corporate Investment. *The Journal of Finance, 60*(6), pp. 2661-2700.

Manne, H. G. (1966). *Insider trading and the stock market.* New York: The Free Press.

March, J. and Shapira, Z., (1987). Managerial perspectives on risk and risk taking, *Management Science*, *33*(11), pp. 1404–19.

Miller, D. T., & Ross, M. (1975). Self-serving biases in the attribution of causality: fact or fiction? *Psychological Bulletin*, *82*(2), pp. 213–25.

Moore, P. G., (1977). The manager's struggle with uncertainty, *Journal of The Royal Statistical Society Series A*, *149*, pp. 129–65.

Moore, D. A., & Kim, T. G. (2003). Myopic social prediction and the solo comparison effect, *Journal of Personality and Social Psychology*, *85*, 6, pp. 1121–35.

Moore, D. A. & Cain, D. M. (2007). Overconfidence and underconfidence: When and why people underestimate (and overestimate) the competition, *Organizational Behavior and Human Decision Making, 103, 197-213.*

Moore, D. A., & Healy, P. J. (2008). The trouble with overconfidence. *Psychological Review, 115*(2), pp. 502-17.

Modigliani, F., & Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment, *The American Economic Review, 48*(3), pp. 261-297.

Myers, S. C. (1984). The capital structure puzzle, *The journal of finance, 39(*3), pp. 574-592.

Neale, M. A. & Bazerman, M. H. (1985). The effects of framing and negotiator overconfidence on bargaining behaviors and outcomes, *Academy of Management Journal, 4*(1), pp. 34-49.

Nisbett, R. E., & Ross, L. (1980). *Human inference: Strategies and shortcomings of social judgment.* Englewood Cliffs, NJ: Prentice-Hall.

Oliver, B. R. (2005). The impact of management confidence on capital structure. Mimeo.

Pallant, J. (2011). SPSS survival manual: A step by step guide to data analysis using the SPSS program. 4th Edition, Allen & Unwin, Berkshire.

Plous, S. (1993). *The Psychology of Judgment and Decision Making.* Philadelphia: Temple University Press.

Presson, P. K. & Benassi, V.A. (1996), Illusion of Control: A Meta-Analytic Review, *Journal of Social Behavior and Personality, 11*(3), 493-510

Ramirez, P. A., & Levine, D. S. (2013). *A review of the certainty effect and influence of information processing.* Discussion Paper No. 2013-47.

Ravina, E., & Sapienza, P. (2010). What do independent directors know? Evidence from their trading. *The Review of Financial Studies, 23*(3), pp. 962-1003.

Roll, R. (1986). The Hubris Hypothesis of Corporate Takeovers. *Journal of Business, 59*(2), pp. 197-216.

Roese, N. J., & Vohs, K. D. (2012). Hindsight bias, *Perspectives on Psychological Science, 7*(5), pp. 411-426.

Roll, R., (1986). The hubris hypothesis of corporate takeovers, *Journal of Business*, *59*(2), pp. 197–217.

Roll, R., Schwartz, E., & Subrahmanyam, A. (2009). Options trading activity and firm valuation. *Journal of Financial Economics, 94*(3), pp. 345-360.

Scarpetta, S. Hemmings, P., Tressel, T. Woo, J. (2002). *The role of policy and institutions for productivity and firm dynamics: evidence from micro and industry data.* Forthcoming as an OECD Economics Department Working Paper.

Shyam-Sunder, L. & Myers, S. C. (1999). Testing static tradeoff against pecking order models of capital structure, *Journal of Financial Economics, 51*(2), pp. 219-244.

Stigler, G. J., (1958), The economies of scale, *Journal of Law and Economics*, *1*, pp. 54–71.

Svenson, O. (1981). Are we all less risky and more skillful than our fellow drivers? *Acta Psychologica*, *47*, pp. 143–48.

Teigen, K. H. & Jorgenson, M. (2005). When 90% confidence intervals are 50% certain: On the credibility of credible intervals, *Applied Cognitive Psychology, 19*, pp. 455–475.

Thompson, S. C. Armstrong, W. & Thomas, C. (1998) Illusions of control, underestimations, and accuracy: a control heuristic explanation. *Psychological Bulletin, 123*(2), pp. 143-161.

United States. National Aeronautics and Space Administration. National Advisory Committee for Aeronautics National Aeronautics and Space Council. (1986). *Report to the President: actions to implement the recommendations of the Presidential Commission on the Space Shuttle Challenger Accident*. Washington, D.C. :NASA.

Weinstein, N. D., (1980). Unrealistic optimism about future life events, *Journal of Personality and Social Psychology*, *39*, pp. 806–20.

Weinstein, N. D., & Klein, W. M., (2002). Resistance of personal risk perceptions to debiasing inter- ventions. In T. Gilovich, D. Griffin & D. Kahneman (eds.), *Heuristics and Biases: the Psychology of Intuitive Judgment* (pp. 313–23). Cambridge: Cambridge University Press.

Ye, B., & Yuan, J. (2008). Firm Value, Managerial Confidence, and Investmets. *Journal of Leadership Studie, 2*(3), pp. 26-36.

Yermack, D. (1995). Do corporations award CEO stock options effectively? *Journal of Financial Economics, 39*(2-3), pp. 237-269.