The influence of CEO overconfidence on firm value

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Abstract

This study contributes to the finance research that examines how the behavioural biases of managers influence corporate decisions. Firstly, this study provides a theoretical review of how CEO overconfidence influences firm value. The consensus on this topic is that moderate levels of CEO overconfidence have a positive influence on firm value. This effect would be due to greater innovation, higher effort levels, higher motivation, lower cost of debt, and possibly a more optimal investment level. However, other studies state that CEO overconfidence induces a suboptimal leverage and investment level, and suboptimal decisions. Secondly this study examines these theoretical expectations empirically using panel data of 1,402 ExecuComp firms. Two CEO overconfidence measures are constructed based on the option exercise behaviour of CEO's: one measure indicates overconfidence and one measure specifically indicates low versus high overconfidence. A third CEO overconfidence measure, NetBuyer, is inconsistent in this study. This is further examined and it is shown that inside information and signaling question the use of this measure using this or a comparable dataset. The influence of low CEO overconfidence on firm value can not be inferred in this study with reasonable certainty; although most results indicate a negative influence. The results do consistently indicate that high CEO overconfidence has a significantly positive influence on firm value; this implies that moderate CEO overconfidence is not optimal. Furthermore the results indicate that most probably the positive effect of high CEO overconfidence on firm value is due to greater innovation and a lower cost of debt, and is despite the influence of CEO overconfidence on leverage and investment, which both become suboptimal.

Preface

Over the past months I have been working on this thesis as a final project to finish my Master in Financial Management. Despite the fact that working on this thesis was at times very challenging and time consuming I did enjoy writing it. I am therefore very pleased that my study is able to present some significant evidence that CEO overconfidence influences firm value.

Even though I enjoyed working on this final project of my student life there were certainly some moments that I needed the help of other people; either because I was in need of advice, or because I was in need of some distraction from my thesis. First of all I am very thankful for the help of my supervisor Dr. O.G. Spalt, who gave me very useful and practical advice. Without his help this thesis would not have had the same quality as I believe it has now. Second of all I want to thank my family; my parents, sister and brother, who have always supported me in every way possible throughout my studies, but especially during these last months when I was working on my thesis. I especially want to thank my parents; if it were not for them I would not have been able to enjoy my student life to the fullest and broaden my horizon by going on exchange and being a board member. Also I want to thank Jarri, he always had total faith that I would write a great thesis, which made me try to accomplish this even more. Of course I also want to thank all my friends, especially Inge, Manon, Miranda, Nydia, Pleun, and Wouter, who were always there for advise, support, lunch, dinner or a party when I needed and who made my whole student life a great experience.

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1. Introduction

The last decade has seen a growing amount of research on the topic of behavioural finance. Behavioural finance is the field of study that focuses on the idea that investors and managers are not rational which is assumed in traditional finance research (Shefrin, 2001). It is based on the concept that there are physiological phenomena that interfere with the basic concepts of the traditional theory, and it is thought to be an explanation of some important patterns which have not yet been explained by traditional finance theory (Baker, Ruback, & Wurgler, 2007). For example, Baket et al. state that optimism shares many predictions with established theories like moral hazard and adverse selection, and therefore can be a candidate to explain many earlier findings in finance.

In the field of behavioural finance there are two approaches, the first approach considers that investor behaviour is less than fully rational, and the second approach emphasises that managerial behaviour is less than fully rational. The latter approach is less developed at this point in time, and focuses on situations where a manager believes he is maximising firm value, but is actually deviating from this goal (Baker et al., 2007). In psychology and economy there is extensive literature on these situations (Kahneman & Tversky, 1979), however, according to Baker et al. the corporate finance literature on this topic is in the beginning of its development. The two biases that have been examined extensively in the behavioural corporate finance literature are optimism and overconfidence, however the impact of other biases on corporate finance has also been examined recently (Baker et al., 2007). Especially managers, or more precise CEO's, seem to be prone to overconfidence and optimism, and many studies have documented the consequences of these biases: loss averseness, the belief that one's own firm is undervalued, encouragement of overinvestment from internal resources, a preference for internal instead of external finance and a preference for debt instead of equity (Ben-David, Graham, & Harvey, 2007; Shefrin, 2001).

Multiple authors (Baker et al., 2007; Fairchild, 2009; Subrahmanyam, 2008) have suggested that there is still a considerable amount of questions that behavioural corporate finance could answer. For example, the economic losses associated with managerial biases have not yet been clearly quantified, although evidence suggests that these losses could be significant. Also the influence of managerial overconfidence on firm value remains ambiguous and there has been little empirical analysis of this relationship (Fairchild). However, there are several papers that indicate a relationship between the two variables.

For example, both Gervais and Goldstein (2004) and Fairchild (2009) argue that CEO overconfidence leads to better functioning organisations because it increases productivity. However, the models of other authors show that irrational managers overinvest to the point where marginal value created decreases, and that managers issue more debt than is value maximising, which leads to higher financial distress costs (Hackbarth, 2009; Heaton, 2002; Malmendier & Tate, 2005a). On the other hand high leverage results in high investment-cash flow sensitivity which moderates the overinvestment problem (Fairchild; Malmendier & Tate). Hackbarth finds that overconfident managers take costly measures to accumulate internal liquidity, but also that managerial overconfidence leads to a more favourable policy to bondholders which leads to a higher external capital capacity. Furthermore, research by several authors (Gervais, Heaton, & Odean, 2003; Goel & Thakor, 2008) indicates that in the light of other imperfections such as risk aversion, optimism moves investment from an inefficient low level to a more efficient high level. All in all, there are several theories that point to a relationship between CEO overconfidence and firm value, and to examine this relationship the following research question is the focus of this study:

What is the influence of CEO overconfidence on firm value?

Using panel data of 1,402 ExecuComp firms from 2006 to 2009, two CEO overconfidence measures are constructed following Hirshleifer, Low and Teoh (2010) and Campbell, Gallmeyer, Johnson, Rutherford and Stanley (2010). These measures are based on the option exercise behaviour of managers; one measure indicates overconfidence and one measure distinguishes specifically between low and high overconfidence. Furthermore, a third CEO overconfidence measure is constructed based on the amount of firm shares the CEO buys; NetBuyer. This measure is inconsistent in this study; it is shown that inside information and signaling question the use of this measure using this or a comparable dataset. The results of this study are unable to indicate with reasonable certainty what influence low CEO overconfidence has on firm value; however most results demonstrate a negative influence. The results do consistently indicate that high CEO overconfidence has a significantly positive influence on firm value; this implies that moderate CEO overconfidence is not optimal. Furthermore the results indicate that the positive effect of CEO overconfidence on firm value is most probably due to greater innovation and a lower cost of debt, and is despite the influence of CEO overconfidence on leverage and investment, which both become suboptimal.

This study contributes to the behavioural corporate finance literature in two ways. First, the relevant existent literature on the relationship between CEO overconfidence and firm value is brought together in one encompassing framework. Many studies have modelled the effects of managerial overconfidence on different variables that in turn influence firm value, and this study aims to summarise these different models into one framework. Second, the notion that CEO overconfidence has an effect on firm value is tested empirically, thereby extending the knowledge of the effect that managerial biases have in business life. Hirshleifer et al. (2010) studied this relation only briefly; this study extends theirs by using a more elaborate model. Ye and Yuan (2008) study this relation for Chinese firms and focus on investment; this study instead focuses on North American companies and extends their study by taking into account more variables.

This study is organised as follows. Section 2 starts with an extensive review of the literature on the research question. Section 3 describes the model, variables, and data and in section 4 the methodology used in this study is described. Section 5 elaborates on the empirical results and robustness tests and section 6 concludes and describes the implications and limitations of this study.

2. Theoretical background

This section contains the theoretical background of this study. Firstly, the bias overconfidence is discussed for managers. Secondly, the various theories that indicate that there is a relationship between firm value and CEO overconfidence are presented, after which the section is concluded with an overview of how exactly CEO overconfidence influences firm value.

2.1 Overconfidence

Over the last decade especially the biases overconfidence and optimism have received a lot of attention from scholars (Ben-David et al., 2007; Malmendier & Tate, 2008). Both biases are characteristics of individuals, not of the firm or market the individual is acting in, and both can have a pronounced influence on the firm (Hackbarth, 2008).

According to Hackbarth (2008) and Ben-David et al. (2007), optimism is often modelled as an overestimation of a mean, and it is defined as the belief that favourable future events are more likely to occur than they are in reality. For example, Heaton (2002) finds that the actual cash flows of firms with optimistic managers systematically fall short of their forecasts, thus indicating that optimistic managers attach too much probability to good outcomes, and too little to bad outcomes. Overconfidence, which is also referred to as miscalibration, is often classified as an underestimation of a variance. Or in other words: people's probability distributions of future events are too tight (Ben-David et al., 2007; Hackbarth, 2009). According to De Bondt and Thaler (1994), miscalibration is one of the most robust and best documented findings in psychology. Another expression of miscalibration is that people overestimate the reliability of their knowledge and information (Gervais et al., 2003).

Malmendier and Tate (2005a) note that managers, and especially high ranking managers, are particularly susceptible to miscalibration and optimism. They deal with complex and abstract situations and outcomes where learning is limited, they perceive a high extent of control and they express a high degree of commitment; all these factors make them more prone to overconfidence. It is also observed that people attribute good outcomes to their own actions and not to luck, which is known as the self-attribution bias (Ben-David et al., 2007). This implies that managers and especially CEO's would display miscalibration and optimism because they attribute their position in the company to their own actions and not to luck. Furthermore, some authors believe that there is a selection bias; overconfident people would more often apply for positions in

management than people who are not overconfident (Gervais et al., 2003; Goel & Thakor, 2008). Goel and Thakor further find that overconfident managers are more likely to win the tournaments that lead to the selection of a new CEO. Selection in these tournaments is based on the outcomes, and higher risk leads to higher outcomes. Because overconfident managers are more prone to take projects with higher risks they tend to be promoted more often. These reasons show that managers, and especially CEO's, will display more overconfidence than the general population.[1] Because especially CEO's are prone to overconfidence, and because more detailed data is available on CEO's, this study specifically focuses on the relation between CEO overconfidence and firm value.

Both psychological and behavioural research has shown that optimism and miscalibration are likely to appear jointly (Gervais et al.; Hackbarth, 2009). Therefore in this study miscalibration and optimism are jointly referred to as overconfidence, and are captured by one proxy.[2] Overconfidence is defined as an overestimation of one's own abilities and knowledge and the ability to positively impact the firms' undertakings, which leads to an overestimation of the mean of the firms' future profitability and an underestimation of the risks the firm faces.

2.2 The influence of CEO overconfidence on corporate policies

Research during the last decade has established that managers indeed show signs of overconfidence, and that this also affects corporate policies (Ben-David et al., 2007; Gervais et al., 2003; Malmendier & Tate, 2008). This section utilises this research and demonstrates the theoretical relationship between managerial overconfidence and firm value. This section is divided into five subsections; each subsection focuses on one corporate policy that is influenced by CEO overconfidence and in turn influences firm value. Each section starts with simple theoretical models describing the relation; building on that, other more extensive models are discussed. It should be noted that the influences the different corporate policies have on firm value are very much affected by each other, and it is thus difficult to study these effects in isolation.

2.2.1 Leverage

A well documented implication of managerial overconfidence is that it decreases the amount of equity in firms. In his survey into behavioural finance Shefrin (2001) states that overconfident CEO's underestimate the probability of default and thus choose a capital structure that is overly dependent on debt.

[1] This bias is not fully tempered by corporate governance mechanisms (Heaton, 2002).
[2] In many studies that are discussed either optimism or miscalibration is modelled. Only if these biases are modelled together the bias is referred to as overconfidence.

The influential paper by Ben-David et al. (2007) shows that miscalibration has two impacts on managers; it leads them to underestimate the volatility of their own firm's cash flow, and to use lower discount rates. This translates into the belief that investors underestimate the value of the projects of the firm and thus that they misprice especially the equity of the firm. This makes managers reluctant to issue equity, which increases the firm's leverage. The more miscalibrated a manager is, the more he believes the equity is undervalued and the more debt is chosen in the capital structure. Also, because these CEO's feel equity is mispriced, share repurchases are more common for miscalibrated CEO's, which also increases the leverage of the firm.

This finding of Ben-David et al. (2007) has been modelled theoretically. In a simple two period model with uncertain cash flows Heaton (2002) models managerial optimism by excluding the effects of asymmetric information and agency costs.[3] Heaton finds that optimism leads managers to believe that an efficient capital market undervalues their firms' risky securities, which induces a pecking order capital structure. Managers prefer to use internal cash or risk free debt because the probability of beliefs does not influence the price of these securities. This implies that the capital structure is most probably not optimal, and thus costly. Also, this preference for internal funds might lead optimistic managers who are dependent on external finance to decline positive net present value projects, because they believe that the cost of external financing is too high. A similar study by Malmendier and Tate (2005a) confirms this finding in the case of overconfidence, not only optimism.

Hackbarth (2008) confirms that managerial optimism leads to a pecking order capital structure, but a new finding in his model is that this higher debt level increases firm risk and leads to discounts on riskier debt and equity of the firm. Moreover he states that, in contrast to optimistic managers, miscalibrated managers view debt and not equity as undervalued because they perceive their future earnings to be safer than the market. Therefore, they are more likely to issue equity instead of debt, leading to a reverse pecking order. However, more in line with general theory, Hackbarth finds that if overconfident managers issue debt they tend to issue more because they perceive lower expected financial distress costs.[4] All in all, Hackbarth states that managerial overconfidence leads to costly higher debt levels. In another paper Hackbarth (2009) predicts that

[3] Miscalibration is not taken into account in this study, but according to the author it would not significantly alter the findings.

[4] Optimistic managers perceive lower expected financial distress costs because they believe the firm is more profitable than it really is, and therefore less prone to financial distress. And miscalibrated managers perceive lower expected financial distress costs because they believe their firm is less risky than it really is, and therefore less prone to financial distress.

managerial optimism and miscalibration lead to higher default thresholds[5], and thus to more frequent or likely defaults, which increases the expected costs of financial distress.

Fairchild (2005b) models managerial overconfidence in two different settings; one where there is asymmetric information, and one where there are moral hazard problems. Moreover, his models further extend the previous models by including the choice of effort levels. In the first model managerial overconfidence leads to an excessive use of debt which increases the expected costs of financial distress. The high debt issuances are not only due to the belief that equity is undervalued, but also due to the fact that an overconfident manager underestimates the expected financial distress costs because he overestimates his skills. In the second model managerial overconfidence leads to higher leverage levels, and thus higher expected financial distress costs, but also to higher effort levels. In an extension of this previous paper, Fairchild (2009) focuses on the combined effect of moral hazard and managerial overconfidence in two situations. The first situation describes a mature firm with no investment opportunities; here managerial overconfidence results in a higher debt level. This higher debt level is due to two reasons; firstly, the underestimation of the probability of financial distress, and secondly the attempt to commit to a higher effort level. Fairchild's second model describes an early stage firm with productive investment opportunities. In contrary to most other models, overconfidence leads the manager to choose a lower debt ratio than the rational manager. This surprising finding is the result of the inclination of an overconfident manager to overestimate the probability of success, and his wish to execute more projects, which is easier if there is more equity in a firm.

Oliver (2005) confirms above findings with empirical results. He finds that managerial confidence is very significant in explaining the financing decisions in firms; higher managerial confidence leads to higher levels of debt. Borokhovich, Hegab and Marciukaityte (2010) find in their empirical research that managerial overconfidence, and the resulting higher debt levels, leads to worse post financing stock performance after debt and equity issuances.

Even with the use of different specifications of managerial overconfidence in different sort of firms and with different sort of models, most studies discussed above reach the same conclusion; managerial overconfidence leads to higher leverage. Firstly because overconfident CEO's underestimate the expected financial distress costs, which makes them more prone to issue debt. Secondly because overconfident CEO's believe that outsiders understate the true value of

[5] A default level is defined as EBIT level at which default occurs.

the firm and this makes them reluctant to issue equity. These effects move leverage away from the optimal amount of leverage, which leads to higher financial distress costs, discounts on risky debt and equity, and according to some authors, worse stock performance. This leads to the following hypothesis:

Hypothesis 1 (leverage): The interaction of CEO overconfidence and leverage influences firm value negatively.

2.2.2 Investment

There are three manners in which managerial overconfidence influences investment; it causes overinvestment, high investment-cash flow sensitivity, and could bring investment to its optimal level.

2.2.2.1 Overinvestment

In his study Heaton (2002) models optimism; he shows that since optimistic managers systematically believe that cash flows are higher than they actually are, more projects are taken on. Heaton states that optimistic managers have the same ranking of projects as rational managers; however their cutoff point for investments is too low. Therefore negative net present value projects, which the manager perceives as positive net present value projects, are executed. Fairchild (2009) confirms this result and finds a free cash flow problem for overconfident managers.[6] He shows that an overconfident manager would actually take on less debt in order to invest more.

Malmendier and Tate (2005a) also show that overconfident managers overestimate future returns and therefore overinvest for all levels of investment. However, they state that the finding of their model depends on how overconfidence is defined; if the CEO is overconfident about the assets in place instead of about investments, overconfidence would lead to underinvestment. However, in both cases the authors believe that overconfident CEO's do not achieve optimal investment levels. Baker, Ruback and Wurgler (2007) confirm this finding, and show that managerial optimism about the value of the firm's assets in place and investment opportunities leads to overinvestment. According to these authors this is due to the fact that optimistic managers use discount rates that are lower than they should be. Furthermore, these authors support the finding of Malmendier and Tate (2005a) that optimism only about assets in place leads to underinvestment.

The studies presented so far assume that managers overestimate returns, but the paper of Ben-David et al. (2007) uses miscalibration instead of optimism

[6] This is only the case if it is a firm with profitable investment opportunities.

to model overconfidence. This paper shows that managerial overconfidence leads to an underestimation of the volatility of the firm's cash flows and therefore to lower discount rates and consequently higher investment. This implies that miscalibration has the same effect on investment as optimism.

Yet a different paper extends the literature on this subject by using a real options model to focus on optimism and miscalibration[7] (Hackbarth, 2009). According to Hackbarth overconfident managers perceive lower exercise thresholds for investments due to a higher expected growth rate and less uncertainty, which both lead to higher opportunity cost of waiting. Therefore investments would be executed earlier, leading to higher investment in the present value sense. Hackbarth also states that sub-optimal investment decisions can be made as managers execute projects earlier with less information.

Goel and Thakor (2008) actually show that an overconfident, non risk averse manager, overinvests in comparison to the optimal level. Their reasoning is that because managerial overconfidence increases the amount of investments executed, the probability of executing investments with less profitable payoffs also increases. Thus, if the CEO is not risk averse, an increase in his overconfidence would lead to excessive risk.[8]

Especially in the case of mergers and acquisitions (M&A's) overinvestment due to managerial overconfidence has been studied extensively. Roll (1986) was one of the first to introduce the idea that managerial overconfidence could be a reason for M&A's. Roll states that irrational managers have an erroneously higher valuation, and because of that are subject to the winners curse: the winner of a takeover bid will on average overpay. Rational managers will take this into account whereas overconfident managers will not. Thus overconfident managers are winners in takeover battles more often, and consequently overpay. In one of their studies directed at managerial overconfidence Malmendier and Tate (2008) focus on mergers. They state that the implications of managerial overconfidence are more than just overbidding. Overconfidence leads managers to overestimate their ability and thereby the returns they generate internally and thus the merger synergies. This leads them to execute too many mergers, and to take on value destroying mergers. Furthermore, overconfident managers are reluctant to raise external capital, thus in case financing is needed to conduct a value increasing merger they may forgo it because they perceive a too high cost of financing. The empirical findings of Malmendier and Tate confirm their predictions; overconfident CEO's conduct more mergers especially when the firm has enough internal resources. Besides that, overconfident CEO's undertake especially more

[7] Both about the growth rate and the riskiness of assets in place.
[8] The case where managers are risk averse is described in section 2.2.2.3

diversifying acquisitions. These acquisitions are generally thought to be value destroying, leading to the conclusion that overconfident CEO's engage in more value destroying mergers than rational CEO's. This idea is confirmed by their finding that investors react significantly more negative to the announcement of mergers of overconfident CEO's than to the announcement of mergers of rational CEO's.

Another implication of overconfidence is that it motivates managers to engage in more complicated tasks more easily than rational managers (Doukas & Petmezas, 2007). Also this effect of managerial overconfidence leads to more acquisitions, which is confirmed by the empirical findings of Doukas and Petzemas. Furthermore, these authors show that the long run post-acquisition stock performance is lower in firms with overconfident managers, which further indicates that overconfident managers overestimate the synergies and operational efficiencies of acquisitions and execute potentially value destructive acquisitions.

2.2.2.2 Investment-cash flow sensitivity

Due to the fact that overconfident managers are generally reluctant to issue equity the influence of managerial overconfidence on investment is not always as straightforward as described in the previous section.

In his model about managerial optimism Heaton (2002) finds that because managers are reluctant to issue equity, they will pass up positive net present value projects when they perceive the cost of external financing to be too high. This alleviates the overinvestment problem of optimistic managers. However, it also implies that some positive net present value projects are not undertaken, which leads to underinvestment. All in all, little free cash flow in a firm with optimistic managers can deter value destroying overinvestment, but can also enhance value destroying underinvestment. A high amount of free cash flow always leads to the overinvestment problem. Malmendier and Tate (2005a) model the investment-cash flow sensitivity of overconfident CEO's. They reach the same conclusion as Heaton; because the CEO is unwilling to issue shares, high investment-cash flow sensitivity is present when there are little internal resources. The empirical results of these authors confirm that overconfident CEO's display a large sensitivity of investment to cash flow. Baker et al. (2007) confirm both findings: overconfident managers overinvest from current resources, not from new financing, and the degree of overinvestment falls with the amount of equity needed.

Hovakimian and Hovakimian (2009) find that firms with high investment-cash flow sensitivity significantly underinvest in years with low cash flow, and overinvest in years with high cash flow. But in aggregate, firms with high cash

flow sensitivity overinvest. Furthermore, they show that managers accumulate internal liquidity when possible in order to finance investment in periods where financial constraints are binding, and that this accumulation is costly. Even though they cannot show that this effect is not due to agency explanations they believe it is mainly due to managerial overconfidence.

2.2.2.3 Move investment to optimal level

Baker et al. (2007) state that on top of other managerial imperfections, for example risk aversion, optimism can move investment from an inefficient low level to the firm's best.

In their paper Gervais et al. (2003) model an all equity firm with risky projects. The manager has the option to wait with investing and to gather more information in each period, but waiting results in a probability that the project cannot be executed anymore. They show that a risk averse manager is reluctant to undertake the project with less than perfect information. This agency problem increases the chance that the project cannot be executed. However, a miscalibrated manager puts too much weight on his own information, and an optimistic manager always thinks the project is better than it is in reality. Both biases lead overconfident managers to be less reluctant to start a new project, thereby decreasing agency costs.[9] Thus overconfident managers have the natural tendency to overcome the effects of risk aversion, and thereby align the incentives of managers and shareholders and decrease the need for costly outside incentives. A similar study confirms these findings (Goel & Thakor, 2008). Goel and Thakor show that a risk averse CEO underinvests relative the optimal investment level, and that mildly overconfident managers overcome this underinvestment problem because they overact to their own information.

The study by Hackbarth (2009) extends these findings in a real options framework. Hackbarth shows that overconfident managers perceive lower exercise thresholds for investments and thus execute investments earlier, which reduces the underinvestment problem that is existent in leveraged firms.

De La Rosa (2008) further extends these theories, and studies managerial overconfidence in an investment model including career concerns. In his model career concerns equate to future compensation, and outcomes in the present affect that compensation. The author shows that if risk averse agents are not fully insured from reputational risk they forgo profitable investments to insure themselves. However, managerial overconfidence increases the perceived likelihood of favourable outcomes, and thus of a higher future compensation; this

[9] This also implies that too much overconfidence will lead the manager to rely too much on his own information or on his upwardly biased opinion of the project, and possibly undertake value destroying projects.

reverses this effect of reputational risk. Thus overconfidence alleviates the incentive problem of rational managers and the corresponding agency costs.

Another paper analyses the impact of managerial overconfidence on entry into markets (Pires & Santos-Pinto, 2008). In this model every player has private information about costs, and one player is overconfident and the other rational. Overconfidence is defined as an erroneously lower perception of one's own costs. The authors show that players with moderate confidence have higher probabilities of entering a market before the rational player because of this mistaken perception. If the asymmetry in costs is small this increases the profits of the overconfident player. However, overconfidence could also lead to overproduction which lowers profits.

Lastly, Sudarsanam and Huang (2006) show that overconfidence leads managers to engage in risky acquisitions thereby overcoming the problems associated with being risk averse.

All in all, it is shown that managerial overconfidence has a significant influence on investment; however, so far there is no consensus on what the overall effect is. It is discussed that managerial overconfidence first of all leads to firm value destroying overinvestment, especially in the domain of M&A. However managerial overconfidence also causes high investment-cash flow sensitivity. This sensitivity can partly temper overinvestment, but can also cause underinvestment. Furthermore, overconfidence can move the underinvestment of risk averse managers to an optimal level, and thereby result in a more favourable policy for shareholders. The interest of this section is to find what influence the interaction of CEO overconfidence and investment has on firm value, and not if it has an influence; therefore a one sided hypothesis is devised. In order to test the relation between CEO overconfidence, investment and firm value the following hypothesis is tested:

Hypothesis 2 (investment): The interaction of CEO overconfidence and investment influences firm value positively.

2.2.3 Effort, productivity and innovation

There are several papers that discuss the influence of managerial overconfidence on effort, decision making, productivity, and innovation.

Firstly, the paper by Goel and Thakor (2008) finds that overconfident CEO's underinvest in information. Consequently, the acquisition of information of an overconfident CEO is suboptimally low which leads to errors in project selection. Secondly, another paper studies managerial overconfidence in the setting of venture capital decision making (Zacharakis & Shepherd, 2001). Zacharakis and

Shepherd discover that overconfidence negatively affects venture capitalists decision making accuracy. In accordance with Goel and Thakor(2008), they find that overconfident managers rely on existing knowledge too much, and do not seek enough new information. Therefore new opportunities or pitfalls are either not discovered, or only later. Furthermore, Baker et al. (2007) show that optimists tend to inefficiently persist in their initial business plan.

However, not all papers point to a negative influence of managerial overconfidence. Bernardo and Welch (2001) model the finding that overconfident individuals rely more on their own information than on external information. The actions taken because of this reliance ensure that the overconfident individuals broadcast their information to the remainder of the group. Thus even though overconfidence can lead to wrong decisions more often because of this reliance on own information, these wrong decisions help the remainder of the group because they learn what the wrong decisions are. This implies that overconfidence has beneficial outcomes to a firm. However, the authors state that too many overconfident individuals will lead to too many decision errors and to negative social outcomes. Gervais and Goldstein (2004) model overconfidence in a team setting. In their model the productivity of a player increases as the effort of other players increases, however effort is not observable. They show that overconfident players exert more effort independent of the effort levels of the other team players because they overestimate their productivity; they perceive that the higher effort costs are less than the extra reward in productivity. Since the other players know that overconfident players exert more effort they will also increase their productivity. This model is further extended by Fairchild (2005a) who includes bargaining over the projects share into the model; he reaches the same conclusion. However, he also shows that an overconfident agent can negotiate a higher share of the project for himself, and that this will reduce the incentive and effort of other agents. In two other papers by Fairchild (2005b, 2009) the combined effects of managerial overconfidence and moral hazard are modelled. Fairchild shows that in all situations the optimal effort level of managers is higher when their overconfidence is higher. This is due to a higher amount of debt and a higher bankruptcy threat, which motivates managers. Interestingly, he shows that overconfident managers choose higher debt levels in an attempt to commit to a higher effort level in order to increase current market valuation and compensation.

Managerial overconfidence also influences innovation. Englmaier (2004) analyses both Bertrand and Cournot duopoly competition and focuses on Research and Development (R&D). In the Bertrand competition the overconfident

manager thinks the tournament is biased in his favour[10] and therefore decreases his effort. This implies that managerial overconfidence can overcome the value destroying nature of R&D tournaments which are often present in this duopoly. In the Cournot model the overconfident manager perceives the product market to be more profitable than it truly is, and therefore commits to more aggressive R&D; in this type of duopoly that is an advantage. So for both duopolies managerial overconfidence has advantages for firms. Hirshleifer et al. (2010) find that firms with overconfident CEO's undertake riskier projects, invest more heavily in R&D and achieve greater innovation as measured by patents and citations. Even after controlling for the level of R&D expenditure, innovation is more successful in firms led by overconfident managers, which leads these authors to believe that overconfident CEO's innovate more effectively. According to Hirshleifer et al. this is mainly because overconfident CEO's overestimate the gains of projects and thus are willing to accept greater risk. Another paper examines the relation between CEO overconfidence and innovation in a career concern model (Galasso & Simcoe, 2010). These authors find that because overconfident CEO's underestimate the probability of failure they are more likely to innovate, as they believe this is best for their career. Furthermore, they find that this influence is largest in competitive industries[11]; both notions are confirmed by their empirical findings.

A few papers have drawn attention to the motivational value of overconfidence. Hackbarth (2009) shortly states that positive distortions like overconfidence, cause positive illusions and lead to for example, a greater ability to care for others, higher motivation, better task performance and greater creative problem solving. Puri and Robinson (2007) have a similar finding; according to them optimistic people work significantly harder, expect to retire later, and save more. Shapira-Ettinger and Shapira (2008) emphasise this constructive value of overconfidence by showing that overconfidence raises the estimation of future rewards and therefore produces higher incentives, more perseverance, higher performance and more consistent achievements. They show that in situations where rational managers would be deterred to undertake actions due to high risks involved, an overconfident manager's assessment of risks would be the key to optimal behaviour. Weinberg (2009) confirms this finding; in his model, moderate overconfidence leads people to take on risky tasks that raise the expected output, however, high levels of overconfidence leads people to take on tasks that are too challenging.

[10] An overconfident manager believes his product fits the wishes of the consumer better than other products.
[11] In these industries successful innovations provide more information about the ability of the CEO.

Lastly, Russo and Schoemaker (1992) point to the motivational value of overconfidence, however they state that managerial overconfidence has its downsides. According to them managers have to be able to make the right decisions, which requires realism, and overconfidence endangers this realism.

All in all the different theories in this section point in different directions with regards to the influence of CEO overconfidence on firm value. Many studies confirm that managerial overconfidence ultimately results in higher effort levels. However, it can also lead to sacrificing the precision of information which leads to bad decisions. On the other hand these bad decisions signal to other entrepreneurs or other people in the same organisation what not to do, thereby increasing total welfare. Yet other authors point to the motivational value of managerial overconfidence, and that overconfidence overcomes risk aversion; here there is consensus that CEO overconfidence is good for a firm. Also when it comes to innovation there are clear signs that CEO overconfidence has more advantages than disadvantages for the firm. The hypothesis of this section focuses specifically on innovation because effort and decision making are very difficult variables to measure. The hypothesis is as follows:

Hypothesis 3 (innovation): The interaction of CEO overconfidence and innovation influences firm value positively.

2.2.4 More favourable policy towards bondholders

Hackbarth (2008, 2009) argues that managerial overconfidence leads to a more favourable policy towards bondholders. The main conclusion of his papers is that for a leveraged firm a mild degree of managerial overconfidence reduces conflicts between bondholders and shareholders, like asset stripping or risk-shifting. Using a real options framework Hackbarth shows that since bondholders cannot set contracts to make managers maximise firm value instead of equity value, they discount the firms bonds, which increases the cost of debt for the firm and thus shareholders can raise less capital. Furthermore, he shows that overconfident managers exercise options early, which leads to a higher investment in present value sense. And he shows that overconfident managers have tighter default boundaries because they believe the firm is less risky or has a higher expected profit. Both notions result in the idea that overconfidence acts as a commitment device for managers to maximise firm value; and this results in a more favourable policy towards bondholders. Thus bondholders discount the firms' debt less, which lowers the cost of debt and this leads to the capability to attract relatively more external capital. Hackbarth actually argues that because

of this effect overconfident managers should be preferred over rational managers. To research this prediction the following hypothesis is tested:

Hypothesis 4 (cost of debt): The interaction of CEO overconfidence and the cost of debt influences firm value positively.

2.2.5 Other

Next to the above mentioned influences of managerial overconfidence on corporate policies there are some studies that discuss the influence of managerial overconfidence on a variety of other corporate policies.

De La Rosa (2008) studies the effects that managerial overconfidence has on incentive contracts. Firstly, in his model an overconfident agent values success contingent claims more than a rational agent because he believes he will be successful more often than is he is in reality. Secondly, if an agent is overconfident about his influence on the likelihood of success, lower powered incentives are sufficient to induce any given effort level. For moderate levels of overconfidence the latter effect dominates which is beneficial because it ensures that the manager bears less risk.

A paper with an accounting topic shows that managerial overconfidence increases the probability that the firm will commit financial reporting fraud (Schrand & Zechman, 2010).

Van den Steen (2005) shows that managers that have strong beliefs about the right course of action, which can be described as overconfidence, attract employees that share the same beliefs. This alignment of beliefs gives direction to the firm, and decreases the need for coordination. However, he also shows that overconfidence leads to slow learning.

Lastly, Gervais et al. (2003) show that because overconfidence overcomes agency problems, compensating overconfident managers as if they are rational hurts shareholders. This is because wealth is transferred unnecessarily and because it induces managers to take more risk than is in the interest of shareholders. This would imply that if managers are overconfident and shareholders can observe this, costly compensation schemes are not needed, which is beneficial to the firm (Sudarsanam & Huang, 2006).

2.3 Relationship between CEO overconfidence and firm value

This section starts with a review of the literature that models the relationship between CEO overconfidence and firm value. Then all factors of section 2.2 are brought together in one framework which shows what overall influence CEO overconfidence is most likely to have on firm value.

Fairchild's (2005b, 2009) studies include several models. In his model including asymmetric information the author shows that managerial overconfidence is always bad for a firm because it leads to excessive debt and higher expected financial distress costs. In his model including moral hazard managerial overconfidence can lead to both an increase or decrease in firm value. The influence depends on what effect is larger; the effect of a higher effort level, or the effect of a higher probability of financial distress. Fairchild concludes that there is an optimal amount of managerial overconfidence that maximises firm value. According to him, managerial overconfidence is optimal when it is moderately high. When it is moderate the manager switches to debt but does not increase his effort sufficiently to offset the increase in expected financial distress costs. An excessive level of managerial overconfidence is undesirable because the expected financial distress costs are so high that the manager can never exert sufficient effort to offset these costs. Other authors confirm the findings of Fairchild (Gervais et al., 2003; Sudarsanam & Huang, 2006). According to these authors mild managerial overconfidence overcomes the underinvestment problem and increases effort levels, and the problems associated with higher debt levels are not severe yet. Thus they believe that managerial overconfidence increases firm value for mild biases but decreases firm value for extreme biases.

Hackbarth (2009) finds two effects of managerial overconfidence. The leverage effect means that biased managers choose higher debt levels, which leads to underinvestment. The timing effect means that biased managers tend to invest earlier and this diminishes underinvestment. He finds that for mild biases the timing effect is larger than the leverage effect and thus that the benefits of managerial overconfidence outweigh the cost of this bias for a leveraged firm. However, in an all equity firm the leverage effect is not present and managerial overconfidence leads to value destroying overinvestment. Another study by Hackbarth (2008) reaches the same conclusion; overconfident managers can increase firm value.[12] Because managerial overconfidence leads to higher debt levels the manager-shareholder problem of overinvestment is less of a problem according to this author, which leads to lower agency costs. Also bondholder-shareholder conflicts are mitigated, leading to lower discounts on security prices. According to Hackbarth, both optimism and miscalibration lead to an increase in firm value for mild biases, but lead to a decrease in firm value for extreme biases.

The main result from the study of Goel and Thakor (2008) is that overconfident CEO's overcome the problem of underinvestment of risk averse CEO's, thereby increasing firm value. However, too much managerial

[12] He reaches this conclusion in his most extensive model, even though his baseline model suggests the opposite relationship.

overconfidence decreases firm value as too many projects are taken on, some of which have negative net present values.[13]

Lastly, Puri and Robinson (2007) conclude that for mild biases optimism leads to sound financial choices, whereas extreme optimism leads to unreasonable financial behaviour.

To the knowledge of this author there has hardly been direct empirical research on the relationship between CEO overconfidence and firm value. One study that does research this relationship is that by Ye and Yuan (2008). They empirically test the relation between CEO overconfidence and firm value in 239 listed Chinese firms. The authors believe that CEO confidence mainly affects firm value through investments and focus on this with the use of a simultaneous equation model: they treat firm value, investment, and CEO overconfidence as endogenous variables. They show that the effect of CEO overconfidence on firm value is positive at first, but after a certain point turns negative, which according to these authors implies that there is an optimal level of managerial overconfidence. They state that for moderate degrees of confidence agency costs and risk aversion decreases and managers exert higher effort levels, but as confidence increases more negative net present value projects are taken on and firm value decreases.

One other study that briefly looks into this relationship empirically is that by Hirshleifer et al. (2010). They find no sign that CEO overconfidence is associated with worse performance as measured by sales, return on assets, or Tobin's Q. Even though the results of their study are mixed they find indications that CEO overconfidence is positively related to firm performance.

The above discussion has shown that CEO overconfidence influences a firm's policies and decisions, and thereby it is another factor that could affect firm value. It is very difficult to predict how CEO overconfidence affects firm value in reality because many theoretical models are too abstract to make predictions about reality and because all the different corporate policies are intertwined which affects how they influence firm value. Based on the literature in the previous section, the general influence of CEO overconfidence on firm value can be captured with the following framework. Firstly, CEO overconfidence leads to higher leverage which in general has a negative effect on firm value. This is because it leads to higher financial distress costs, and to discounts on

[13] Goel and Thakor emphasise that overconfidence is not the same as the flip side of risk aversion. According to Goel and Thakor overconfidence only increases firm value for mild biases; less risk aversion always increases firm value.

risky debt and equity. Secondly, this same increase in leverage also causes higher effort levels, which has a positive effect on firm value. Also it causes high investment cash-flow sensitivity. Thirdly, CEO overconfidence leads to overinvestment, especially in the case of M&A's, which has a negative effect on firm value. However, high investment-cash flow sensitivity tempers overinvestment, although it can also lead to underinvestment. Fourthly, CEO overconfidence leads risk averse managers to move investment to the optimal level, thereby increasing firm value. Furthermore overconfidence increases motivation, encourages innovation, attracts similar minded employees, ameliorates bondholder-shareholder conflicts and increases the external capital capacity, all of which increase firm value. All in all, CEO overconfidence is believed to positively impact some firm policies, while negatively impacting others; thus the overall influence on firm value remains unclear. However, many authors believe that the advantages of CEO overconfidence are likely to be larger than the disadvantages for mild CEO overconfidence. This implies that there would be an optimal amount of overconfidence for CEO's, and that both low and high CEO overconfidence have a negative influence on firm value. To test these inferences the following hypothesis is tested:

Hypothesis 5: Low CEO overconfidence and high CEO overconfidence influence firm value negatively compared to moderate CEO overconfidence.[14]

All five hypotheses stated in this section lead to answering the research question of this study: What is the influence of CEO overconfidence on firm value?

[14] For clarity, in the remainder of this study the effects of Low CEO overconfidence are referred to as the first part of this hypothesis, while the effects of High CEO overconfidence are referred to as the second part of this hypothesis.

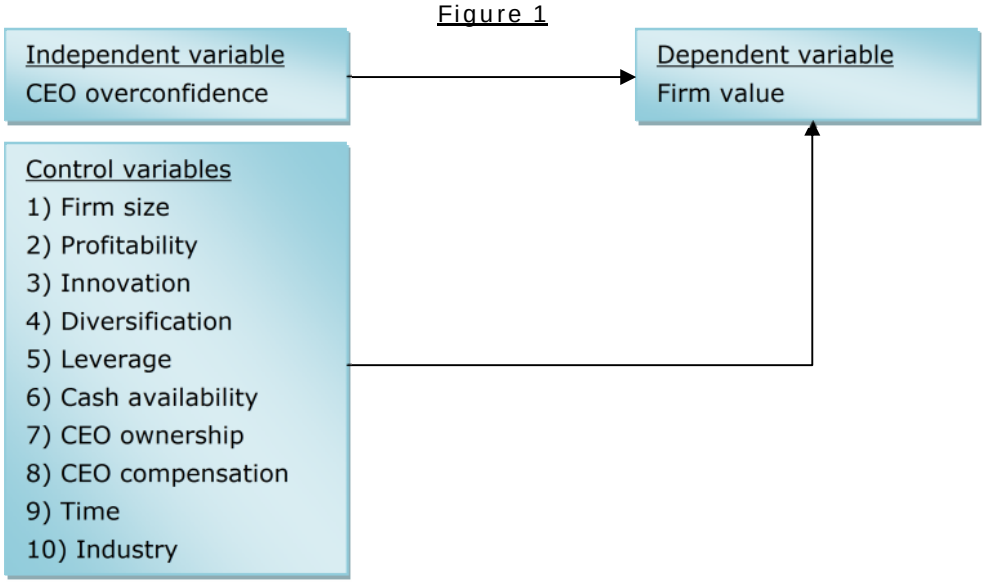
3. Model, variables and data

This section discusses the model that is used to answer the research question and hypotheses in this study. Furthermore, all the different variables included in this model, and the data used to examine the model are discussed.

3.1 Model

Figure 1 represents the model that is tested in this study, and Table 1[15] specifies all variables and predicted influences. In accordance with the research question, the dependent variable in this study is firm value and the independent variable CEO overconfidence. However, firm value is influenced by many other variables, thus to be able to draw a conclusion about the influence of CEO overconfidence on firm value these other variables are controlled for.

Figure 1



The model depicted in Figure 1 is used to answer the research question of this study and Hypothesis 5. When the other four hypotheses are tested two other independent variables are included in the model besides CEO overconfidence; a second independent variable reflecting the subject of the hypothesis, and the interaction of CEO overconfidence and that variable.

3.2. Measuring CEO overconfidence

As many authors have noted, one of the biggest challenges and obstacles for a study into overconfidence is to construct a proxy for overconfidence

[15] All tables can be found from page 59 onwards.

because it is a biased belief that cannot be easily observed (Baker et al., 2007; Malmendier & Tate, 2005b). Nevertheless several authors have constructed different kinds of proxies for overconfidence.

Some authors base their proxies on surveys, for example Ben-David et al. (2007) use a set of questions in their survey to measure CFO miscalibration; CFO's are defined as miscalibrated if they have very wide distributions of an estimated variable. Oliver (2005) estimates confidence with the use of the Consumer Sentiment Index, which measures public perceptions about economic conditions. A similar measure that defines aggregate overconfidence is used by Puri and Robinson (2007), who based their proxy on the Survey of Consumer Finances. Lastly, Zacharis and Shepherd (2001) conduct experiments with venture capital employees in order to determine their level of overconfidence. However, these types of proxies are not well suited to determine CEO overconfidence in this study, as this implies either conducting a survey or executing experiments among many CEO's.

Other authors use firm characteristics to construct a proxy for managerial overconfidence. For example, Hegab et al. (2010) use a measure of excess leverage since many studies had already shown that managerial overconfidence leads to higher leverage. Doukas and Petzemas (2007) use the observation that overconfident managers execute many acquisitions as a measure of overconfidence. The problem with these proxies is that many factors other than managerial overconfidence contribute to these firm characteristics.

Recently some authors have constructed proxies that directly measure the overconfidence of individual managers. For example Barros and Silveira (2007) use the status of a manager as an entrepreneur as an indication of overconfidence since theoretical studies have demonstrated that entrepreneurs are more prone to this behavioural bias. But by far the most influential proxies for managerial overconfidence have been constructed by Malmendier and Tate (2005a, 2005b, 2008; 2010), whose proxies and dataset have been used in many other studies into overconfidence (Deshmukh, Goel, & Howe, 2009; Hirshleifer et al., 2010; Hribar & Yang, 2010; Sudarsanam & Huang, 2006; Ye & Yuan, 2008). Malmendier and Tate have developed three different sorts of overconfidence measures. The first measure builds on the assessment of CEO's by the press; if the number of articles describing the CEO as confident is higher than the number of articles describing the CEO as conservative, the CEO is classified as overconfident. The difficulty with this measure is that it requires verifying every article, and thus data can be limited. Both the second and third measure exploit the underdiversification of CEO's. As part of their compensation CEO's receive large quantities of stocks and options; the stocks are usually restricted and cannot be sold, and the options cannot be traded. Furthermore the

CEO is not allowed to engage in short selling of the firms securities and has its human capital invested in the firm. These factors ensure that the CEO is very exposed to the idiosyncratic risk of the company, and means he is underdiversified. In order to reduce this underdiversification, risk averse managers should want to exercise their options early, and minimise their holdings of the firm's stock. However, as was specified in section 2.1, overconfidence leads managers to believe their firm will do better than can be expected in reality, which induces the belief that the stock price of the firm will increase. To benefit from the increase in the stock price, the overconfident CEO's postpones exercising stock options[16] and buys additional company stock. Based on this logic Malmendier and Tate construct two measures based on the option exercise behaviour of managers: "Longholder" and "Holder 67", and one measure based on the acquisition of company stock: "Net Buyer". Due to the very detailed data that Malmendier and Tate had available on option exercise it is not possible to construct the exact same measures using data gathered from a database like the Compustat Executive Compensation (ExecuComp) database that is used in this study. However, Hirshleifer et al. (2010) have been able to construct a measure similar to "Holder 67" based on the data in ExecuComp, and this measure is one of the proxies for CEO overconfidence that is used in this study. Also, following Campbell et al. (2010) another measure similar to "Holder 67" is constructed that differentiates between low and high CEO overconfidence. Besides that, a measure similar to "Net Buyer", but constructed from ExecuComp data, is also used in this study.

Both Malmendier and Tate (2005a) and Hirshleifer et al. (2010) discuss the possible alternative explanations of these CEO overconfidence measures and reach the conclusion that these are not a concern in their dataset. Therefore, it is assumed that the alternative explanations do not apply to the overconfidence measures used in this study.[17]

3.2.1 OC67 overconfidence measure

The first overconfidence measure used in this study is based on the option exercise behaviour of managers and is specified by Hirshleifer et al. (2010).[18]

[16] It could be argued that the lower firm risk perceived by the overconfident CEO should lead him to believe company options are less valuable in the future and thus to execute these options quickly. However, Hirschleifer et al. (2010) explain that miscalibration is also captured by the option based measures of overconfidence.

[17] A more thorough discussion of these conclusions can be found in the papers of these authors.

[18] The proxy in this study is slightly different from the proxy used by Hirschleifer et al. (2010): these authors use information until 2006, and this study uses information from 2006 onwards. The distinction is important as from 2006 onwards more detailed information on the value of unexercised exercisable options is available. Before 2006 only accounting data for option values, or the value realized on option exercise was available in ExecuComp, and from 2006 onwards the difference between the exercise price of the options and the close price of the company's stock is

Following these authors, this study defines a CEO as overconfident if he holds vested options that are at least 67% in the money once.[19] The dummy variable OC67 takes the value of one if the CEO is defined as overconfident and zero otherwise. The 67% cut-off point follows Malmendier and Tate (2005a), who choose this as a rational benchmark for option exercise based on the Hall and Murphy (2002) framework. The CEO is identified as overconfident as of the first moment he has exercisable options outstanding that are 67% or more in the money and this is consistent with the notion that overconfidence is a persistent trait.[20] CEO's who never have valuable options outstanding are excluded and regarded as missing data for this variable.[21] If CEO's without valuable options would be included in the sample they would always be classified as non overconfident even though it is not possible to observe this personality trait. The average moneyness of the options of the CEO is calculated as follows. First for each CEO year the average realisable value per option is calculated by dividing the realisable value of all exercisable options by the number of exercisable options held by the CEO.[22] Second the exercise price is calculated as the stock price at fiscal year end minus the average realisable value per option. Third and last, the options moneyness is calculated as the stock price at fiscal year end divided by the estimated exercise price, minus one, which results in the percentage by which the options of the CEO are in the money. Following Hypothesis 5 OC67 is expected to have a negative influence on firm value. Campbell et al. (2010) conduct validation analysis to verify that this particular construction of the overconfidence measure is similar to the construction of Malmendier and Tate. They show that the measures of overconfidence produced using ExecuComp data are valid.[23]

3.2.2 Low versus high overconfidence measure

Following Campbell et al. (2010), three other measures of CEO overconfidence are created based on the option exercise behaviour of managers. Since these measures are based on the same logic as the OC67 measure the same validation analysis of these authors applies to these measures. Just as is the case for the OC67 measure, CEO's who never have a positive value for

available. This ensures the measure is more comparable to the original measure of Malmendier and Tate (2005a) and thus could lead to more reliable results.

[19] In their robustness tests Hirschleifer et al. (2010) require the CEO to have outstanding in the money options of 67% at least twice; this does not alter their findings.

[20] If the first years have missing data on the moneyness the dummy variable is assumed to be equal to what it is in later years.

[21] The precise restriction is that the CEO at least once during the sample period has a positive value for Estimated Value of In-the-Money Unexercised Exercisable Options.

[22] The exact ExecuComp variables used are: Estimated Value of In-the-Money Unexercised Exercisable Options, and the Number of Unexercised Exercisable Options.

[23] The study of Campbell et al. (2010) contains a more thorough discussion of the matter.

unexercised exercisable options are excluded for this variable. For this measure two dummy variables are constructed indicating low and high overconfidence: Low_OC and High_OC respectively. Thus the baseline group of CEO's is moderately overconfident.[24] A CEO is classified as highly confident as of the first moment he holds stock options that are more than 100% in the money.[25] The moneyness of the option is calculated in the exact same manner as for the OC67 measure. According to Hypothesis 5 High_OC is expected to have a negative influence on firm value. A CEO is defined as having low overconfidence from the first moment he exercises stock options that are less than 30% in the money, and if he does not hold exercisable options that are more than 30% in the money.[26] The percentage moneyness of the exercised options is calculated as follows. The value realised from exercising the options is divided by the number of options exercised which gives the realised value per option.[27] Then this per option realised value is divided by the estimated exercise price, which is calculated in the exact same manner as for the OC67 measure. According to Hypothesis 5, Low_OC is expected to have a negative influence on firm value. Following Campbell et al. overconfidence is treated as a semi-permanent behavioural trait; if the CEO displays behaviour signalling the opposite overconfidence level the classification of the CEO changes.[28]

3.2.3 NetBuyer overconfidence measure

The third measure of CEO overconfidence used in this study is based on the extent to which CEO's buy additional company stock and is similar to the "Net Buyer" measure of Malmendier and Tate (2005a). The dummy variable NetBuyer equals one if the CEO is a net buyer of company stock during the sample period and zero otherwise. Following Malmendier and Tate being a net buyer during the sample period implies that there are more years in which the CEO is a net buyer of company stock than that there are years in which the CEO is a net seller.[29] An

[24] The variable Moderate_OC is also created and covers all CEO years that are not classified as Low_OC or High_OC. Since this variable is the third of three dummy variables there is no need to add it to the regression specifications. CEO's are classified as moderately overconfident if they hold and/or exercise options that are between 30% and 100% in the money. CEO's with no realized value from options exercise and a moneyness of unexercised exercisable options below 30% cannot be classified as they are not moderately overconfident and cannot with certainty be classified as Low_OC; these observations are treated as missing.

[25] The CEO only needs to exhibit the behaviour once to be identified as overconfident.

[26] CEO's that have not exercised any options could never be classified as having low overconfidence. However, there is no reason to exclude these CEO's since they choose not to exercise and thus should not be classified has having low overconfidence.

[27] The exact ExecuComp variables used are; Value Realized on Option Exercise and the Number of Shares Acquired on Option Exercise.

[28] The classification only changes if either low or high overconfidence is signalled. A signal of moderate overconfidence does not alter the classification of low or high overconfidence.

[29] With this dataset that implies that the CEO should be a net buyer for two out of three years. If there is three years of data then the CEO should be a net buyer in two out of two years for which

alternative variable is also constructed where it is required that the CEO is a net buyer of company stock in all years in the sample[30]. In each year the increase (decrease) in shares owned is regarded as the net amount of shares the CEO has bought (sold).[31] According to Hypothesis 5 NetBuyer is expected to have a negative influence on firm value.

3.3 Measuring firm value

Earlier research into firm value has mainly used measures of Tobin's Q as a proxy for firm value (Fang, Noe, & Tice, 2009; Mackay & Moeller, 2007; Yermack, 1995). According to Chung and Pruitt (1994) Tobin's Q is the generally accepted proxy for firm value in finance literature. Tobin's Q is defined as the market value of assets divided by the replacement cost of assets. However instead of using the replacement cost of assets, which requires many assumptions, often the book value of assets is used (Kaplan & Zingales, 1997; Mackay & Moeller; Roll, Schwartz, & Subrahmanyam, 2009). This study follows Malmendier et al. (2005) in computing Tobin's Q, which is defined as the market value of assets divided by the book value of assets. The authors calculate the market value of assets as Total Assets plus market equity value minus book equity value. Market equity value is defined as the Number of Common Shares Outstanding times the stock price at fiscal year end, and book equity is defined as Total Stockholder's Equity minus Preferred Stock at Carrying Value[32] plus Deferred Taxes (Balance Sheet).[33] To ensure that the results are not sensitive to the measure of Tobin's Q used, an alternative proxy follows Chung and Pruitt's (1994) method to calculate Q.[34] They define Tobin's Q as the market value of equity, defined as the Number of Common Shares Outstanding times the stock price at fiscal year end, plus the Preferred Stock Liquidating Value plus debt, divided by Total Assets. Debt is defined as Total Current Liabilities minus Total Current Assets plus Total Inventories plus Total Long Term Debt.[35]

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the measure is constructed. CEO's who are only in the sample for two years are excluded for this variable and treated as missing data.

[30] The results of the NetBuyer measure are robust to the use of the alternative proxy.

[31] The Increase in Shares Owned Excluding Options is the ExecuComp variable used for these calculations. If options were included the number of shares that could be received by options that are exercisable within 60 days would be included in the number of shares.

[32] This value is always missing and therefore assumed zero.

[33] The missing values for this variable are assumed to be zero because they are considered as non material. In robustness tests the missing values are treated as missing and this produces qualitatively similar results.

[34] The regressions indicate that all results are robust to the use of this alternative proxy.

[35] Missing values for the variables Total Current Liabilities, Total Current Assets, Total Inventories and Total Long Term Debt are assumed to be zero because they are considered as non material. In robustness tests the missing values are treated as missing and this produces qualitatively similar results.

3.4 Control variables

3.4.1 Firm size

According to Allayannis and Weston (2001) the evidence about the influence of firm size on accounting profitability, and thus firm value, is ambiguous. However, it is generally accepted that firm size has an influence, and thus most Q regressions include this control variable (Allayannis & Weston, 2001; Fang et al., 2009; Yermack, 1995). Following these papers the log of Total Assets is the measure of firm size, and the log of Net Sales is used as an alternative measure.

3.4.2 Profitability

Profitability can have a significant positive impact on a company's market value (Yermack, 1995). Both Yermack and Allayannis and Weston (2001) use return on assets (ROA) as a proxy for profitability. Following these authors, ROA is calculated by Operating Income Before Depreciation divided by Total Assets and the alternative specification of ROA in this study is Net Income divided by Total Assets.

3.4.3 Innovation

Both Allayannis and Weston (2001) and Yermack (1995) add a variable to control for the growth opportunities, or in other words innovation, a firm faces and predict a positive influence of this variable on firm value.[36] Innovation is defined as Research and Development Expense[37] normalised by Total Assets (Hirshleifer et al., 2010). Following Allayannis and Weston and Yermack, the level of Capital Expenditures to Net Sales and Advertising Expense to Net Sales are included in this study as alternative measures of innovation.[38] The innovation variable is also used to test Hypothesis 3 (innovation). The coefficient of the interaction variable of CEO overconfidence and innovation is expected to be positive as the combined effect of CEO overconfidence and innovation is expected to positively influence firm value.

3.4.4 Diversification

According to several authors (Allayannis & Weston, 2001; Yermack, 1995) diversification could have an influence on firm value. However, the effect of

[36] This is because value firm value partly consists of valuable future investment opportunities.
[37] If the values for Research and Development expense are missing they are considered as non material and assumed zero (Hirshleifer et al., 2010). In robustness tests the missing values are treated as missing and this produces qualitatively similar results.
[38] If the values for Advertising are missing they are considered as non material and assumed zero (Hirshleifer et al., 2010). In robustness tests the missing values are treated as missing and this produces qualitatively similar results.

diversification on firm value remains ambiguous. This study follows Allayannis and Weston and controls for the effects of diversification using a dummy variable that takes the value of one when the firm operates in more than one business segment and the value of zero if it does not.

3.4.5 Leverage

As Allayannis and Weston (2001) state, the capital structure of a firm could have an effect on its value. Theoretically leverage is assumed to have a quadratic relationship with firm value as firstly taxes are lowered, but secondly financial distress costs are increased (Ross, Westerfield, & Jaffe, 2005). However empirically the effect remains unclear (Allayannis & Weston). Following Allayannis and Weston in order to control for differences in capital structure, leverage is measured by the sum of Total Long Term Debt and Total Debt in Current Liabilities to Total Assets and as alternative measured by Total Long Term Debt divided by Total Stockholder's Equity.[39] This variable is also included as an independent variable in Hypothesis 1 (leverage). In these regressions the coefficient of the interaction variable of CEO overconfidence and leverage is expected to be negative as the combined effect of CEO overconfidence and leverage is expected to have a negative influence on firm value.

3.4.6 Cash availability

If a firm has a lot of cash available it could invest in unprofitable projects. However, due to capital constraints firms are unable to invest in these unprofitable projects. Therefore cash availability is expected to have a negative influence on a firms' Q (Allayannis & Weston, 2001; Roll et al., 2009). Following these authors in order to measure the absence of capital constraints, a dividend dummy is created which equals one if the firm has a positive value on Cash Dividend Paid, and zero otherwise. This dummy is expected to be negatively related to firm value as it indicates that capital constraints are not present.

3.4.7 CEO ownership

Both Malmendier et al. (2010) and Hirshleifer et al. (2010) use CEO ownership as a control variable in their research into overconfidence. Following these papers CEO ownership is measured by the Total Percentage of Shares Owned by the CEO, excluding options.[40] This variable is expected to have a positive influence on firm value as it increases CEO incentives (Griffith, 1999).

[39] If there is missing data on long term debt or short term debt these variables are assumed zero because they are considered as non material. In robustness tests the missing values are treated as missing and this produces qualitatively similar results.

[40] ExecuComp does not report percentages below zero, thus missing data is assumed zero. In robustness tests missing values are treated as missing; this produces qualitatively similar results.

3.4.8 CEO compensation

CEO compensation, measured by Total Compensation including option grants, is included as a control variable in this study following Malmendier et al. (2010) and Hirshleifer et al. (2010). The influence of the level of CEO compensation on firm value is ambiguous (Mehran, 1995).

3.4.9 Time and industry

As do Yermack (1995) and Allayannis and Weston (2001), year dummies are included for every year in the sample in order to control for time effects. Besides that, following Yermack (1995) this study uses dummy variables for two-digit SIC industries in order to control for a possible industry effect on firm value.

Besides the control variables explained above two additional independent variables, besides leverage and innovation, are constructed to test the other four hypotheses.

3.4.10 Investment

In order to test Hypothesis 2 (investment), the variable Capital Expenditures normalised by Total Assets, is used as a proxy for investment (Malmendier & Tate, 2005a). Following Malmendier and Tate, Capital Expenditures normalised by beginning of the year Total Property, Plant and Equipment is used as an alternative proxy. The interaction variable of CEO overconfidence and investment is expected to have a positive coefficient as the combined effect of CEO overconfidence and investment is expected to have a positive influence on firm value.

3.4.11 Cost of debt

The cost of debt is approximated by Total Interest and Related Expense divided by the average short and long-term debt during the year[41] (Pittman & Fortin, 2004). Following these authors, this variable is trimmed to address the problem of extreme observations.[42] Hypothesis 4 (cost of debt) indicates a negative effect of CEO overconfidence on the cost of debt, which in turn positively affects firm value. Therefore the coefficient of the interaction variable of CEO overconfidence and cost of debt is expected to be positive, which points to a positive influence on firm value.

[41] As measured by sum of Total Long Term Debt and Total Debt in Current Liabilities.

[42] Observations outside the 5th or 95th percentile in the distribution are regarded as missing. In robustness tests the observations outside the 1st and 99th percentile in the distribution are regarded as missing; the results of these tests are quantitatively similar.

3.5 Sample

The sample in this study consists of all firms included in the ExecuComp database for the years 2006 until 2009, and thus only concerns North American companies. Only data from 2006 onwards is included to make use of the more detailed data on option values available from that year onwards.[43] As this research focuses on the effects of CEO overconfidence, only CEO's are included in the sample and CEO's with missing data on all overconfidence measures are deleted from the sample. Besides that, financial firms (SIC 6000-6999) and regulated utilities (SIC 4900–4999) are excluded from the sample due to their specific nature. Following Hirshleifer et al. (2010) firm years with missing data on the dependent, independent, and control variables are not included. However, if the missing data can be reasonably assumed, this option is chosen.[44] Besides ExecuComp, the Compustat database is used to gather information for the dependent and control variables. The final sample of panel data consists of 1,402 firms, 1,460 CEO's and 5,470 CEO years. For the OC67 measure there are 4,221 observations, for the low versus high overconfidence measure there are 3,451 observations and for the NetBuyer measure there are 4,133 observations.

[43] The variable Estimated Value of In-the-Money Unexercised Exercisable Options is more detailed from 2006 onwards. Before 2006, this variable gives the value of In-the-Money Unvested Options at fiscal year end as reported by the company.
[44] Whether or not missing data is assumed to be zero or treated as missing is mentioned in section 3.2 to 3.4, where each variable is described.

4. Methodology

This section focuses on the methodology used in this study. First of all the data gathering process is described, then the regression specifications and robustness tests are described.

4.1 Data gathering

After the data is gathered from the ExecuComp database, all variables are checked for errors and these are deleted from the data. To address the problem of extreme values all dependent and control variables are winsorised at the 1% level in both tails. Furthermore, the variables included in the regressions should fulfil the conditions of multiple regression. Firstly, variables should not be very highly correlated and thus not show signs of multicollinearity (Keller, 2005). To check for this a correlation matrix is constructed; if two control variables are very highly correlated[45] one of the variables is excluded from the regression equations and is included in the robustness tests instead. Secondly the error term has some required conditions. In order to test for the normality of the error variable a histogram is made of the residuals of the model. Because the standard errors are robust and clustered at the firm level, the problems of heteroscedasticity and autocorrelation are not disturbances that influence the standard errors, and therefore need not to be tested. All statistical tests are performed using the programme Stata, a data analysis programme.

4.2 Regression specification

All variables in the model are either quantitative or dummy variables, and the dependent variable is a continuous variable. Therefore the Ordinary Least Squares (OLS) multiple regression technique is considered to be most useful and is thus applied in this study (Keller, 2005).[46] Furthermore, the Fixed Effects (FE) regression technique is used as a method to alleviate the endogeneity concerns that are discussed in section 6.3 (Allayannis & Weston, 2001; Fang et al., 2009; Malmendier & Tate, 2005a).[47] However, FE regressions are based on the intra firm variation, which could be small in this study as only four years of data are

[45] High correlation is defined as 0.7 or higher (Pallant, 2001).
[46] This method is used in most research relating managerial overconfidence to firm factors (Hirshleifer et al., 2010; Malmendier & Tate, 2005a).
[47] If firm fixed effects are included in a regression specification industry dummies are excluded.

included. Therefore these regressions may prove to not be suitable in this study.[48] The base specification that is tested in this study is as follows:

$$\text{Tobin's } Q_{it} = \beta_0 + \beta_1 OC67_{it} + \beta_2 Year'_{it} + \beta_3 Industry'_{it} + \varepsilon_{it}$$

Where β_0 is the intercept, Year' and Industry' are year and industry dummies, and ε_{it} is the error term. Besides the variable OC67, also NetBuyer is tested using this equation. If the regressions are performed using the low versus high overconfidence measure, Low_OC and High_OC are included in one regression to compare both effects to moderate overconfidence. The coefficient of OC67, Low_OC, High_OC and NetBuyer, is expected to be negative. This base regression is extended with control variables to see if the results still hold. When control variables are added to the base specification the regression model becomes as follows:

$$\text{Tobin's } Q_{it} = \beta_0 + \beta_1 OC67_{it} + \beta_2 \text{Firm size}_{it} + \beta_3 \text{Profitability}_{it} + \beta_4 \text{Innovation}_{it} + \beta_5 \text{Diversification}_{it} + \beta_6 \text{Leverage}_{it} + \beta_7 \text{Cash availability}_{it} + \beta_8 \text{CEO ownership}_{it} + \beta_9 \text{CEO compensation}_{it} + \beta_{10} Year'_{it} + \beta_{11} Industry'_{it} + \varepsilon_{it}$$

The regressions equations stated so far answer Hypothesis 5. The other four hypotheses are tested using different regression equations. These equations all include the independent variable specifically for high overconfidence using the proxies OC67, High_OC or NetBuyer. Also a second independent variable is added to the model; this variable refers to the content of the hypothesis.[49] The variable of interest in these regressions is the interaction variable of CEO overconfidence and the second independent variable. Thus, the general model that is tested is;

$$\text{Tobin's } Q_{it} = \beta_0 + \beta_1 OC67_{it} + \beta_2 \text{Leverage}_{it} + \beta_3 OC67_{it} * \text{Leverage}_{it} + \beta_4 Year'_{it} + \beta_5 Industry'_{it} + \varepsilon_{it}$$

Where Leverage is the independent variable in Hypothesis 1 (leverage), this variable is replaced by; Investment, Innovation and the Cost of debt when Hypothesis 2 (investment), 3 (innovation) and 4 (cost of debt) are examined respectively. This base regression is extended with control variables in the same fashion as for the equation testing Hypothesis 5.

[48] This problem is addressed in the robustness tests section, see section 4.3.
[49] Since interactions are included in the model the coefficients of the CEO overconfidence and second independent variable are difficult to interpret and therefore are not studied.

4.3 Robustness tests

After the regressions are executed some basic robustness tests are performed.[50] To verify the predicted influences of the independent variables on the dependent variable, scatter plots are made of every variable in conjunction with the dependent variable.[51] Furthermore, to test if the results are robust to the use of different proxies for a certain measure, the regression equations are run with the alternative proxies for the different variables. Also, variables for which missing data is assumed zero are altered so that missing data is treated as missing, and it is verified that the results are robust to this classification. Furthermore, it is tested if none of the control variables, including the year and industry fixed effects, are responsible for the results found; therefore, these variables are excluded from the regressions one by one. Besides that it is examined if the extensive use of control variables influences the results; therefore regressions are executed including only the variables firm size, profitability and innovation. Also the variables firm stock returns and CEO turnover are added to the regression equations to examine if this alters the results. Stock return[52] could have an important influence on Tobin's Q, and is therefore added to the regressions. The dummy variable turnover, which takes the value of one if another CEO enters the company the next year and zero otherwise, is added to test if this is not the only driving factor of the results in this study. Furthermore, to acknowledge the concern that the results of FE models are based on only a few observations, Generalised Least Squares (GLS) random effects regressions are executed. These regressions pose fewer demands on the data but also alleviate endogeneity concerns.

Besides these basic robustness tests two other tests are conducted. First of all the regressions of Hirshleifer et al. (2010) are reproduced with the use of the CEO overconfidence measures used in this sample. This gives an indication of the reliability of the CEO overconfidence measures employed in this study. Second of all, tests are conducted in which the variables are lagged with one year with respect to the dependent variable (Hirshleifer et al., 2010). Although there is no specific reason to believe that CEO overconfidence influences Tobin's Q with a lag, it could be that the real effect of CEO overconfidence on Tobin's Q is only present a year later, and therefore this is tested for. Also this test reduces some endogeneity concerns, as discussed in section 6.3.

[50] The results of these tests are mainly mentioned throughout the text in the next section, and are only discussed if they lead to a difference in results.
[51] If the relationship appears to be different than predicted, new regressions are executed to confirm that the general conclusions remain unchanged.
[52] The percentage stock return for a firm is calculated as the increase in the end of the fiscal year stock price divided by last years end of fiscal year stock price.

5. Results

This section provides the results of this study starting with the descriptive statistics, followed by the results from the correlations, regression analyses and robustness tests. The results of the NetBuyer measure are not included in section 5.1 to 5.4 as these pointed out that this measure may not be suitable in this study. Therefore section 5.5 describes the results, and addresses the inconsistency of the NetBuyer measure. The tables including all results can be found from page 59 onwards.

5.1 Descriptive statistics

The descriptive statistics of this study can be found in Table 2.[53] OC67 defines about 50% of CEO years as overconfident[54], and the second CEO overconfidence measure classifies 5%, 48% and 47% of CEO years as having low, moderate and high overconfidence respectively.[55] These percentages are very similar to those found in earlier studies using similar CEO overconfidence measures; this indicates the measures are comparable even with the use of different datasets. For the low versus high CEO overconfidence measure, the percentage of CEO years classified as either Low_OC or High_OC increases throughout the sample period due to its construction;[56] Low_OC increases from 2.7% in 2006 to 10.5% in 2009 and High_OC from 42.6% to 48.1% respectively. Even though OC67 is constructed similarly, the increase in CEO's classified as overconfident over the years is considerably lower. Unfortunately, the number of observations for Low_OC is quite low[57] which could result in insignificant findings for this variable, especially in the regressions including many control variables.

Table 3 provides a first indication of the relationship between CEO overconfidence and Tobin's Q; it shows that firms with overconfident managers, as specified by OC67, have a significantly higher mean and median Q. Furthermore these firms are significantly smaller, more profitable, spend less on innovation, invest more and have CEO's who own a higher percentage of the shares of the firm.[58] If CEO overconfidence is specified by High_OC the results

[53] Of all variables in this study it is verified that the average is similar to the average in other studies.
[54] In the sample of Malmendier and Tate (2005a) and Hirshleifer et al. (2010), 51% and 61% of CEO years is classified as overconfident respectively, using this measure.
[55] Campbell et al. (2010) find percentages of; 9%, 57% and 34% respectively.
[56] The construction of the variables leads to an increased fraction of Low_OC and High_OC classifications over the years since a CEO is classified as having low or high overconfidence as of the first moment he exhibits behaviour that leads to this classification and only alters if the CEO shows signs of the opposite behaviour.
[57] The number of Low_OC classifications is 22 in 2006, 34 in 2007, 47 in 2008 and 79 in 2009.
[58] Hirshleifer et al. (2010) find similar results.

are similar: firms with overconfident CEO's have a significantly higher mean and median Tobin's Q. A different result is that firms with overconfident CEO's are significantly less diversified and that these CEO's have a significantly lower compensation.[59]

5.2 Correlations

First of all, untabulated results point out that multicollinearity is not a problem; pairwise correlation shows that there is no high correlation between any of the variables in the model. In most cases the correlations between the different proxies of the variables are high, indicating that different proxies for one variable measure the same effect.[60]

Table 4 reports pairwise correlations between Tobin's Q and the different CEO overconfidence measures.[61] The correlation between OC67 and High_OC is 0.733, thus indicating that the variables that indicate high CEO overconfidence are indeed very highly related. This is further established by the large overlap in the classification of CEO years for these measures; 46.93% of CEO years are jointly classified as overconfident and 37.88% of CEO years are jointly classified as non overconfident for these measures.[62] Table 4 provides a second indication of the relationship between CEO overconfidence and firm value as measured by Tobin's Q. The correlation between both OC67 or High_OC and Tobin's Q indicates a positive relationship between CEO overconfidence and Tobin's Q, and Low_OC indicates a negative relationship between low CEO overconfidence and Tobin's Q. However in all cases the correlations cannot be considered as high.

5.3 Regression results

The result of the OLS regressions can be found in Table 5; the first three specifications include no other control variables than year and industry fixed effects. In these specifications both OC67 and High_OC have a positive and significant coefficient, whereas Low_OC has a significantly negative coefficient. These findings provide support for the first part of Hypothesis 5; low CEO overconfidence has a negative influence on Tobin's Q in comparison to moderate CEO overconfidence. However, these findings do not provide support for the second part of Hypothesis 5. On the contrary, the results indicate that high CEO

[59] Leverage is also lower, but this difference is not very significant. This finding differs from the expectation based on the literature review and on the evidence found by Ben-David et al. (2007), but it is similar to what Hirshleifer et al. (2010) find.
[60] Therefore all second or third proxies are only included in robustness tests.
[61] The correlations of OC67, Low_OC and High_OC are all significant and remain so also after performing the Sidak test.
[62] This only concerns CEO years with non missing data for both variables.

overconfidence has a positive influence on Tobin's Q compared to moderate CEO overconfidence. Regressions four to six of Table 5 include all control variables and thus test whether the effect of CEO overconfidence on Tobin's Q holds after controlling for factors that are known to influence Tobin's Q. Adding control variables to the specification does not significantly alter the results of the simple OLS regression. The coefficient of OC67 is still positive and significant, and this effect is also economically significant: CEO overconfidence increases Tobin's Q from its base level by about 21.52%.[63] The High_OC measure is also consistent: high CEO overconfidence still has a positive and significant influence on Tobin's Q in comparison to moderate CEO overconfidence. This effect is also economically significant: CEO overconfidence increases Tobin's Q from its base level by 17.58%.[64] In contrast to earlier results, Low_OC has a positive although insignificant coefficient, which would indicate low CEO overconfidence positively influences Tobin's Q. The economic effect of low CEO overconfidence is not very significant: it increases Tobin's Q from its base level by only 0.72%.[65] The reason for this change in sign and for the fact that Low_OC is either only just significant or not at all, is in line with the expressed concern that there are too little observations to be able to make inferences about this measure. This variable becomes insignificant especially when more variables are added to the regression, which reduces the number of observations due to the exclusion of cases with missing observations. This means that it is very difficult to provide sound evidence on this measure in this study. The difference in coefficients between Low_OC and High_OC is significant[66], which indicates that high CEO overconfidence has a more positive influence on Tobin's Q than low CEO overconfidence.

The control variables in the regression specification all have the predicted signs.[67] Size has a significantly negative influence on Tobin's Q, and both profitability and innovation[68] have a significantly positive influence on Tobin's Q. Diversification has a negative coefficient; in this sample being a diversified company negatively influences Tobin's Q. Leverage has a significantly negative

[63] Calculated as the ratio of the coefficient 0.314, to the median Q of non overconfident CEO's in Panel A of Table 3, following Hirshleifer et al. (2010).
[64] Calculated as the ratio of the coefficient 0.270 to the median Q of non overconfident CEO's in Panel B of Table 3 , following Hirshleifer et al. (2010).
[65] Calculated as the ratio of the coefficient 0.014, to the median Q of non Low_OC CEO's of 1.937, following Hirshleifer et al. (2010).
[66] As indicated by a Wald test.
[67] Furthermore, the inclusion of different proxies for the control variables does not alter most results regarding CEO overconfidence, or regarding the effect the control variable has on Tobin's Q.
[68] When capital expenditures divided by sales is included as the measure of innovation, the coefficient becomes negative but insignificant, and when advertising divided by sales is included the coefficient is positive but again insignificant.

influence on Tobin's Q in all but one regression.[69] Cash availability does not have a consistent effect on Tobin's Q; in some regressions it has a negative coefficient, in others a positive coefficient. But in none of the regressions this variable is significant. Share ownership does not seem to have an important influence on Tobin's Q; the coefficient is almost zero and not significant. CEO compensation has a coefficient of almost zero, but this slightly positive coefficient is significant. As can be seen in Table 5 the R^2 of the different models including control variables lies around 0.50, this can be considered as an indication that the models fit the data well.[70]

FE regressions are reported in Table 6. This table shows that the CEO overconfidence measures OC67 and High_OC are robust to the inclusion of firm fixed effects: the coefficients are positive and significant independent of the inclusion of control variables. The coefficient for Low_OC is positive and significant in FE regressions, which indicates that low CEO overconfidence would increase Tobin's Q. This confirms the finding of the OLS regression including control variables; furthermore, these results are significant now. However, because there are very little observations for this variable one should be cautious to interpret the findings of especially FE regressions.[71] Furthermore, section 5.4 further questions the robustness of these results. Still the coefficients for Low_OC and High_OC are significantly different from each other which implies that high CEO overconfidence has a significantly more positive influence on Tobin's Q than low CEO overconfidence. All control variables remain to have the same influence on Tobin's Q as in the OLS regressions. Only cash availability now has a significantly positive influence on firm value, instead of the inconsistent effect found earlier. Moreover the R^2 of the models is greatly improved to about 0.86 due to the inclusion of firm fixed effects.

All in all, Table 5 and 6 indicate that both OC67 and High_OC are robust measures of CEO overconfidence that point to a positive influence of CEO overconfidence on Tobin's Q. Thereby they provide evidence in favour of rejecting the second part of Hypothesis 5. Moreover, FE regressions show that both CEO overconfidence variables are not determined by an unobserved constant firm factor. Unfortunately, it is difficult to provide evidence either in favour of accepting or rejecting the first part of Hypothesis 5, because the low CEO overconfidence measure is not consistent across regressions.

[69] When the alternative proxy for leverage is included the result is that leverage increases firm value, instead of decreasing it, but this coefficient is insignificant.
[70] This is comparable to other studies that focus on Tobin's Q. Yermack (1995) finds an R^2 of 0.55 for his OLS regressions and Allayannis and Weston (2001) find one of 0.73.
[71] To check the findings of FE regressions, GLS regressions are executed. These random effects regressions confirm the results of the OLS regression and do not find a significantly positive coefficient for Low_OC.

The results of the regressions executed to answer Hypothesis 1 (leverage) can be found in Table 7. The results in this table provide support for the hypothesis and indicate that leverage in conjunction with CEO overconfidence has a negative influence on Tobin's Q. For both OC67 and High_OC the coefficient of the interaction variable is negative and significant, independent of the inclusion of control variables.[72] The results found are also economically significant: if the CEO is overconfident, an increase in leverage of one standard deviation decreases Tobin's Q with 0.134, where for a non overconfident CEO this decrease is 0.025.[73] Hence, an increase in leverage of one standard deviation decreases Tobin's Q for firms with overconfident CEO's with 5.89% more than for firms with non overconfident CEO's.[74] The results of the untabulated FE model are similar with the only difference that the coefficient of the interaction of High_OC and leverage is not significant. Altogether, there is more evidence in favour of accepting Hypothesis 1 than of rejecting it.

Table 8 displays the results of the regressions executed to answer Hypothesis 2 (investment). The interaction coefficient of CEO overconfidence and investment indicates a negative and significant influence of CEO overconfidence in conjunction with investment on Tobin's Q, both for OC67 and High_OC. However, when control variables are included in the specification this negative coefficient of the interaction term is not significant. The economic effect is small: if the CEO is overconfident, an increase in investment of one standard deviation decreases Tobin's Q with 0.054, where for a non overconfident CEO this decrease is 0.045.[75] Hence, an increase in investment of one standard deviation decreases firm value for firms with overconfident CEO's with only 0.48% more than for firms with non overconfident CEO's.[76] In untabulated FE regressions the coefficient of the interaction variable of OC67 and investment indicates a positive combined effect of CEO overconfidence and investment on Tobin's Q, however this is not significant. The coefficient of the interaction of High_OC and investment is negative and significant, thereby confirming the results of the OLS regression. Using the alternative proxy for investment does not provide consistent results; none of the interaction coefficients are significant, and for the interaction of OC67 and investment the coefficient is positive, which is inconsistent with above results. Therefore, based on the alternative proxy it is difficult to provide consistent evidence for Hypothesis 2 (investment). However, the alternative proxy does not provide significant results to contradict earlier

[72] These results are also robust to the use of the alternative measure of leverage.
[73] Calculated using regression model five in Table 7.
[74] Calculated using the overall mean Tobin's Q of 1.849.
[75] Calculated using regression model five in Table 8.
[76] Calculated using the overall mean Tobin's Q of 1.849.

inferences. All in all, even though not all results is consistent, there is more evidence in favour of rejecting Hypothesis 2 than of accepting it; it seems that the interaction of CEO overconfidence and investment negatively influences Tobin's Q.

Table 9 shows the results of the regressions executed to answer Hypothesis 3 (innovation). The coefficient of the interaction of CEO overconfidence and innovation is positive in all specifications but only significant for OC67 excluding control variables, and for High_OC including control variables.[77] Even though the results are not always significant they do provide evidence to support Hypothesis 3; the interaction of CEO overconfidence and innovation positively influences firm value as measured by Tobin's Q. Economically these findings are significant: if the CEO is overconfident, increasing innovation with one standard deviation increases Tobin's Q with 0.412, where for a non overconfident CEO this increase is 0.274.[78] Hence, an increase in innovation of one standard deviation increases firm value for firms with overconfident CEO's with 7.46% more than for firms with non overconfident CEO's.[79] Untabulated FE models confirm the results of the OLS regressions, however only the coefficient of interaction of OC67 and innovation is significant.[80] Altogether, even though not all results are significant they do provide more evidence in favour of accepting Hypothesis 3.

The results of Hypothesis 4 (cost of debt) can be found in Table 10. The regressions indicate that the interaction of overconfidence and the cost of debt positively influences Tobin's Q. The coefficients of the interaction terms with OC67 or High_OC and the cost of debt are positive independent of the inclusion of control variables, but only the coefficient of interaction of High_OC and the cost of debt is significant. The effects found are economically significant: if the CEO is overconfident, increasing the cost of debt with one standard deviation increases Tobin's Q with 0.084, where for a non overconfident CEO Tobin's Q decreases with 0.034.[81] Thus an increase in the cost of debt of one standard deviation increases firm value for firms with overconfident CEO's with 6.38% in comparison to the decrease for firms with non overconfident CEO's.[82] Untabulated FE models confirm these findings although the results are not

[77] Using the alternative measures of innovation does not alter the main results of this hypothesis.
[78] Calculated using regression model five in Table 9.
[79] Calculated using the overall mean Tobin's Q of 1.849.
[80] Since FE regressions can be demanding on the data this finding is not worrying. The regressions executed with the use of the GLS models indicate positive and significant coefficients for all interaction coefficients.
[81] Calculated using regression model five in Table 10.
[82] Calculated using the overall mean Tobin's Q of 1.849.

significant.[83] All in all, even though OC67 is never significant, the results provide evidence to support Hypothesis 4; the interaction of CEO overconfidence and the cost of debt positively influences Tobin's Q.

5.4 Robustness tests

Firstly the requirements of the error variable are checked: the error variable appears to be normally distributed. Furthermore scatter plots are constructed of all independent and control variables in conjunction with the dependent variable. In general all scatter plots indicate a linear relation; there are no clear patterns that indicate another form of relation should be tested for.

Secondly the regressions of Hirshleifer et al. (2010), where the dependent variables are Tobin's Q, log(sales), return on assets, and innovation respectively, are reproduced using the different measures of CEO overconfidence used in this study.[84] Both the OC67 and High_OC measure confirm the findings of these authors, even though this study includes more control variables. Hence, this study extends the study of Hirshleifer et al. by providing more evidence to the notion that CEO overconfidence has a positive influence on a firm. Furthermore, the tests ensure that these measures are valid in this dataset as they confirm the findings of established research.

Thirdly robustness tests are executed for the variable Low_OC in order to explain the inconsistent effect this variable has on Tobin's Q. First of all year fixed effects are excluded from the regression equation because these effects are believed to have an influence on especially the Low_OC and High_OC measures.[85] The variable OC67 are not sensitive to the inclusion of year fixed effects and neither is High_OC. However, Low_OC is sensitive to the inclusion of year fixed effects. If these effects are excluded the coefficient of Low_OC is always negative, and significant in most cases. This provides evidence in favour of the first part of Hypothesis 5. Furthermore, untabulated results show that the Low_OC measure is sensitive to the inclusion of the variable diversification; if this variable is excluded Low_OC is negative in all OLS regressions. Theoretically this result is difficult to explain, however in this dataset there is a reasonable explanation for this finding. The variable diversification has a large amount of missing values, thus when this variable is included the already low number of observations for Low_OC decreases even further. This again indicates that the

[83] Since FE regressions can be demanding on the data this finding is not worrying. The GLS regressions do indicate significant coefficients for the interaction of High_OC and the cost of debt, and indicate almost significant coefficients for the interaction of OC67 and the cost of debt.
[84] Return on assets is measured by operating income before depreciation divided by total assets, and innovation by research and development expense divided by total assets.
[85] Because of its construction year fixed effects may influence the conclusions of this measure as discussed in section 5.1.

Low_OC measure is not very robust, and as stated before, makes it difficult to base any inferences on this variable. However, both results do indicate that more evidence is provided in favour of the first part of Hypothesis 5 then against it.

In another series of untabulated robustness tests the independent and control variables are lagged with one period with respect to the dependent variable.[86] This could alleviate some endogeneity concerns, such as the concern that reverse causality is responsible for the results found; this is further discussed in section 6. The results of the OLS model remain largely unchanged even after the independent and control variables are lagged with one year.[87] The only difference is that the explanatory power of the models is decreased significantly to an R^2 of 0.41. This implies that the variables in the models have a direct effect on Tobin's Q, and that the lagged effect is less important. The results of the FE model are less consistent; none of the CEO overconfidence variables is significant, and in some cases the sign of the coefficient is different than in the regressions without lagged variables. This is probably a result of the decreased number of observations due to lagging the variables and thus the lower intra firm variation; this makes FE regressions very sensitive to a few observations. To test this possibility, a GLS random effects regression is run. The results of these regressions confirm the findings of the OLS model including lagged variables. All in all, the results of the regressions with lagged variables indicate that CEO overconfidence mainly influences Tobin's Q in the same period, however, one period later overconfidence still has a positive, although less significant influence.[88]

As section 4.3 stated, it is examined if one of the control variables is responsible for the found results. None of the control variables proves to be the driving factor behind the results in this study. Furthermore, using different proxies of these variables also does not influence the main results. Moreover, using only firm size, profitability and innovation as control variables does not alter the results of any of the regressions. This shows that the extensive control variables used in this study do not account for the influences reported.

As indicated in section 4.3, the variable percentage stock returns, is included in all regression equations. This variable is positive and significant in most regression equations, but does not alter the coefficients of the other variables. Only in the case of Low_OC this variable has an influence; in the OLS regression including control variables the effect of Low_OC is negative and insignificant whereas it had a positive and insignificant effect before. Moreover, a

[86] Although the main focus of these tests is on Hypothesis 5, robustness tests point out that the results of the other four hypotheses do not alter significantly if lagged variables are included.
[87] Also if only the independent variables are lagged and the control variables are not, the conclusions remain unchanged.
[88] The economic significance is also smaller.

turnover dummy is included in different regression specifications. This turnover dummy is not significant in the regression models and does not alter any of the results.

5.5 NetBuyer

Even though it is not the main interest of this study to focus on the robustness of a CEO overconfidence measure, the results point to an inconsistency of one of the proposed measures of this study. To examine why this inconsistency arises and whether it could be a problem for other studies, this section elaborates on the possible alternative explanations for the NetBuyer measure.

The NetBuyer measure classifies 59% of CEO years as overconfident in this study.[89] The first indication that NetBuyer is inconsistent with the other CEO overconfidence measures can be found in Table 3; firms with CEO's who are identified as overconfident have a significantly lower mean and median Tobin's Q instead of a significantly higher mean an median Q.[90] Also the firms of these CEO's are larger, more diversified, have higher leverage, more cash available, and lower investment than firms with non overconfident CEO's. Again, this conflicts with the findings of OC67 and High_OC. Moreover, overconfident CEO's own a significantly lower percentage of the firm's shares and receive significantly more compensation than non overconfident CEO's. This last result is especially worrying; an overconfident manager, who expects the company to do better than can be expected in reality, should be more willing to receive performance sensitive compensation (Ben-David et al., 2007; Hirshleifer et al., 2010). This could indicate that the NetBuyer measure is not measuring overconfidence but another variable that leads to an increase in the amount of shares the CEO owns.

A second indication that the NetBuyer measure may not actually measure CEO overconfidence can be found in Table 4; the correlation between the NetBuyer and OC67 or High_OC measure is slightly negative.[91] This implies that the CEO overconfidence measures do not indicate the same effect, otherwise correlation would be positive. Malmendier and Tate (2005a) find a correlation of 0.06 between their "Net Buyer" and "Holder 67" measures; thus it is very plausible that either the NetBuyer or the OC67 and low versus high

[89] This is similar to the 61% Malmendier and Tate find with their NetBuyer measure (2005a).
[90] It could be that the other CEO overconfidence measures specify overconfidence in an erroneous manner. However especially the NetBuyer measure seems prone to measure something else than CEO overconfidence in this study. This is the case because its construction is very different from the construction in earlier papers, which is explained at the end of this section.
[91] This finding is not significant when the significance levels are Sidak adjusted.

overconfidence measure is not suitable in this particular sample, while they were in the sample of Malmendier and Tate. Also, only 31.84% of CEO years are jointly classified as overconfident using the OC67 and NetBuyer measure while 29.26% of CEO years are classified as overconfident using the NetBuyer measure but not using the OC67 measure, and 21.63% of CEO years are classified as overconfident using the OC67 measure, but not using the NetBuyer measure. This lack of overlap suggests that one of the measures does not measure CEO overconfidence: otherwise more overlap would be expected. Furthermore, this table implies that NetBuyer has a negative influence on Tobin's Q, as the correlation is negative, which is contrary to the results of OC67 and High_OC.

Also the reproduced regressions of Hirshleifer et al. (2010) discussed in section 5.4, are executed using the NetBuyer measure. NetBuyer is not significant in any of the regressions and has the opposite sign of what these authors find with their CEO overconfidence measure. Thus the NetBuyer measure contradicts the results of these authors; this provides more conclusive support on the earlier inference that with the use of the data in this study the NetBuyer measures does not lead to a correct classification of CEO overconfidence.

The main indication that NetBuyer is significantly different from the other CEO overconfidence measures in this study is given by the results of the regressions. In almost all equations NetBuyer indicates the opposite effect from what the other CEO overconfidence measures indicate. However, if all measures indeed measure CEO overconfidence this could not be the case. Table 5 indicates that NetBuyer has a negative and significant influence on Tobin's Q instead of the significantly positive influence the other CEO overconfidence measures indicate. But if control variables are added to the regression this negative influence is not significant anymore. Also the economic significance is low; CEO overconfidence decreases Tobin's Q from its base level only by 1.45%.[92] However in FE regressions the coefficient of NetBuyer is positive but only significant when control variables are added to the specification, which is consistent with the results of the other CEO overconfidence measures. This indicates that NetBuyer may be both measuring a firm effect and CEO overconfidence. And when this firm effect is controlled for, NetBuyer only measures CEO overconfidence, and is indeed consistent with the other CEO overconfidence measures. For Hypothesis 1 (leverage) the NetBuyer measure again provides results contradicting the other CEO overconfidence measures: the interaction variable of NetBuyer and leverage has a positive and significant coefficient, which provides evidence to reject Hypothesis 1 instead of accepting it. Also in FE regressions the interaction of NetBuyer and leverage is positive, although not significant. For Hypothesis 2

[92] Calculated as the ratio of the coefficient -0.023, to the median Q of non overconfident CEO's in Panel C of Table 3.

(investment) the coefficient of the interaction variable of NetBuyer and investment is negative in all cases. The FE regressions confirm this, but here the coefficient is always insignificant. Only for this hypothesis the result is consistent with the OC67 and High_OC measure. For Hypothesis 3 (innovation) NetBuyer indicates a positive but insignificant interaction between CEO overconfidence and innovation, which is consistent with the other CEO overconfidence measures. However, in untabulated FE regressions the interaction coefficient is negative and insignificant. Also for Hypothesis 4 (cost of debt) the NetBuyer measure implies a different effect: the coefficient of the interaction term for this variable is negative instead of positive, although insignificant in both the OLS and FE regressions.

The different robustness tests executed in section 5.4 are also executed for the NetBuyer measure. Including the alternative NetBuyer measure does not alter the results, and neither does any of the other tests.

Malmendier and Tate (2005a), who first employed the overconfidence classification based on the share buying behaviour of CEO's, were able to provide consistent results using the NetBuyer measure. Moreover, these results were consistent with regards to their other CEO overconfidence measures. However in this study the NetBuyer measure does not provide consistent results. This could very well be due to the fact that the construction of the NetBuyer measure in this study is quite different than in the study of Malmendier and Tate due to differences in the datasets. Therefore it is not possible to construct the exact same measure; only the idea of these authors is used to construct a similar measure. There are several reasons why it is not possible to construct the same measure as Malmendier and Tate with the use of the dataset in this study.

The sample of these authors contains five years of data on the "Net Buyer" measure, and fifteen years of data in total. This study consists of at most three years of data on the NetBuyer measure, and four years of data in total. This difference is important as the NetBuyer measure is based on the idea that the CEO is a net buyer of company's shares for more than 50% of years in the sample; therefore the amount of years included in the sample could lead to differences in classification.[93]

More importantly, in the paper of Malmendier and Tate (2005a) a CEO is classified as overconfident if he is a net buyer of the shares of the firm during the first five years of their sample. These first five years are then excluded from the regression specifications; the regressions include only the years after which the CEO is classified as overconfident. Malmendier and Tate use this feature to explain that the possible alternative explanations for this measure can not be

[93] This is not a problem for the option based measures since here it is only important that the CEO exhibits the behaviour once.

correct. Specifically, these authors explain that NetBuyer can not measure inside information instead of CEO overconfidence because overconfidence is persistent and inside information is transitory.[94] Because CEO overconfidence is measured five years before the dependent variable is measured, CEO overconfidence still affects the dependent variable in a disjoint future time period, which indicates it is a persistent variable. If inside information would be the explaining factor there would not be an influence five years later as it is a transitory variable. This study however, includes the years in which the CEO is classified as overconfident in the regression models; therefore it may be that a transitory effect is measured and that the results could be explained by inside information.[95] It does seem counterintuitive that positive inside information, which leads to the CEO buying additional shares of the company, negatively influences Tobin's Q as indicated by the regressions. However, this is not necessarily the case: although the share price is expected to go up due to the presence of positive inside information, Tobin's Q may go down due to the influence of the other variables that it is comprised of. Therefore, the share price should be examined. Another difference between inside information and CEO overconfidence is performance. If inside information is the reason behind buying shares, the share return of CEO's who are classified as overconfident is expected to be higher. Thus to examine if inside information could indeed be an alternative explanation for the NetBuyer measure, the percentage stock returns of the firms are examined. For overconfident CEO's classified by NetBuyer the mean percentage return of the shares of the firm is 33.74%, while for non overconfident CEO's this is 9.40%. For CEO's classified by OC67 these percentages are 6.31% and 7.48% respectively, and for CEO's classified by High_OC these percentages are 7.89%, and 2.99% respectively.[96] Even though the differences between the means of these groups are not significant, it does indicate that CEO's classified as overconfident with the use of the NetBuyer measure run firms that have a much higher percentage share returns. In the case of OC67 the opposite is true, and for High_OC the difference between overconfident and non overconfident CEO's is much smaller. This could indicate that it is in fact inside information that leads the NetBuyer measure to classify a CEO as overconfident instead of actual overconfidence. Even though this study is unable to provide conclusive evidence,

[94] Overconfidence is seen as persistent because it is a behavioural trait; see section 3.2.1.
[95] For the measures based on the option exercise behaviour of a CEO this is not a problem as these are exactly the same as the measures of Hirshleifer et al. (2010). These authors explain that these concerns are not an issue for these measures. The paper of Hirshleifer et al. includes a more thorough discussion of the matter.
[96] The differences between the means of the groups are not significant as indicated by Wilcoxon rank-sum tests. The total percentage return of the firm's stock differs per measure, as each measure utilises different observations in the dataset. However this difference does not alter the main intuition that there is a distinct difference in percentage stock returns for overconfident and non overconfident CEO's.

these results do indicate that inside information is an important concern for the NetBuyer measure if it is constructed in a same manner as in this study.

Besides inside information, signaling could be another alternative explanation for the NetBuyer measure. Signaling is a method to reduce information asymmetries between firms and the market by conveying a signal to the market that the prospects of the firm are better than the prospect of other firms (Malmendier & Tate, 2005a). Thus, the aspired effect of signaling is to increase the stock price of the firm. Malmendier and Tate (2005a) state that the use of two disjoint time periods, one to measure CEO overconfidence, and one to measure its effects, is specifically implemented to eliminate the influence of signaling. Thereby they acknowledge this is an important threat for the robustness of the measure. Because it is not possible in this study to use two disjoint time periods, signaling could be an alternative explanation for the NetBuyer measure. However, if signaling is driving the NetBuyer measure, it is counterintuitive that Tobin's Q would decrease, which the regressions indicate, because Tobin's Q is to a large extent determined by the share price of the firm. But as stated before, Tobin's Q is determined by more factors than only the share price. Therefore it is the share price of the firm that should be examined. And as was shown for the case of inside information, the return of firms with CEO's who buy additional company shares, and thus possibly signal their better prospects to the market, is higher. Again, this is not conclusive evidence, but it does indicate that signaling is a valid concern and that this may be driving the classification of the NetBuyer measure.

Another alternative explanation for the reason why CEO's buy shares that does not indicate overconfidence could be that some firms simply encourage CEO's to buy shares more than other firms, and that these firms have another characteristic in common that negatively influences Tobin's Q. It could thus be that NetBuyer measures both a firm characteristic and a CEO characteristic. This alternative explanation would explain why in FE regressions NetBuyer has a positive influence on Tobin's Q and is thus consistent with the other CEO overconfidence measures; because firm factors are absorbed in this regression specification.[97] However, since the sample includes a limited number of years, and hence does not have a lot of CEO variation per firm, it is difficult to determine whether a only a CEO characteristic is being indicated by the NetBuyer measure.

All in all, the sample in this study does not have the same as merits the sample of Malmendier and Tate (2005a), which leads to inconsistencies of the

[97] Since in case of the other CEO overconfidence measures the OLS specification is consistent with the FE specification this is not a concern for these measures.

NetBuyer measure. While the OC67 and High_OC measures are exactly constructed as in earlier studies that thoroughly explain why alternative explanations are not an issue, for the NetBuyer measure this is not the case. Even though it is very difficult to provide conclusive evidence that one of the above mentioned alternative explanations accounts for the contradictory findings of this measure, it is shown that there are some troubling questions about the suitability of this measure for this kind of sample, and thus to the applicability of the NetBuyer measure in other studies. Because the NetBuyer measure very probably does not classify CEO overconfidence correctly in this study, the robustness of the results of this study should not be questioned because of the inconsistent findings of this measure.

6. Conclusion and discussion

6.1 Summary and conclusion

The goal of this study is to describe the relation between CEO overconfidence and firm value. Therefore the research question of this study is: What is the influence of CEO overconfidence on firm value? CEO overconfidence in particular is studied as especially CEO's are prone to possess this behavioural trait. The study starts with an overview of how CEO overconfidence can be defined. In this study CEO miscalibration and optimism are addressed with the use of one proxy and are jointly defined as: an overestimation in one's own abilities and knowledge and the ability to positively impact the firms' undertakings, which leads to an overestimation of the mean of the firms' future profitability and an underestimation of the risks the firm faces. This study is comprised of two parts: the first part describes the relevant literature on all aspects of CEO overconfidence and corporate decisions and integrates this into one framework, and the second part consists of an empirical research of the predictions of the literature review section.

The first part of this study indicated several effects. Firstly, CEO overconfidence is expected to have a positive influence on leverage. This effect in turn would lead to a suboptimal level of leverage and higher costs of financial distress, which influences firm value negatively. This is the main intuition of Hypothesis 1 (leverage). Secondly, many studies indicate that CEO overconfidence influences investment; it induces overinvestment, but also investment-cash flow sensitivity which tempers this overinvestment. Furthermore, in the case of risk averse managers it could move investment to its optimal level. Because many studies point to different effects, the influence of the interaction of CEO overconfidence and investment on firm value is ambiguous. To test this effect, Hypothesis 2 (investment), which states that the interaction of CEO overconfidence and investment has a positive influence on firm value, is examined. Thirdly, most authors agree that CEO overconfidence has a positive effect on effort, innovation and motivation, which is partly tested with the use of Hypothesis 3 (innovation), which focuses on the combined influence of CEO overconfidence and innovation on firm value. Fourthly, CEO overconfidence is thought to lead to a more favourable policy towards bondholders, which decreases the cost of debt, increases the external capital capacity, and thus would positively affect firm value. Hypothesis 4 (cost of debt) tests this inference. Overall, current literature on this topic has not reached a consensus on what the expected influence of CEO overconfidence on firm value is. However, most authors believe that moderate levels of CEO overconfidence

are good for a firm, and regard this as an optimum. This leads to the last hypothesis of this study. Hypothesis 5: Low CEO overconfidence and high CEO overconfidence influence firm value negatively compared to moderate CEO overconfidence. All five hypotheses give an insight into the relation between CEO overconfidence and firm value and together are able to answer the research question of this study.

The measures of CEO overconfidence used in this study are based on the idea that CEO's are underdiversified, and that risk averse CEO's should want to reduce this underdiversification (Malmendier & Tate, 2005a). However, overconfident CEO's should not want to reduce this underdiversification because of their biased beliefs. Following Hirshleifer et al. (2010) the OC67 measure is created, which classifies a CEO as overconfident as of the first moment he holds firm options that are more than 67% in the money. A second measure is created following Campbell et al. (2010) which makes the distinction between low and high CEO overconfidence also based on the option exercise behaviour of CEO's. A CEO is defined as having low overconfidence (Low_OC) if he exercises options that are less than 30% in the money and does not hold options that are more than 30% in the money. A CEO is classified as having high overconfidence (High_OC) if he holds options that are more than 100% in the money. In this study firm value is measured by Tobin's Q, based on the papers by Malmendier and Tate and Chung and Pruitt (1994). Furthermore, a number of control variables are added to the model to ensure the results are robust to the inclusion of these factors.

The empirical section of this study leads to the following conclusions. First of all, both OC67 and High_OC are shown to have a positive and highly significant influence on Tobin's Q in all regression specifications, including the FE regressions. These measures indicate high CEO overconfidence and thereby provide evidence in favour of rejecting the second part of Hypothesis 5; high CEO overconfidence decreases firm value in comparison to moderate CEO overconfidence. The fact that more evidence is found to reject the second part of Hypothesis 5 means that high CEO overconfidence increases firm value, which implies that moderate CEO overconfidence is not the optimal level of CEO overconfidence. This is not in accordance with the predictions of most theoretical studies and therefore sheds a new light on the influence of managerial biases on a firm.[98] The results are also economically significant; in regressions including control variables CEO overconfidence increases Tobin's Q from its base level by 17.57% to 30.40% depending on which overconfidence measure and which

[98] The results in this study are consistent with the results of Hirshleifer et al. (2010), who also find that managerial biases have a positive influence on firm value.

regression model is used.[99] Unfortunately this study is unable to provide consistent evidence for the Low_OC measure; in some cases the coefficient of this measure is negative, in some cases positive. Most probably this is due to the low amount of observations of this measure. Also this measure is very sensitive to year fixed effects, which is due to the little amount of observations and high variation in low CEO overconfidence percentages over the years. When year fixed effects or variables with little observations are excluded, the Low_OC measure provides more evidence in favour of accepting the first part of Hypothesis 5 than of rejecting it. However the influence of low CEO overconfidence on Tobin's Q remains difficult to interpret in this study. The question in which manner CEO overconfidence influences firm value is answered by the other four hypotheses. First of all, most results in this study find evidence to support Hypothesis 1: the interaction of CEO overconfidence and leverage negatively affects firm value as measured by Tobin's Q. Hypothesis 2 leads to somewhat mixed results, however more results provide evidence to reject the hypothesis than to accept it. Therefore it is most probable that the interaction of CEO overconfidence and investment negatively influences Tobin's Q. The results in this study provide evidence in favour of Hypothesis 3: in all regressions the interaction of CEO overconfidence and innovation has a positive influence on firm value as measured by Tobin's Q, although it is not always significant. The same is true for Hypothesis 4: all results point to a positive influence of the interaction of CEO overconfidence and the cost of debt on firm value. However these findings are insignificant in most cases.

Besides the OC67 and High_OC measures of CEO overconfidence, a third measure is employed in this study: the NetBuyer measure. Here a CEO is classified as overconfident if he is a net buyer of the company's shares in more years than he is a net seller. However, due to the specific data in this study the NetBuyer measure results in inconsistencies. Since NetBuyer is specified differently than in earlier studies, certain alternative explanations could be driving the classification of the NetBuyer measure. Indeed it is shown that both inside information and signaling could be valid alternative explanations. Even though it is very difficult to provide conclusive evidence that one of these alternative explanations accounts for the contradictory findings of this measure, it is shown that there are some troubling questions about the suitability of this measure for this kind of sample, and thus to the applicability of the NetBuyer measure in other studies.

To conclude this study the research question should be answered: What is the influence of CEO overconfidence on firm value? This study shows that high

[99] The base level is the median Tobin's Q for firms with non overconfident managers as defined by either OC67 or High_OC and is 1.459 or 1.536 respectively.

CEO overconfidence has a positive influence, more so than moderate CEO overconfidence, on firm value as measured by Tobin's Q. This positive influence is due to greater innovation and a decreased cost of debt, and despite the influence of CEO overconfidence on leverage and investment levels, which both become suboptimal.

6.2 Implications

The results of this study have several implications. First of all this study suggests another reason for the question raised by most theoretical research why many firms employ overconfident CEO's (Ben-David et al., 2007; Graham, Harvey, & Puri, 2009). Whereas Hirshleifer et al. (2010), who also suggest a solution for this puzzle focus on innovation, this study shows that CEO overconfidence exerts a positive influence in more areas than only innovation. Second of all, high CEO overconfidence is shown to have a positive influence on firm value as measured by Tobin's Q. This implies that firms could increase their value by hiring overconfident CEO's who can make decisions that benefit the firm. Therefore the hiring process should be biased towards hiring overconfident CEO's. Besides that, the monitoring of overconfident CEO's could be adjusted. If it is established within a firm that the CEO is overconfident, more monitoring should be directed towards leverage and investment decisions and less monitoring towards innovation decisions. This could lead to more optimal monitoring.

6.3 Limitations and recommendations for future research

One of the limitations of this study is the endogeneity concerns. As Malmendier and Tate (2005a) and Hirshleifer et al. (2010) state in their papers, there is the issue of endogeneity in the selection of CEO's. If CEO's are selected on overconfidence indirect or directly, CEO overconfidence is not an exogenous variable, which is assumed in the regression methods used in this study. However, both authors state the use of different control variables like size, industry, and profitability alleviates these concerns. Besides that, the fact that overconfident CEO's are explicitly selected does not necessarily change the results; the difference in CEO overconfidence levels still leads to differences in Tobin's Q. Another endogeneity concern is the presence of unobserved firm characteristics that may affect both CEO overconfidence and Tobin's Q. This could imply that there is an unobserved factor that leads to the observed relationship between CEO overconfidence and firm value, instead of an actual relationship between these two variables. However, this concern is alleviated by

using FE models, where unobserved firm characteristics are controlled for. Furthermore, these concerns are alleviated by including the control variables mentioned earlier.

Graham et al. (2009) point to another limitation of overconfidence studies: the direction of causality. It could be that CEO's that are overconfident choose to work at companies with a high Tobin's Q, or that firms with a high Tobin's Q always select overconfident CEO's, or that a high Tobin's Q increases overconfidence for the CEO's of these firms. All three effects would lead to a positive relation between the CEO overconfidence measure and Tobin's Q; however all three cases imply that it is in fact Tobin's Q that influences the classification of CEO overconfidence. This study is unable to fully alleviate these concerns. However, with the use of lagged variables it is shown that CEO overconfidence measured a year before the measurement of Tobin's Q, and therefore unaffected by this variable, also has a positive influence on Tobin's Q. This partly alleviates these concerns, as does the use of control variables. However, to further alleviate these concerns a recommendation for future research is to use an event study methodology to research the influence CEO overconfidence has on firm value. This type of methodology is able to show, with more certainty, a causal direction between the two variables. Another recommendation to address the possibility that Tobin's Q and CEO overconfidence influence each other simultaneously is to treat both variables as endogenous and use a simultaneous equation model to research this. Ye and Yuan (2008) use this methodology but limit themselves to the Chinese market and only focus on investment, therefore their paper could be extended by the variables used in this study.

Also the dataset itself has limitations. The dataset only contains four years of data which is very limited. This lack of data prevented this study from using an event study methodology, and prevented the use of some extended robustness tests.[100] Besides that, a problem for especially FE models is that a few observations could account for the results found as there is little intra firm variation. This could explain why in FE regressions especially the coefficients of the interaction terms are insignificant in many cases. Therefore it is difficult to provide consistent and significant evidence for these FE regressions. In specific the variable Low_OC suffers from this limitation as it consists of very little observations. Therefore this study is unable to provide reliable evidence for this measure. Even though the GLS model does not suffer from this problem and is

[100] A CEO is classified as overconfident if he once exhibits the behaviour that leads to this classification. Because there is a maximum of only four years of data for each CEO it is very stringent to include robustness tests that classify a CEO as overconfident if he exhibits the behaviour twice, a robustness test which is employed by other authors (Campbell et al., 2010).

used to alleviate these concerns, a recommendation for future research would be to extend the dataset in order to provide more consistent and significant results. Another limitation of this dataset is that only North American firms are included. It could be the case that CEO overconfidence in other regions of the world has a different impact on Tobin's Q. Therefore it is not possible to generalise these results to regions other than North America. A recommendation for future research is thus to study the relation between CEO overconfidence and firm value in other regions of the world.

Campbell et al. (2010) state another concern: the decision underlying the classification of the CEO as overconfident or non overconfident, holding high percentage in the money options, could be related to Tobin's Q. This would mean there could be omitted variables. For example, if the CEO decides to increase his effort levels he will expect the market to reflect that and thus Tobin's Q to increase, but then he will also not exercise his stock options and wait. This is similar to the alternative explanation of inside information. Malmendier and Tate (2005a) addressed this problem by basing the overconfidence classification on a time period before the dependent variable is determined. In this study that is done by including lagged variables of overconfidence. Furthermore, this study alleviates these concerns by using the exact same measures as in other studies which state that this is not an important concern for these measures. However, this study could be extended by using the press based measure of Malmendier and Tate to measure CEO overconfidence to examine if the results hold. This measure does not depend on a choice of the CEO and therefore does not have the same concerns.

Table 1: Overview of variables

This table includes an overview of the main variables used in this study. The alternative variables are not listed in this table; their construction can be found in the text.

Variable	Description	Expected influence
	Dependent variable	
Tobin's Q	(Assets total + (common shares outstanding x price close annual fiscal) – (stockholders equity – preferred stock at carrying value + deferred taxes balance sheet)) / total assets	
	Overconfidence measures	
OC67	Dummy is 1 from the first moment (price close annual fiscal / (price close annual fiscal – (realisable value of exercisable options / number of exercisable options))) -1 > 0.67, and 0 otherwise	Negative
Low_OC	Dummy is 1 from the first moment (value realised from exercising options / number of exercised options) / (price close annual fiscal – (realisable value of exercisable options / number of exercisable options)) < 0.3 and OC67 <0.3, and 0 otherwise	Negative
High_OC	Dummy is 1 from the first moment (price close annual fiscal / (price close annual fiscal – (realisable value of exercisable options / number of exercisable options))) -1 > 1 and 0 otherwise	Negative
NetBuyer	Dummy is 1 if change in shares owned > 0 in two out of three years, and 0 otherwise	Negative
	Control variables	
Firm size	Log(total assets)	Ambiguous
Profitability	Operating income before depreciation / total assets	Positive
Innovation	R&D / total assets	Positive
Diversification	Dummy is 1 if number of business segments > 1, and 0 otherwise	Ambiguous
Leverage	(Long term debt + total debt in current liabilities) / total assets	Negative/ quadratic
Cash availability	Dummy is 1 if cash dividend paid > 0, and 0 otherwise	Negative
CEO ownership	Percentage of shares owned by the CEO	Positive
CEO compensation	Total compensation of the CEO including option grants	Ambiguous
Year	Dummy for every year included in the sample	-
Industry	Dummy for every two-digit SIC industry	-
Investment	Capital expenditures / total assets	-
Cost of debt	Interest and related expense / ((long term debt beginning of year + short term debt beginning of year)+(long term debt end of year + short term debt end of year) / 2)	-

Table 2: Descriptive statistics

The table gives the number of observations, means, standard deviations, minimum observations and maximum observations of the variables included in this study. The abbreviation alt. in the variable name indicates that the measure is the alternative proxy of the variable. The reported numbers concern the full sample of CEO years.

Variable	Number of observations	Mean	Standard deviation	Minimum value	Maximum value
Dependent Variable					
Tobin's Q	5375	1.849	1.078	0.656	6.702
Tobin's Q alt.	5375	1.431	1.033	0.087	6.111
Overconfidence measures					
OC67	4221	0.509	0.499	0	1
Low_OC	3451	0.052	0.223	0	1
High_OC	3451	0.468	0.499	0	1
NetBuyer	4133	0.586	0.492	0	1
NetBuyer alt.	4133	0.372	0.483	0	1
Control variables					
Firm size	5451	7.399	1.589	3.857	11.632
Firm size alt.	5435	7.344	1.589	3.514	11.419
Profitability	5441	0.132	0.103	-0.252	0.444
Profitability alt.	5450	0.033	0.128	-0.637	0.286
Innovation	5451	0.031	0.053	0	0.273
Innovation alt.	5435	0.045	0.085	0	0.463
Innovation alt.	5435	0.012	0.026	0	0.155
Diversification	4209	0.577	0.493	0	1
Leverage	5451	0.211	0.189	0	0.870
Leverage alt.	5451	0.513	1.511	-6.384	8.882
Cash availability	5419	0.475	0.499	0	1
CEO ownership	5470	1.764	5.136	0	32.76
CEO compensation	4807	5137.998	5504.03	248.97	30566.14
Investment	5441	0.050	0.052	0.002	0.291
Investment alt.	4014	0.127	0.111	0.009	0.687
Cost of debt	3057	0.066	0.022	0.024	0.157

Table 3: Differences in descriptive statistics

The table gives the means and medians of the main dependent and control variables as described in Table 1. Panel A divides the firm-years based on the OC67 measure of CEO overconfidence, Panel B on the High_OC measure and Panel C on the NetBuyer measure. Wilcoxon rank-sum tests are conducted to test for differences between the means of the firms with overconfident CEO's and firms with non overconfident CEO's. Nonparametric equality of medians tests are conducted to test for the differences between the medians. The; *, **, and *** state the significance of the differences for the 10%, 5%, and 1% level respectively.

Panel A: OC67 measure of overconfidence

	OC67 = 0		OC67=1		Difference	
Variable	Mean	Median	Mean	Median	Mean	Median
Tobin's Q	1.708	1.459	2.029	1.668	0.321***	0.209***
Firm size	7.547	7.417	7.449	7.414	-0.098*	-0.003
Profitability	0.122	0.120	0.155	0.150	0.033***	0.030***
Innovation	0.041	0.011	0.023	0	-0.018***	-0.011***
Diversification	0.601	1	0.578	1	-0.023	0
Leverage	0.209	0.189	0.210	0.195	-0.001	0.006
Cash availability	0.502	1	0.475	0	-0.027*	-1*
CEO ownership	1.140	0.05	2.078	0.35	0.938***	0.300***
CEO compensation	5418.748	3531.5	5327.28	3558.35	-91.468	26.850
Investment	0.109	0.085	0.153	0.116	0.044***	0.031***
Cost of debt	0.065	0.062	0.066	0.063	0.001	0.001

Panel B: High_OC measure of overconfidence

	High_OC=0		High_OC=1		Difference	
Variable	Mean	Median	Mean	Median	Mean	Median
Tobin's Q	1.775	1.536	2.077	1.677	0,302***	0,141***
Firm Size	7.701	7.618	7.402	7.380	-0,299***	-0,238***
Profitability	0.135	0.131	0.159	0.153	0,024***	0,022***
Innovation	0.035	0.009	0.023	0	-0,012***	-0,009***
Diversification	0.624	1	0.565	1	-0,059***	0
Leverage	0.558	0.325	0.468	0.286	-0,090	-0,039*
Cash availability	0.541	1	0.456	0	-0,085***	-1
CEO ownership	1.186	0.12	2.249	0.4	1,063***	0,280***
CEO compensation	5768.695	3920.405	5315.716	3533.115	-452,979**	-387,290***
Investment	0.177	0.090	0.161	0.125	-0,016***	0,035***
Cost of debt	0.063	0.062	0.067	0.064	0,004***	0,002***

Panel C: NetBuyer measure of overconfidence

	NetBuyer=0		NetBuyer=1		Difference	
Variable	Mean	Median	Mean	Median	Mean	Median
Tobin's Q	1.925	1.580	1.783	1.489	-0,142***	-0,091***
Firm size	7.307	7.153	7.615	7.535	0,308***	0,382***
Profitability	0.139	0.132	0.134	0.134	-0,005	0,002
Innovation	0.030	0.000	0.029	0.000	-0,001	0,000
Diversification	0.536	1	0.611	1	0,075***	0
Leverage	0.463	0.218	0.537	0.327	0,074***	0,109***
Cash availability	0.443	0	0.532	1	0,089***	1***
CEO ownership	3.325	0.37	1.190	0.15	-2,135***	-0,220***
CEO compensation	4659.371	3002.345	5649.57	3818.55	990,199***	816,205***
Investment	0.138	0.102	0.124	0.093	-0,014***	-0,009***
Cost of debt	0.065	0.063	0.067	0.064	0,002**	0,001

Table 4: Correlations

The table shows the pairwise correlations between Tobin's Q and the different measures of CEO overconfidence. The significance levels reported are Sidak adjusted. The definitions of the variables can be found in Table 1.

	Tobin's Q	OC67	Low_OC	High_OC	NetBuyer
Tobin's Q	1.000				
OC67	0.151	1.000			
	0.000				
Low_OC	-0.083	-0.242	1.000		
	0.000	0.000			
High_OC	0.140	0.733	-0.221	1.000	
	0.000	0.000	0.000		
NetBuyer	-0.065	-0.034	0.018	-0.014	1.000
	0.000	0.352	0.977	0.995	

Table 5: CEO overconfidence and firm value - OLS

The table presents OLS regressions where the dependent variable is Tobin's Q as specified in Table 1, and the independent variables are the different measures of CEO overconfidence. The robust standard errors are clustered at the firm level, and the associated t-statistics are reported in parentheses, where; *, **, and *** state the 10%, 5%, and 1% significance level respectively.

	Dependent variable = Tobin's Q					
	(1)	(2)	(3)	(4)	(5)	(6)
OC67	0.415***			0.314***		
	(8.06)			(8.01)		
Low_OC		-0.152*			0.014	
		(-1.71)			(0.16)	
High_OC		0.376***			0.270***	
		(6.55)			(6.03)	
NetBuyer			-0.105*			-0.023
			(-1.90)			(-0.54)
Firm size				-0.118***	-0.108***	-0.088***
				(-5.56)	(-4.30)	(-3.55)
Profitability				5.096***	5.274***	5.505***
				(12.91)	(12.18)	(13.51)
Innovation				6.847***	6.157***	6.392***
				(10.09)	(9.43)	(8.25)
Diversification				-0.181***	-0.205***	-0.199***
				(-3.66)	(-4.14)	(-3.79)
Leverage				-0.209	-0.397*	-0.370**
				(-1.14)	(-1.88)	(-2.32)
Cash availability				0.052	-0.016	-0.000
				(1.15)	(-0.35)	(-0.00)
CEO ownership				0.002	0.001	0.007
				(0.43)	(0.29)	(1.53)
CEO compensation				0.000***	0.000***	0.000***
				(5.33)	(4.57)	(3.63)
Constant	1.515***	1.588***	1.765***	1.597***	1.675***	1.609***
	(43.17)	(41.42)	(39.40)	(11.23)	(9.65)	(9.90)
Number of observations	4195	3434	4109	3610	2961	3525
Adjusted R^2	0.220	0.250	0.173	0.495	0.507	0.475
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 6: CEO overconfidence and firm value - FE

The table presents FE regressions where the dependent variable is Tobin's Q as specified in Table 1, and the independent variables are the different measures of CEO overconfidence. The robust standard errors are clustered at the firm level, and the associated t-statistics are reported in parentheses, where; *, **, and *** state the 10%, 5%, and 1% significance level respectively.

	Dependent variable = Tobin's Q					
	(1)	(2)	(3)	(4)	(5)	(6)
OC67	0.320***			0.271***		
	(6.32)			(5.13)		
Low_OC		0.126**			0.115**	
		(2.20)			(2.13)	
High_OC		0.467***			0.452***	
		(7.40)			(7.21)	
NetBuyer			0.357			0.453*
			(1.50)			(1.95)
Firm size				-0.334***	-0.363***	-0.395***
				(-4.38)	(-3.96)	(-4.51)
Profitability				1.912***	2.032***	1.839***
				(5.45)	(4.94)	(5.45)
Innovation				3.377**	3.873**	3.655***
				(2.45)	(2.36)	(2.74)
Diversification				-0.090	-0.067	-0.098
				(-0.62)	(-0.33)	(-0.80)
Leverage				-0.312	-0.314	-0.368*
				(-1.39)	(-1.11)	(-1.70)
Cash availability				0.158**	0.203**	0.137**
				(2.28)	(2.35)	(2.20)
CEO ownership				0.001	0.002	0.005*
				(0.40)	(0.82)	(1.78)
CEO compensation				0.000	0.000	0.000*
				(1.47)	(1.05)	(1.72)
Constant	1.531***	1.487***	1.475***	3.717***	3.837***	4.049***
	(50.12)	(39.82)	(10.43)	(6.43)	(5.48)	(6.01)
Number of Observations	4195	3434	4109	3610	2961	3525
Adjusted R^2	0.842	0.836	0.831	0.862	0.859	0.856
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 7: CEO overconfidence, leverage and firm value

The table presents OLS regressions where the dependent variable is Tobin's Q as specified in Table 1, and the independent variables are the different measures of CEO overconfidence. Furthermore the variable leverage and the interaction variable of CEO overconfidence and leverage are included in order to answer Hypothesis 1 (leverage). The robust standard errors are clustered at the firm level, and the associated t-statistics are reported in parentheses, where; *, **, and *** state the 10%, 5%, and 1% significance level respectively.

	Dependent variable = Tobin's Q					
	(1)	(2)	(3)	(4)	(5)	(6)
OC67	0.721***			0.457***		
	(8.29)			(6.75)		
High_OC		0.611***			0.383***	
		(6.55)			(5.03)	
NetBuyer			-0.260***			-0.143*
			(-2.77)			(-1.87)
Leverage	-0.210	-0.789***	-1.683***	0.139	-0.135	-0.766***
	(-0.86)	(-3.69)	(-7.18)	(0.70)	(-0.71)	(-3.83)
OC67*Leverage	-1.545***			-0.721**		
	(-4.69)			(-2.56)		
High_OC*Leverage		-1.166***			-0.579*	
		(-3.45)			(-1.86)	
NetBuyer*Leverage			0.950***			0.637**
			(2.99)			(2.50)
Firm size				-0.117***	-0.108***	-0.087***
				(-5.44)	(-4.27)	(-3.57)
Profitability				5.021***	5.224***	5.491***
				(12.76)	(12.15)	(13.59)
Innovation				6.851***	6.157***	6.298***
				(10.22)	(9.45)	(8.16)
Diversification				-0.175***	-0.205***	-0.196***
				(-3.56)	(-4.14)	(-3.75)
Cash availability				0.056	-0.013	-0.002
				(1.24)	(-0.29)	(-0.05)
CEO ownership				0.000	0.000	0.006
				(0.19)	(0.11)	(1.40)
CEO compensation				0.000***	0.000***	0.000***
				(5.28)	(4.48)	(3.76)
Constant	1.568***	1.737***	2.082***	1.525***	1.629***	1.680***
	(26.11)	(29.71)	(29.46)	(10.08)	(8.79)	(10.30)
Number of observations	4195	3434	4109	3610	2961	3525
Adjusted R^2	0.258	0.295	0.208	0.498	0.509	0.477
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 8: CEO overconfidence, investment and firm value

The table presents OLS regressions where the dependent variable is Tobin's Q as specified in Table 1, and the independent variables are the different measures of CEO overconfidence. Furthermore the variable investment and the interaction variable of CEO overconfidence and investment are included in order to answer Hypothesis 2 (investment). The robust standard errors are clustered at the firm level, and the associated t-statistics are reported in parentheses, where; *, **, and *** state the 10%, 5%, and 1% significance level respectively.

	Dependent variable = Tobin's Q					
	(1)	(2)	(3)	(4)	(5)	(6)
OC67	0.502***			0.374***		
	(7.35)			(7.20)		
High_OC		0.459***			0.283***	
		(5.92)			(4.90)	
NetBuyer			-0.017			-0.015
			(-0.24)			(-0.26)
Investment	3.295***	2.635***	3.888***	-0.084	-0.876	-0.026
	(3.66)	(3.13)	(4.41)	(-0.11)	(-1.31)	(-0.03)
OC67*Investment	-2.178**			-1.112		
	(-2.42)			(-1.62)		
High_OC*Investment		-1.579*			-0.179	
		(-1.82)			(-0.28)	
NetBuyer*Investment			-1.681*			-0.167
			(-1.92)			(-0.21)
Firm size				-0.119***	-0.108***	-0.088***
				(-5.59)	(-4.32)	(-3.55)
Profitability				5.138***	5.347***	5.514***
				(12.28)	(11.82)	(12.93)
Innovation				6.872***	6.154***	6.391***
				(10.18)	(9.47)	(8.25)
Diversification				-0.182***	-0.209***	-0.199***
				(-3.68)	(-4.21)	(-3.74)
Leverage				-0.215	-0.404*	-0.370**
				(-1.16)	(-1.89)	(-2.32)
Cash availability				0.050	-0.020	-0.000
				(1.09)	(-0.42)	(-0.02)
CEO ownership				0.002	0.001	0.007
				(0.44)	(0.35)	(1.53)
CEO compensation				0.000***	0.000***	0.000***
				(5.23)	(4.41)	(3.61)
Constant	1.390***	1.459***	1.599***	1.602***	1.711***	1.609***
	(29.80)	(29.87)	(27.40)	(11.66)	(10.06)	(9.72)
Number of observations	4188	3430	4102	3610	2961	3525
Adjusted R^2	0.226	0.253	0.185	0.496	0.508	0.474
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 9: CEO overconfidence, innovation and firm value

The table presents OLS regressions where the dependent variable is Tobin's Q as specified in Table 1, and the independent variables are the different measures of CEO overconfidence. Furthermore the variable innovation and the interaction variable of CEO overconfidence and innovation are included in order to answer Hypothesis 3 (innovation). The robust standard errors are clustered at the firm level, and the associated t-statistics are reported in parentheses, where; *, **, and *** state the 10%, 5%, and 1% significance level respectively.

	Dependent variable = Tobin's Q					
	(1)	(2)	(3)	(4)	(5)	(6)
OC67	0.349***			0.249***		
	(6.25)			(5.40)		
High_OC		0.352***			0.188***	
		(5.83)			(3.89)	
NetBuyer			-0.116**			-0.024
			(-1.99)			(-0.50)
Innovation	4.239***	4.531***	4.648***	6.215***	5.187***	6.376***
	(5.56)	(5.98)	(4.79)	(7.24)	(6.82)	(6.82)
OC67*Innovation	3.692***			1.930		
	(3.01)			(1.53)		
High_OC*Innovation		2.192			2.595*	
		(1.60)			(1.89)	
NetBuyer*Innovation			0.523			0.027
			(0.42)			(0.02)
Firm size				-0.119***	-0.108***	-0.088***
				(-5.62)	(-4.38)	(-3.55)
Profitability				5.048***	5.284***	5.505***
				(12.79)	(12.28)	(13.39)
Diversification				-0.182***	-0.208***	-0.199***
				(-3.67)	(-4.18)	(-3.82)
Leverage				-0.193	-0.390*	-0.370**
				(-1.05)	(-1.88)	(-2.35)
Cash availability				0.056	-0.013	-0.000
				(1.26)	(-0.29)	(-0.00)
CEO ownership				0.001	0.000	0.007
				(0.34)	(0.08)	(1.52)
CEO compensation				0.000***	0.000***	0.000***
				(5.40)	(4.63)	(3.61)
Constant	1.374***	1.435***	1.630***	1.636***	1.718***	1.610***
	(35.72)	(36.31)	(33.43)	(11.43)	(9.72)	(9.54)
Number of Observations	4195	3434	4109	3610	2961	3525
Adjusted R^2	0.278	0.293	0.214	0.497	0.511	0.474
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 10: CEO overconfidence, cost of debt and firm value

The table presents OLS regressions where the dependent variable is Tobin's Q as specified in Table 1, and the independent variables are the different measures of CEO overconfidence. Furthermore the variable cost of debt and the interaction variable of CEO overconfidence and the cost of debt are included in order to answer Hypothesis 4 (cost of debt). The robust standard errors are clustered at the firm level, and the associated t-statistics are reported in parentheses, where; *, **, and *** state the 10%, 5%, and 1% significance level respectively.

	Dependent variable = Tobin's Q					
	(1)	(2)	(3)	(4)	(5)	(6)
OC67	0.000			0.032		
	(0.00)			(0.27)		
High_OC		-0.220			-0.202	
		(-1.42)			(-1.50)	
NetBuyer			0.106			0.088
			(0.79)			(0.79)
Cost of debt	-3.076*	-4.652***	-0.171	-0.171	-1.590	1.271
	(-1.72)	(-2.73)	(-0.13)	(-0.13)	(-1.28)	(1.23)
OC67*Cost of debt	3.661			2.583		
	(1.62)			(1.32)		
High_OC*Cost of debt		6.576***			5.434**	
		(2.75)			(2.51)	
NetBuyer*Cost of debt			-2.179			-1.366
			(-1.11)			(-0.85)
Firm size				-0.085***	-0.068**	-0.060***
				(-3.41)	(-2.29)	(-2.66)
Profitability				4.382***	4.474***	4.850***
				(8.77)	(7.72)	(10.61)
Innovation				7.395***	5.993***	6.972***
				(7.47)	(6.27)	(6.27)
Diversification				-0.126**	-0.135***	-0.141***
				(-2.52)	(-2.74)	(-2.69)
Leverage				0.060	-0.034	-0.137
				(0.28)	(-0.12)	(-0.77)
Cash availability				0.098**	0.023	0.035
				(2.13)	(0.48)	(0.71)
CEO ownership				0.002	0.002	0.012**
				(0.38)	(0.31)	(2.06)
CEO compensation				0.000***	0.000***	0.000***
				(3.69)	(2.80)	(3.22)
Constant	1.658***	1.780***	1.583***	1.348***	1.451***	1.230***
	(14.17)	(15.76)	(16.81)	(6.71)	(5.98)	(6.81)
Number of observations	2420	2019	2402	2036	1700	2021
Adjusted R^2	0.189	0.225	0.144	0.453	0.453	0.430
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

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