

Nurturing CEO overconfidence: the dynamics of corporate governance, managerial beliefs and firm performance

Abstract

This paper draws upon the idea that the expression of CEO overconfidence is contingent to corporate features such as power allocation, quality of corporate governance and entrenchment opportunities. Seeing overconfidence as a belief conditioned by specific contextual elements, rather than an innate unconditional trait, introduces an endogeneity problem in the study of this belief's consequences on firm performance. We use a propensity score matching model that addresses the issue of endogeneity of CEO overconfidence and aims to measure the selection-free effect of this belief on firms' performance. We show that firms with overconfident CEOs outperform similar firms with realistic CEOs. Both operational performance (measured by ROA and ROE), value (measured by Tobin's Q ratio) and stock performance (measured by CARs) are improved for firms whose CEOs became overconfident during the sample period. One of the implications of this result is that CEO overconfidence can be seen as a substitute to corporate governance mechanisms as it allows stronger incentives alignment between executives and shareholders.

Keywords: CEO overconfidence, corporate governance, performance, selection bias

1 Introduction

Those in possession of absolute power can not only prophesy and make their prophecies come true, but they can also lie and make their lies come true. - Hoffer, Eric

Recent academic research has labeled overconfidence as one of the most prominent characteristic of CEOs and biased visions of the future by top executives is now an acknowledged stylized fact. In most of this literature CEO overconfidence is viewed as an individual trait that consists in the tendency to systematically overestimate one's knowledge, information and ability to predict the future. How this trait emerges and why some individuals and not others develop this kind of cognitive bias is however an open question.

An old debate in social psychology about the dualism between the innate origins of human traits as opposed to empiricism or nurture as an explanation of human differences can be an interesting starting point to answer this question. Are overconfident individuals "born" i.e. they carry in their personality a natural tendency to make biased predictions or are all individuals "tabula rasa" at birth and some of them become overconfident as result of education, experience and context.

Seeing overconfidence as an innate individual characteristic matches with a traditional explanation of the prominence of the overconfidence bias among CEOs according to which the recruitment or the selection process of corporate executives facilitates the access of overconfident individuals to top leadership positions. This could take the form of internal tournaments that favor risk takers (Goel and Thakor, 2008) or the board's search for charismatic leaders (Khurana, 2002) or it can even pass through the capacity of overconfident individuals to have stronger social influence and convince others of their managerial qualities (Radzevick and Moore, 2011; Zarnoth and Sniezek, 1997). In contrast, the explanation of overconfidence as a belief that is generated by experience and context, a "nurtured" cognitive bias, would suggest some new insights as to the reasons of CEO hubris. If the development of biased thinking is related to different sorts of social experiences, position and previous practice, then companies' specifics as much as individual characteristics would be likely to induce, reveal or reinforce CEO overconfidence.

In this paper we focus on the nurtured origins of overconfidence and argue that CEO hubris is related not only to CEOs' personalities, but also to corporate features such as power allocation, quality of corporate gover-

nance and entrenchment opportunities. Our conjecture is that the coupling between firms and their CEOs is driven by both the CEO's temperament and the firm's particularity and thus follows a deterministic path. The major implication of this hypothesis is that the study of the consequences of CEO overconfidence in terms of firm performance must take into consideration the determinism of this coupling. On the ground of this reasoning, we propose an empirical model that addresses this issue and aims to measure the selection-free effect of CEO overconfidence on firm performance.

We explore the dynamics of CEO overconfidence and its value consequences on a firm level. The CEOs' stock options exercise behavior during a specific period of time is used to identify the year at which a CEO becomes overconfident (Malmendier and Tate, 2005). The precise moment at which CEOs start to make excessively positive predictions about their companies (become overconfident) is difficult to determine. Instead we use the Malmendier and Tate (2005)'s methodology of detecting overconfident individuals, for each year of our sample period, and set the date at which a specific CEO becomes overconfident at the first year at which he was qualified as overconfident according to this measure. Malmendier and Tate's measure of overconfidence builds upon the idea that undiversified CEOs should generally exercise their stock options quite early in time as long as a certain level of moneyness is assured. Not exercising stock-options when reasonable (Hall and Murphy, 2002) would suggest that the CEO makes (excessively) positive predictions about the company's future and waits for more favorable stock prices. This would classify him as overconfident and we would consider the year during which he was first qualified as overconfident as the specific event year in our study.

One caveat to this empirical strategy is that it suggests a rapid conversion of a CEO from realistic to overconfident. Whatever the reasons leading to the development of overconfident beliefs, this process is necessarily gradual and ongoing. Hence, identifying a lap of time during which the CEO would turn to overconfident can be problematic. We are able to partly alleviate this concern by insisting on long term changes in performance rather than short event windows in our analysis of the consequences of this gradual mutation. An alternative way of seeing this issue is to consider the event year as the period during which the CEO's level of confidence over-passed a specific benchmark level that is implicitly identified as the optimal one. We then use the event of becoming overconfident as a reference point starting from which we link changes in performance to the CEOs psychological profile. In parallel,

the event of becoming overconfident is the major element of the strategy we employ to identify reasonable counterfactuals, i.e. similar CEOs who evolve in similar firms and whose risk of becoming overconfident at a given year is comparable. Our empirical method consists in running a propensity score nearest neighbor matching (Rosenbaum and Rubin, 1983) that allows the construction of a control sample of matched individuals which will serve as a benchmark in our analysis of the changes in firm performance since the conversion of the CEO to an overconfident one.

The results of this paper support the notion that CEO overconfidence is strongly conducted by corporate factors such as managerial power, governance and past firm performance. We find that the quality of the corporate governance and factors influencing the authority of the CEO in the decision making processes such as his role as a Chairman or President of the Board and his involvement in the founding of the company strongly influence the probability of developing an overconfidence bias. Other personal characteristics that would proxy life or professional experience also matter, corroborating the idea of overconfidence as a behaviorist, nurtured individual trait. We also highlight the role of self-attribution as one of the main originators of overconfidence (Baker et al., 2004; Kahneman and Tversky, 1979) since past firm performance and tenure increase the probability of having an overconfident CEO.

Firms with overconfident CEOs were found to outperform similar firms whose CEOs hadn't changed to overconfident. Operating performance, measured as returns on assets and returns on equity varies more positively for firms with overconfident CEOs. This difference can be observed up to two years after the CEO became overconfident suggesting a durable effect of overconfidence on the company's operational performance. The value of the firm, measured by the Tobin's Q ratio also seems to be affected by the CEO's psychological profile as our measure of overconfidence seem to explain a significant positive difference in the evolution of this ratio between firms with overconfident CEOs and firms with realistic CEOs.

The results are similar when we compute abnormal stock performance using market model returns. Cumulative abnormal returns of firms with overconfident CEOs are significantly higher than those of firms with realistic CEOs suggesting that the investors positively react to CEO overconfidence. This result holds for the period of 750 trading days (three years) after the event of becoming overconfident, suggesting that although the market takes some time to recognize and react to CEO overconfidence the effect is long-

lasting. We validate these results by computing the abnormal performance of a zero investment value weighted portfolio which is long in firms whose CEOs became overconfident between 2006 and 2010 and short in firms whose CEOs remained realistic during the same period. We regressed the monthly returns of this portfolio to the four factors (Fama and French, 1993; Carhart, 1997) and found a positive alpha confirming that firms with overconfident CEOs outdo firms with realistic CEOs in terms of stock market profitability.

One of the major implications of these results concerns corporate governance. We show that the degree of managerial protection in a given firm can stimulate the emergence of CEO overconfidence. Considering the globally positive effects of this bias, this is not necessarily a bad thing. In this sense, our results suggest that CEO overconfidence can be an interesting substitute to the disciplinary mechanisms of corporate governance that align the interests of corporate shareholders and executives (Goel and Thakor, 2008; Gervais et al., 2011).

The remainder of the paper is organized as follows. In Section I we develop a theoretical reasoning over the origins of overconfidence and the endogeneity of this belief in the corporate context. In Section II we introduce the data and the construction of our measures. We also present our empirical design and the matching procedure that alleviate concerns related to the endogeneity of CEO overconfidence. Section III presents the results concerning the relationship between CEO overconfidence and corporate performance. Section IV addresses the substitutability between CEO overconfidence and corporate governance as determinants of financial performance. In Section IV we discuss the results and conclude.

2 The endogeneity of CEO overconfidence

The reason why some people demonstrate overconfident beliefs whereas others do not is an issue of open debate. The main question behind this debate is whether overconfident individuals are “born” - they have inherent predispositions to overestimate their capacities and systematically do so whatever the task they are confronted to, or -“made” - their overconfident beliefs emerge from their lifetime experience, their current position, decision power and amount of control they believe to have over future events. The first argument, defining overconfidence as an intrinsic tendency of the individual has found its grounds in behavioral genetics. In an interesting empirical

study comparing 460 twin pairs, Cesarini et al. (2009) suggest that genetic differences explain 16 to 34% of the variation in overconfidence among individuals. In this sense, some individuals, and not others would be predisposed to make overconfident beliefs whatever the context, tasks, and environment they are confronted to. Then, the prevalence of overconfident individuals among specific populations such as entrepreneurs (Busenitz, 1999; Cooper et al., 1988), top executives (Malmendier and Tate, 2005, 2008; Ben-David et al., 2007; Hiller and Hambrick, 2005) analysts (Hilary and Menzly, 2006; Chen and Jiang, 2006) or experts (Griffin and Varey, 1996; Klayman et al., 1999) would be related to the assortment of these specific individuals around forecast-oriented, highly selective professions that call to a great level of risk-taking. In this sense, Goel and Thakor (2008) explain the stylized fact of overconfident CEOs building on the specificity of the process of internal tournament for the position of CEO which would ensure that it is the most overconfident intermediate executives (who are most prompt to invest in highly risky and value generating projects) that are most likely to win the tournament and become corporate leaders.

Alternatively, some academics insist on the relevance of environmental and contextual factors that enhance or on the contrary moderate the natural tendency of the individual to be overconfident. The endogenous emergence of overconfident beliefs, based on life experience, has been widely argued in psychology, socio-cognitive theory and behavioral economics. Two important arguments lie behind the “made” overconfident hypothesis.

The first one is a widely explored human cognitive bias called *self-attribution* (Baker et al., 2004; Gilovich et al., 2002). Self-attribution bias concerns the individuals’ predisposition to overestimate their contribution in past successes and underestimate their fault in unsuccessful experiences, blaming exogenous reasons such as bad luck or hazardous turn of events. Individuals with successful career paths and positive past experience would thus attribute all past accomplishments to themselves and would be more at risk of developing overconfidence. Several studies have empirically demonstrated the manifestation of self-attribution bias among successful individuals. Daniel et al. (1998) show that investors become overconfident after several valuable investments and Hayward and Hambrick (1997) suggest that “the aura of conquest” of acquiring executives may give them great confidence in their managerial abilities and make them believe they can fully manage the acquired firm on their own. Similarly, Billett and Qian (2008) argue that the reduced financial benefits of subsequent acquisitions of fre-

quent acquirers can be explained by the emergence or the development of an overconfidence bias among CEOs who have previously conducted successful mergers and acquisitions and excessively attribute this past success to their personal involvement. Gervais and Odean (2001) and Hilary and Menzly (2006) also argue that successful investors/analysts become overconfident as they take too much credit for their value-creating investments or accurate forecasts.

The second important element of the idea of overconfidence as the product of nurture is *illusion of control* (Langer, 1975). Illusion on control has been defined as the tendency to overestimate one's personal control over future events and the extent to which future events depend on the person's skill rather than luck or other people's involvement. In this sense, this belief is related to the individual's sense of power as well as his vision about his personal influence on future events. The corporate context emphasizes this kind of cognitive biases because the power of the CEO when it comes to deciding the strategic and financial direction of the company and the lack of resistance by shareholders or other corporate stakeholders often encourage a feeling of mastery and controllable future.

In several empirical studies power and the heightened sense of power have been shown to increase optimism and positive thinking: Anderson and Galinsky (2006) propose an experimental analysis of the effect of power on people's attitude towards risk and actual risk taking, whereas building upon the Approach/Inhibition model Keltner et al. (2003) argue that possessing power activates an approach-related behavior that is characterized by stronger optimism over future events, reward seeking and the tendency to underestimate risk. This dis-inhibiting role of power can thus lead to strong beliefs about one's capacity to have control over future events and guarantee successful outcomes.¹ Fast et al. (2012) actually suggest two mechanisms through which power may lead to overconfidence: the first one is that power activates a sense of positive and action-facilitating cognitions such as self-serving beliefs

¹Alternatively, it might also be argued that lacking power would be associated with higher propensity to take risks. Consistent with prospect theory (Kahneman and Tversky, 1979) the powerless individuals can see themselves in the domain of losses and have a risk seeking attitude. We believe that this argument is strongly associated with the durability of power. A powerful individual who is unlikely to lose power because of his actions would be less likely to be in the "nothing to lose attitude" whereas a less "entrenched" power holder would remain more careful. In this sense, entrenchment can be seen as an important moderator of the relationship between power and overconfident predictions or risk taking.

or optimism. The second mechanism concerns the role expectations felt by power holders. People who have been granted power might exhibit extreme confidence in order to correspond to what they believe would be the expected attitude from those in their position. Eventually, this expressed overconfidence can become self-fulfilling and the individuals' stated confidence would end up corresponding to their core beliefs.² By the same reasoning, Paredes (2004) argues that one of the main reasons explaining the prevalence of overconfident individuals among corporate leaders is the deference and the lack of contestation of CEOs by their boards, shareholder or broader financial community. CEO overconfidence is thus seen as the product of weak corporate governance that limits the shareholders opportunities to challenge or question the CEO's decision making and increases the concentration of corporate control in the hands of one decision maker (the manager) whose business judgment shareholders defer to. Weak corporate governance would then not only reinforce the feeling of power and dominance over the course of events that the CEO may resent, but more dangerously, it would facilitate his entrenchment and reduce the necessity of precaution and continuous cross-validation of decisions in the corporate context. This in turn would lead to the development of a strong and persistent overconfidence bias among top executives.

Of course self-attribution bias and illusion of control are inter-correlated; the first one consists in underestimating the part of hazard or others' involvement in past successes while the second one is about underestimating their role in the chances of future ones. The feeling of power and mastery that accompany the illusion of control would furthermore nurture upcoming self-attribution tendencies. Because CEOs level of (over)confidence evolves in time, nurtured by positive feedback and the conquest of stronger position and entrenchment, the study of this belief's consequences must take into consideration this endogeneity. In the empirical analysis that follows we analyze CEO overconfidence as an endogenously generated belief, a product of the CEO's past and the company characteristics. The next section explains the selection bias issue related to such endogeneity and our approach to treat this problem. Then we present our empirical results and discuss their implications.

²In an inspiring article Trivers (2000) argues that self-deception (a general trait that includes overconfidence) may have an evolutionary function as it serves to improve deception of others and thus increase the survivor likelihood of the self-deceived (overconfident) individuals.

3 Empirical strategy

In the ideal empirical experiment, testing the effects of CEO's overconfidence on the performance of the firm would consist in comparing the performance of a firm whose CEO has become overconfident to the performance of the very same firm had the CEO not become overconfident. Unfortunately, this counterfactual is unavailable and most of the studies that aim to evaluate the consequences of overconfidence make cross sectional comparisons between the performance of firms with overconfident CEOs and that of firms with CEOs who do not demonstrate this sort of biased perceptions. This methodology would suggest that the event of a CEO becoming overconfident is completely random among firms and individuals and can be seen as the exclusive element of distinction between the firms with overconfident CEOs and the other ones. As we argued above we believe that this hypothesis is too strong. Even if we considered overconfidence as an individual intrinsic trait that would be unaffected by the corporate context, the matching between specific firms and their leaders' psychological profile might be deterministic and thus bias the results of simple comparisons between firm-level performances of overconfident and non-overconfident leaders.

In order to address this issue, we rely on a quasi-experimental empirical design by comparing a group of overconfident CEOs to a group of CEOs who were equally likely to become overconfident (were in similar corporate context and presented similar individual characteristics) but did not presented signs of this cognitive bias. We thus construct two sub-samples of CEOs, those who reveal overconfidence during a specific sample years (O) and a control group that differs from the group of overconfident CEOs only by the fact that the members of this group were not identified as overconfident. These two sub-samples are constructed based on a propensity score matching approach that we describe below. Once we have established the group of overconfident CEOs and their alike control group we compare the changes in performance from before the moment the CEO became (or was at risk to become) overconfident to several periods after this event for each group. If there is a significant difference between the two groups, this would suggest that two firms that are essentially different only by the fact that one's CEO became overconfident while the other one's didn't, perform differently. In other words, this would allow us to measure the selection-free effect of CEO

overconfidence on firm performance.³

3.1 Sample construction and measures

We use the Capital IQ database over the period 2005-2013. Our sample contains 741 CEO of 736 US public companies, from all industries as described in table 1. The total number of observations after removing all the missing data corresponds to 2175 CEO-years. Our measure of CEO overconfidence is fully inspired by a seminal work of Malmendier and Tate (2005) that proposes a proxy of CEO's upward biased forecasts about the future of their companies by analyzing the way they exercise their stock options packages. The idea behind this proxy is the following: an undiversified risk-averse CEO would presumably exercise his stock options quite early after the vesting period in order to reduce the prominence of firm specific risk in his personal portfolio. Hall and Murphy (2002) propose a simulation-based reference sheet with threshold levels of moneyness for each year of stock option's exercisability above which rational CEOs should exercise their options packages. For example, when a stock option package is in its fifth year of exercisability, rational CEOs with a risk aversion level (ρ) of three in a constant relative-risk aversion utility specification and a percentage of wealth in the company's equity of 66% have full incentives to exercise these packages as soon as they are 67% in-the-money. This specific fifth year threshold level is the one used by Malmendier and Tate to designate overconfident CEOs. In their framework, a CEO would be qualified as overconfident if he fails to exercise stock options that are in their fifth year of exercisability and above 67% in-the-money, at least twice during the sample period. This measure of CEO overconfidence, called *Holder67*, has nurtured several subsequent studies of CEO overconfidence and has been widely accepted by the academic community.⁴

Because we dispose of each CEO's stock options packages for every year in the sample period, we extend the Malmendier and Tate (2005) *Holder67* measure and take into consideration the CEO's decision to exercise or hold his stock-options for each year of exercisability of the package during our sample period. In other words, we do not limit our analysis to decisions about stock options packages that are in the fifth year of exercisability but compare the

³This empirical strategy is similar to Malmendier and Tate (2009)'s article that studies the effect of CEOs' celebrity on corporate performance.

⁴For more references using the *Holder67* measure see Campbell et al. (2011), Galasso and Simcoe (2011), Ahmed and Duellman (2013).

moneyiness of stock options to the specific year’s Hall and Murphy (2002) threshold, whatever the year of exercisability. Thus a CEO in our sample could have the opportunity to exercise the same package of stock options at the rational threshold level of moneyiness several times during the sample period. Analogously to the Malmendier and Tate (2005)’s case, a CEO who has stock-options that are above 67% in-the money at the fifth year of exercisability and fails to exercise them could be in a similar situation the year that follows if his stock options are now above 62% in-the-money, which is the corresponding threshold for stock options in their sixth year of exercisability. Based on this year-by-year analysis we construct a time variant measure of overconfidence in the following way: We take only CEOs who at least twice during our sample period had one or more stock-option package(s) that were above the specific years’ moneyiness threshold.⁵ Then, a specific CEO is qualified as overconfident in a given sample year if he: (i) fails to exercise partly or completely at least one stock option package that is above the year’s threshold level and (ii) has this very same behavior at least one more time in a subsequent year of the sample period. Apart from being addressed annually, the design of this measure is equivalent to Malmendier and Tate’s *Holder67* proxy. Thus, our sample only contains CEOs who had the opportunity to demonstrate overconfidence or rationality (could rationally exercise their stock options at least twice in the sample period). Furthermore, by imposing repetition in the lack of exercise of stock-options we make sure that our measure of overconfidence does reflect the CEOs anticipation on the company’s equity future evolution rather than one-shot mistakes, procrastination or inside information. We call this time variant alternative to the *Holder67* measure, *HolderAboveThreshold*. In what follows we will call Overconfident CEOs, those whose value of the *HolderAboveThreshold* proxy equals to 1 for the specific sample year.

Since most of the CEOs in our sample have several stock options packages during each sample year it is possible that a given CEO would exercise some of the packages that are above the specific year’s threshold and fail to exercise other packages of this kind during the very same period. Our

⁵According to Hall and Murphy (2002)’s benchmark, annual moneyiness thresholds for CEOs with a risk aversion of three and a part of wealth related to company’s equity of 66% would be around: 83% for the first year of exercisability, 80% for the second year of exercisability, 77% for the third year, 72% for the fourth year, 67% for the fifth year, 62% for the sixth year, 53% for the seventh year, and so on up to an at-the-money level for the last year of exercisability.

HolderAboveThreshold measure would qualify all these CEOs as overconfident provided that they subsequently fail to exercise alike options at least one more time (even if they do demonstrate rational exercising behavior on some of their packages). An alternative way of considering this particular case is to set a rule that would qualify as overconfident the CEOs for who the number of above threshold packages that they fail to exercise is superior to the number of above threshold packages they do exercise. We call this alternative measure of overconfidence *HolderAboveThreshold2*. The degree of correlation between the two alternative measures is of 0.98 (significant at the 1% level) so we only keep the first alternative for the subsequent empirical analysis.⁶

We match the CEO overconfidence data with additional data on CEO characteristics, firm characteristics and firm performance. We consider CEO's demographic features (age, gender and education) as well as the CEO's tenure in the company (in number of months since he was first assigned to the position of CEO), the CEO's total annual cash compensation measured as salary plus bonus plus all other cash compensation. We also include three variables that can be seen as factors influencing CEO power and decision rights within the firm: a dummy variable equal to one if the CEO is also the founder of the company, a dummy variable equal to one if he is also Chairman of the Board and President and a dummy variable equal to one if the CEO owns the majority (above 50%) of the company's equity.

Then we merge individual level measures with some company characteristics. Market capitalization is the stock price multiplied by common shares outstanding. The book-to-market ratio is book equity over market equity. Return on assets (ROA) is Operating income scaled by Total Assets and Return on Equity (ROE) is Earnings scaled by Total Equity. We also measure the value of the firm by the Tobin's Q ratio equal to the market value of assets (total assets plus market equity minus book equity) over the book value of assets. Market equity corresponds to common shares outstanding multiplied by the fiscal year closing price. Book equity corresponds to shareholder's total equity plus balance sheet preferred taxes and investments minus post-

⁶We perform several robustness checks related to the *HolderAboveThreshold* measure. First, we retest all our empirical models by increasing all annual exercisability thresholds by 20% and then 50%. Similarly, we compare our overconfidence measure annual results to the *LongHolder* measure suggested by Malmendier and Tate (2005). While generally confirmed, results are somewhat weaker in this case and we choose not to report them here.

retirement assets minus preferred stock liquidating value.

Corporate governance is measured by the 24 items G-index as proposed by Gompers et al. (2003). This index takes into consideration different corporate legal anti-takeover provisions from the Investor Responsibility Research Center (IRRC) including: Indemnification Contracts, Limitation on Director Liability, Supermajority requirements, Limitations on actions upon written consent and so on. All these provisions are designed to protect the corporate executives and assure them stronger power so the stronger the GIM index the weaker the company’s corporate governance. We also include the 6-items ”Entrenchment Index” proposed by Bebchuk et al. (2009) that resumes the main drivers of the positive effect of corporate governance quality on financial performance. This index is a compact version of the G-index and contains essentially provisions that protect the managers from forced turnover. At last we add a dummy variable Block that equals one when the major institutional shareholder in the company possess at least 5% of the shares of the company. This measure has been proposed by Cremers and Nair (2005) as a proxy of internal governance quality (as opposed to the external governance quality measured by the G-index). The argument behind this measure builds on the fact that institutional block-holders have both strong incentives and high aptitude to monitor the managers’ behavior and decision-making.

3.2 Empirical design

In order to isolate the effect of overconfidence on performance from selection bias and the endogeneity of overconfidence described above we construct a propensity score matching estimator (Rosenbaum and Rubin, 1983; Abadie and Imbens, 2007). We match overconfident CEOs to their alike realistic counterparts (that we call Predicted Overconfident CEOs) for each sample year. The remaining heterogeneity between the overconfident CEOs (treated sample) and the Predicted Overconfident CEOs (control sample) might bias our results, so we test for differences between overconfident CEOs and their matches along other variables that are not included in the matching procedure. Table 2 summarizes this analysis.

We construct the matching sample of individuals named Predicted Overconfident CEOs in two steps. First, we run a probit regression to predict the probability that a specific CEO would become overconfident in a given year based on his personal characteristics (age, education, tenure, compensation) as well as the corporate context and past financial performance. Table

Table 1: Determinants of Overconfidence

	Odds Ratios	Std. Errors	Odds Ratios	Std. Errors
Age	-0.179	(0.067)***	-0.104	(0.071)
Age2	0.001	(0.001)**	0.001	(0.001)
Female	-0.577	(0.268)**	-0.726	(0.284)**
MBA (dummy)	0.522	(0.107)***	0.557	(0.115)***
Tenure (in n° of months)	0.000	(0.000)**	0.000	(0.000)*
Cash Compensation	0.000	(0.000)**	0.000	(0.000)*
Founder (dummy)	0.159	(0.100)	0.023	(0.1092)
CEO owns majority (dummy)	0.033	(0.107)	0.200	(0.116)*
Chm., pres. & CEO	-0.089	(0.095)	-0.174	(0.103)*
GIM index	0.042	(0.017)**	0.039	(0.018)**
ROA[-1]	0.005	(0.006)	-0.004	(0.006)
ROE[-1]	-0.005	(0.002)**	0.001	(0.002)
Tobins' Q [-1]	0.216	(0.033)***	0.140	(0.034)***
Industry Dummies		No		Yes
Year Dummies		No		Yes
Pseudo R2		0.0648		0.1582
Observations		2175		2175

Notes. The sample includes all firms in each year from 2006 to 2012. The dependent variable is a dummy variable (*HolderAbove Threshold*) equal to one when a CEO fails to exercise at least one stock option package that is above the year's threshold level and presents the same behavior at least one more time in a subsequent year of the sample period. Cash compensation is salary plus bonus, CEO owns majority is a dummy variable equal to one if the CEO owns at least 50% of the company's equity, Chm., pres. & CEO is a dummy variable equal to one of if the CEO is also Chairman and President of the Board. GIM index is a governance index as in Gompers et al. (2003). ROA[-1] is the company's Return on Assets at the end of the fiscal year prior to the measure of overconfidence, defined as Operating income divided by Total Assets, ROE[-1] is the company's Return on equity at the end of the fiscal year prior to the measure of overconfidence, defined as Earnings divided by Total Equity. Tobin's Q [-1] is the ratio of market value of assets over book value of assets at the end of the fiscal year prior to the measure of overconfidence.

1 presents the results of this regression, both with and without year and industry fixed effects. The coefficients in the table, shown as odds ratio, confirm that the probability that a CEO would become overconfident in a specific year is endogenously conducted by several individual and firm characteristics as well as feedback about the firm's performance. A younger, more educated, male CEO who has been in the company for long is more likely to become overconfident about future performance. This probability is also reinforced when corporate governance is weak and the CEO is the founder of the company or he simultaneously occupies the CEO and the Chairman of the board and President position. At last, positive feedback about past performance is also a good indicator about the CEO's biased beliefs since previous year's level of ROA and Tobin's Q is a significant predictor of the probability that the CEO would become overconfident.

The second step of our matching procedure is to use the predicted values from the probit regression (propensity scores) to construct the sample of nearest neighbor matched counterfactuals. Thus, for each overconfident CEO we designate, with replacement, the non-overconfident CEO with the closest propensity score, i.e. the most similar probability of becoming overconfident. Rather than characteristics, we use propensity scores as matching variables in order to reduce the dimensionality problem (Abadie and Imbens, 2007). This procedure allows us to ensure that, apart from the fact of becoming overconfident; all the CEOs in the sample have identical distributions on several characteristics that presumably affect the firm's performance. In other words, we can presume that in the absence of the overconfidence bias of the CEO, the individual and firm specific characteristics are almost identical across the two samples and we can presumably expect similar evolution of the operational and financial performance of these two groups. Table 2 presents the summary statistics of the sample of Overconfident CEOs, Predicted overconfident CEOs and All non-Overconfident CEOs. For each variable it also provides the p-values for the t-test of the hypothesis that the difference between overconfident and predicted overconfident CEOs (second to last column) and overconfident and all non-overconfident CEOs (last column) is zero. Among the variables used for the matching procedure, eight are significantly different between overconfident CEOs and all non-overconfident CEOs while none of them are significantly different between overconfident CEOs and the matched predicted overconfident CEOs. There is also no remaining significant difference in the distribution across industries in the three sub-samples.

Table 2: Summary statistics

	Overconfident CEOs(O)			Predicted overconfident CEOs(P)			All non-overconfident CEOs(A)			Diff. in means			
	Obs.Mean	Median	Std.Dev.	Obs.Mean	Median	Std.Dev.	Obs.Mean	Median	Std.Dev.		p(O-P)/p(O-A)		
Match variables													
Founder (dummy)	912	0.406	0.491	0.000	912	0.404	0.491	0.000	18610.356	0.479	0.000	0.9240	0.0127
Female	912	0.025	0.157	0.000	912	0.023	0.150	0.000	18610.035	0.185	0.000	0.7604	0.2346
MBA (dummy)	912	0.294	0.456	0.000	912	0.309	0.462	0.000	18610.218	0.413	0.000	0.4753	0.0000
Age	912	50.5887	286	49.00	912	50.1686	755	50.0000	186251.5467	249	51.00	0.2019	0.0002
Age2	912	2612	760	2401	912	2562	698	2500	18622709	764	2601	0.1454	0.0003
Cash Compensation (in K\$)	912	1315	1512	815	912	1368	1540	800	18121205	1396	686	0.4620	0.0438
Tenure2 (in n of months)	912	24762	41839	11664	912	23319	33566	12321	183923836	32960	12996	0.4166	0.7277
CEO owns majority (dummy)	912	0.688	0.464	1.000	912	0.657	0.475	1.000	18710.701	0.458	1.000	0.1627	0.8589
Chm., pres.& CEO (dummy)	912	0.349	0.477	0.000	912	0.373	0.484	0.000	18610.378	0.485	0.000	0.2837	0.0426
GIM index	912	10.9102	712	11.000	912	10.9932	899	11.000	186510.5082	970	11.000	0.5262	0.0031
Tobin's Q [-1]	912	0.712	0.621	0.021	912	0.585	0.446	0.224	18510.527	0.600	0.397	1.0000	0.3867
Return on Assets [-1]	912	-0.663	16.729	4.540	912	-0.222	15.475	2.640	1782-0.223	14.721	1.940	0.9378	0.0286
Return on Equity [-1]	912	-3.281	37.069	9.250	912	-0.957	33.187	8.070	18041.188	27.783	7.675	0.4307	0.0009
Other firm variables													
Total Assets (in)	910	2428	6814	313	907	3890	10570	582	18453486	10531	560	0.0005	0.0016
Market Capitalization (in)	912	2342	8355	489	911	2863	6844	396	18632351	8001	286	0.1452	0.8378
Book-to-market	906	0.511	0.517	0.380	897	0.785	1.473	0.475	17660.577	3.163	0.529	0.0000	0.2584
Cash Flows (by capital)	900	12.355	102.96	0.967	894	4.863	25.070	0.775	180220.0674	61.86	0.764	0.0346	0.7066
Capex to sales	844	11.565	253.4190	0.014	834	0.295	1.785	0.015	16732.544	33.434	0.018	0.1992	0.076
E-index	912	2.714	1.480	3.000	912	2.702	1.503	3.000	18652.477	1.593	2.000	0.8629	0.0009
Instit. blockholder (dummy)	902	0.867	0.340	1.000	885	0.806	0.396	1.000	17210.787	0.410	1.000	0.0005	0.0001
Separate Chair (dummy)	912	0.333	0.472	0.000	912	0.311	0.463	0.000	18710.336	0.473	0.000	0.3166	0.8595

	Overconfident CEOs(O)		Predicted overconfident CEOs(P)		All non-overconfident CEOs(A)		Diff. in means p(O-P)p(O-A)
	Obs.Mean	MedianStd.Dev.	Obs.Mean	MedianStd.Dev.	Obs.Mean	MedianStd.Dev.	
Other CEO characteristics							
Total Compensation (in)	762 2819 8404	598	720 2754 8779	578	14662605	7931 611	0.8842 0.8026
Finance Education (dummy)	912 0.202 0.402	0.000	912 0.162 0.369	0.000	18610.161	0.368 0.000	0.0289 0.0023
Technical Education (dummy)	912 0.212 0.409	0.000	912 0.145 0.352	0.000	18610.110	0.313 0.000	0.0002 0.0000
Depression Baby (dummy)	912 0.038 0.192	0.000	912 0.016 0.127	0.000	18610.031	0.174 0.000	0.0041 0.4834
Industries							
Information Technology	28% Utilities	2%	Info.Tec. 18%	Utilities 1%	Info.Tec. 17%	Utilities 1%	
Financials	7% Healthcare	22%	Fin. 23%	Health. 16%	Fin. 27%	Health. 13%	
Consumers Discretionary	11% Energy	5%	Cons.Dis. 12%	Energy 6%	Cons.Dis.12%	Energy 5%	
Materials	8% Cons. St.	3%	Materials 6%	Cons.St. 3%	Materials 6%	Cons.St. 3%	
Industrials	11% Tel. Ser.	1%	Ind. 14%	Tel.Ser. 1%	Ind. 15%	Tel.Ser. 1%	

Notes. The sample includes all firms in all years in which CEO overconfidence is measured. Cash compensation is salary plus bonus, CEO owns majority is a dummy variable equal to one if the CEO owns at least 50% of the company's equity, Chm., pres. & CEO is a dummy variable equal to one if the CEO is also Chairman and President of the Board. GIM index is a governance index as in Gompers et al. (2003). ROA[-1] is the company's Return on Assets at the end of the fiscal year prior to the measure of overconfidence, defined as Operating income divided by Total Assets, ROE[-1] is the company's Return on equity at the end of the fiscal year prior to the measure of overconfidence, defined as Earnings divided by Total Equity. Tobin's[-1] is the ratio of market value of assets book value of assets at the end of the fiscal year prior to the measure of overconfidence. Market Capitalization is Common Stock times the share price at the end of the fiscal year. Book-to-market is book equity over market capitalization. Cash flow is earnings before extraordinary items plus depreciation normalized by Capital at the beginning of the year. E-index is constructed as in Bechuk et al. (2009). Institutional blockholder is a dummy variable equal to one when an institutional investors holds more than 5% of the firm's equity (as in Cremers and Nair (2005)). Total compensation is Cash compensation plus Non-Equity Incentive Plan Compensation plus All Other Compensation. Depression baby is a dummy variable equal to one if the CEO was born between 1925 and 1935 (Malmendier and Nagel, 2011). The column p(O-P) shows the p-values of the t-tests that the difference in means between Overconfident CEOs (O) and predicted overconfident CEOs (P) is zero, and p(O-A) shows the p-values of the t-tests that the difference in means between Overconfident CEOs (O) and all non-overconfident CEOs (A) is zero. * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Several additional robustness checks allow us to test the quality of the matching procedure. We perform the same sort of test of significant difference in means for 12 additional variables that are not included in the matching procedure (reported in Table 2). This allows us to check for the similarity between the treated and the control sub-samples, both on the individual CEO level and on the firm level. None of the firm related variables are significantly different between the Overconfident and the Predicted Overconfident CEOs. We also confirm the similarity of the samples along several other personal characteristics such as the CEO's finance education, technical background and total compensation as well as a dummy variable if the CEO was born during the Great Depression (Malmendier and Nagel, 2011). In parallel, we perform a Kolmogorov-Smirnov test for equality of distribution functions between the treated and the control sample. The p-values of the null hypothesis that the distribution functions are equal for our matching variables is between 0.344 and 0.953, suggesting that the two sub-samples have similar distribution functions across all the matching variables. All these tests corroborate the choice of matching variables and confirm that our procedure identifies control individuals that are similar to the sample of overconfident CEOs.

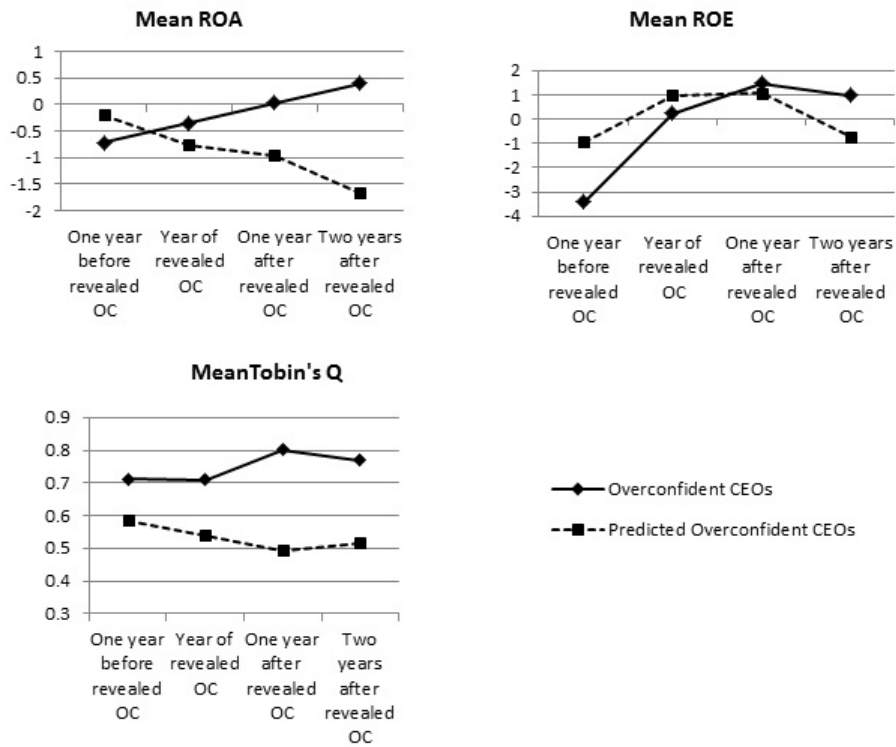
4 Results

We link CEO overconfidence to three different measures of firm performance: operational performance (measured by the company's ROA and ROE), firm value (approximated by the Tobin's Q ratio) and stock performance (represented by the estimation of cumulative abnormal returns). In this section we present the results of all the tests and comment their implications.

4.1 CEO overconfidence, Operating performance and Value of the firm

We analyze the effects of CEO overconfidence on the firm's operating performance by studying the variation of Return on Assets, the variation of Return on Equity and the variation of the value of the firm (measured by the log of the firm's Tobin's Q). We measure changes in ROA, ROE and Tobin's Q around the period when the CEO became overconfident. We call year of

Figure 1: CEO Overconfidence, Operating Performance and Value of the Firm



Notes. Predicted Overconfident CEOs are chosen using nearest neighbor propensity-score matching with controls for Age, Age2, Female, MBA (dummy), Tenure (in n° of months), Cash Compensation, Founder (dummy), CEO owns majority (dummy), Chm., pres. & CEO, GIM index, ROA[-1], ROE[-1] and Tobin's Q [-1]. Year of revealed OC is the year the CEOs was identified as overconfident. ROA is Operating income divided by Total Assets, ROE is Earnings divided by Total Equity. Tobin's Q is the ratio of market value of assets over book value of assets at the end of the fiscal year. Log values of Tobin's Q are reported in order to avoid extremes-driven results.

revealed overconfidence (T) the year when a given CEO was first identified as Overconfident based on our *HolderAboveThreshold* measure. We then retrieve data about the company’s performance from the end of the fiscal year previous to the year of revealed overconfidence (T-1), the end of the fiscal year of revealed overconfidence (T) and one (T+1) and two (T+2) years after the year of revealed overconfidence. Figure 1 plots mean values of ROA, ROE and Tobin’s Q for Overconfident CEOs and Predicted Overconfident CEOs for each of these periods.

The pattern of overconfident CEOs is quite different from the one of predicted overconfident CEOs. The mean value of ROA is increasing for Overconfident CEOs and decreasing for Predicted Overconfident CEOs. The mean value of Return on Equity follows similar patterns for the two subsamples but the difference between the mean value of ROE of Predicted Overconfident CEOs and the one of Overconfident CEOs switches from positive to negative during the year that follows the period of revealed overconfidence. Likewise, we can observe an almost symmetric evolution of the log of Tobin’s Q between the sample of Overconfident CEO’s (whose mean firm value is increasing) and the sample of Predicted Overconfident CEOs (where the Tobin’s Q ratio is decreasing over the four years).

In Table 3 we test the significance of these differences. Column 1 reports changes in ROA, ROE and Tobin’s Q for Overconfident CEOs, using the last fiscal year prior to the revelation of overconfidence (T-1) as the base year. The difference in ROA for Overconfident CEOs from the base year to two years after Overconfidence is revealed is of 1.12 base points (significant at the 1% level). This difference corresponds to 4.39 in the case of ROE and 5% in the case of the mean of the firm’s Tobin’s Q. When it comes to Predicted Overconfident CEOs the three years difference is negative both for ROA and the log of Tobin’s Q, suggesting that performance got slightly poorer during the sample period for this group. The third column of Table 3 presents the difference in differences between the Overconfident and the Predicted Overconfident CEOs from one year before becoming overconfident to zero, one and two years after. The estimator is significant for all three performance measures when we look at the three year differences. Significant differences one year after the CEO became overconfident can be noticed in the case of ROA and Tobin’s Q.

Generally, these results would suggest that CEO overconfidence has a positive effect on the firm’s operating performance and value. However, this effect is not immediate (the difference between the evolution of performance

Table 3: Overconfidence, Operating Performance and Value of the Firm

	Overconfident CEOs average	Predicted Overconfi- dent CEOs average	Difference in aver- ages	T- statistics of diff. in averages
$\Delta\text{ROA}[-1,0]$	0.356 (0.36)	-0.572 (0.35)	0.928 (0.55)	1.67
$\Delta\text{ROA}[-1,+1]$	0.741 (0.52)	-0.759 (0.36)	1.500 (0.68)	2.20**
$\Delta\text{ROA}[-1,+2]$	1.112 (0.49)	-1.472 (0.47)	2.584 (0.79)	3.28***
$\Delta\text{ROE}[-1,0]$	3.657 (1.24)	1.917 (1.24)	1.741 (2.07)	0.84
$\Delta\text{ROE}[-1,+1]$	4.913 (1.29)	1.991 (1.25)	2.922 (2.23)	1.31
$\Delta\text{ROE}[-1,+2]$	4.393 (1.35)	0.198 (1.20)	4.195 (2.20)	1.90***
$\Delta\text{Tobin's Q} [-1,0]$	-0.001 (0.02)	-0.044 (0.01)	0.043 (0.02)	1.78**
$\Delta\text{Tobins'Q} [-1,+1]$	0.089 (0.03)	-0.092 (0.02)	0.181 (0.05)	3.56***
$\Delta\text{Tobin's Q} [-1,+2]$	0.057 (0.03)	-0.068 (0.03)	0.125 (0.06)	1.97*

Notes. Δ indicates difference between the end of the fiscal year before Overconfidence was revealed and the horizon of years after overconfidence was revealed shown in brackets. ROA is Operating income divided by Total Assets; ROE is Earnings divided by Total Equity. Tobin's Q is the ratio of market value of assets over book value of assets at the end of the fiscal year. Log values of Tobin's Q are reported in order to avoid extremes-driven results. Predicted Overconfident CEOs are chosen using nearest neighbor propensity-score matching with controls for Age, Age2, Female, MBA (dummy), Tenure (in n° of months), Cash Compensation, Founder (dummy), CEO owns majority (dummy), Chm., pres. & CEO, GIM index, ROA[-1], ROE[-1] and Tobin's Q [-1]. The last column reports t-statistics for the difference-in-differences estimators. Absolute values of standard errors are in parentheses. * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

of firms in the group of overconfident CEOs and Predicted Overconfident CEOs is weakly significant during the year of revealed overconfidence). Later on, firms whose CEO became overconfident outperform firms whose CEOs were as likely to become overconfident but did not. Hence, overconfidence alone can significantly affect the variation of firms' operational performance in time.

4.2 CEO Overconfidence and market returns

The next step towards understanding the effect of overconfidence on corporate performance consists in measuring the stock market reaction to CEO overconfidence. We compute the cumulative abnormal returns after the moment the CEO becomes overconfident using a market model with the CRSP value weighted index as a proxy for market returns. We estimate α and β using three years daily returns ending at the end of the fiscal year before the CEO became overconfident. Because we cannot measure precisely the time at which shareholders become aware of CEO overconfidence we construct the event windows starting from three different dates: (i) the beginning of the year when CEO overconfidence was revealed (day 0); (ii) the 1st of July of the year when CEO overconfidence was revealed (day 125); (iii) the end of the year CEO overconfidence was revealed (day 250). We then look at the cumulative abnormal returns starting from each specific date and until one year (250 days); two years (500 days) and three years (750 days) after. Table 4 provides results about the average CAR of each event window for Overconfident and Predicted overconfident CEOs (column 1 and 2) and the cross sample difference between averages (column 3).

There is a positive difference between the average cumulative abnormal returns of overconfident CEOs versus the one of Predicted overconfident CEOs. This difference is stronger when we include in our analysis the entire year during which the CEO was first identified as overconfident (starting from day 0) suggesting that the stock market impact of CEO overconfidence is presumably quite prompt. This would imply two important ideas: not only do investors positively react to CEO overconfidence but they seem to notice and integrate it in the company's valuation quite quickly.

Furthermore, the effect of CEO overconfidence on stock performance seems long-lasting (remains significant even two years after the revelation of overconfidence) even though it fades as we go further from the time the

Table 4: CEO Overconfidence and Stock Market Performance

	Overconfident CEOs average	Predicted overconfi- dent CEOs average	Difference in aver- ages	T- statistics of diff. in averages
CAR (0, 250)	1.318 (0.07)	0.527 (0.08)	0.791 (0.14)	5.66***
CAR (0, 500)	3.923 (0.15)	2.500 (0.18)	1.422 (0.32)	4.49***
CAR (0, 750)	6.202 (0.18)	5.287 (0.21)	0.915 (0.36)	2.51*
CAR (125, 375)	1.679 (0.07)	1.267 (0.09)	0.412 (0.15)	2.70**
CAR (125, 625)	4.169 (0.13)	3.639 (0.16)	0.530 (0.27)	1.97*
CAR (125, 875)	8.451 (0.19)	7.255 (0.26)	1.196 (0.44)	2.70***
CAR (250, 500)	2.082 (0.08)	1.679 (0.09)	0.403 (0.16)	2.45**
CAR (250, 750)	4.830 (0.13)	4.752 (0.15)	0.077 (0.26)	0.29
CAR (250, 900)	7.623 (0.16)	7.208 (0.21)	0.415 (0.34)	1.22

Notes. Predicted Overconfident CEOs are chosen using nearest neighbor propensity-score matching with controls for Age, Age2, Female, MBA (dummy), Tenure (in n° of months), Cash Compensation, Founder (dummy), CEO owns majority (dummy), Chm., pres. & CEO, GIM index, ROA[-1], ROE[-1] and Tobin's Q [-1]. Event windows are in trading days with 0 as the first trading day of the year the CEO overconfidence was revealed. Expected returns are calculated using a market model with the CRSP value weighted index as a proxy for market returns. Each alpha and beta values are estimated by a 2 years estimation period ending at date 0. The last column reports t-statistics for the difference-in- average CAR estimators. Absolute value of standard errors in parentheses. * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

CEO was first identified as overconfident.

We perform an additional analysis of the stock market consequences of CEO overconfidence by constructing a zero-investment value weighted portfolio of overconfident CEOs and of non-overconfident CEOs. The portfolios are constructed in the following way. We run a new propensity score matching procedure between firms whose CEO became overconfident during the sample period and those whose CEO remained realistic during the entire sample period. In other words we restrict our sample to one period of four years and use a new, time-invariant dummy variable *HolderAboveThresholdTIV* that equals one if the CEO was revealed as overconfident at any time between 2006 and 2010 and 0 if not. Then we run a probit regression that measures the probability that a CEO would become overconfident during the 5 sample years (see Table 5). We use the results of this regression to construct the control sub-sample of Predicted Overconfident CEOs. This strategy allows us to have a sample of 278 overconfident CEOs and a control sample of 278 Predicted Overconfident CEOs who were equally likely but did not reveal overconfidence during the entire sample period.

Based on this distinction we construct 3 different value weighted portfolios. A portfolio of only overconfident CEOs, a portfolio of only Predicted Overconfident CEOs and a zero-investment strategy portfolio that buys the Overconfident CEOs stocks and sells short the Predicted overconfident CEOs stocks (for more details about this methodology see Gompers et al. (2003)). We run a time series regression of the value weighted average portfolios returns on the value-weighted market returns minus the risk free rate (RMRF) and the terms: SMB (small minus big), HML (high minus low) and Momentum which are the daily returns on a zero-investment factor-mimicking portfolio designed to capture size, book-to-market, and momentum effects.

Table 6 reports the results of the regression for the period between 2006 and 2010 (1260 trading days). The first column reports the estimations of the value-weighted portfolio of firms with overconfident CEOs whereas the second column reports results about the value-weighted portfolio of firms with Predicted overconfident CEOs. In the last column we report the results of estimating the four factors model where the dependent variable is the monthly return difference between the Overconfident CEOs portfolio and the Predicted Overconfident CEOs portfolio. We view the four factor model here as a method of performance measurement and interpret the estimated

Table 5: Determinants of Overconfidence
(Time Invariant Analysis)

	Odds- ratios	Std. Errors
Age	-0.0775	(0.065) ^{***}
Age2	0.0005	(0.001) ^{**}
Female	-0.2937	(0.262)
MBA (dummy)	0.3501	(0.118) ^{***}
Tenure (in n° of months)	0.0000	(0.000) ^{***}
Cash Compensation	0.0000	(0.000) ^{***}
Founder (dummy)	0.2403	(0.107) ^{**}
CEO owns majority (dummy)	0.0097	(0.131)
Chm., pres. & CEO	-0.0419	(0.103)
GIM index	0.0372	(0.018) ^{**}
ROA	0.0002	(0.001)
ROE	0.0000	(0.000)
Tobins' Q	-0.0008	(0.002)
Pseudo R2		0.0457
Observations		690

Notes. The sample includes all firms in each year for the period from 2006 to 2010. The dependent variable is a dummy variable (HolderAboveThresholdTIV) equal to one when a CEO has been identified as overconfident at least once during the entire sample period i.e he twice failed to exercise a stock option package that was above the year's threshold level. Cash compensation is salary plus bonus, CEO owns majority is a dummy variable equal to one if the CEO owns at least 50% of the company's equity, Chm., pres. & CEO is a dummy variable equal to one if the CEO is also Chairman and President of the Board. GIM index is a governance index as in Gompers et al. (2003). ROA[-1] is the company's Return on Assets at the end of 2005, defined as Operating income divided by Total Assets, ROE[-1] is the company's Return on equity at the end of 2005, defined as Earnings divided by Total Equity. Tobin's Q [-1] is the ratio of market value of assets book value of assets at the end of 2005. * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Table 6: Long-run returns to different portfolios

	Value-weighted portfolio of firms with OC CEOs	Value-weighted portfolio of firms with Predicted OC CEOs	Firms with OC CEOs - Firms with Predicted OC CEOs value-weighted portfolio
Alpha	0.060 (0.01)***	0.040 (0.02)***	0.025 (0.02)
RMRF	1.110 (0.01)***	1.117 (0.02)***	-0.014 (0.02)
SMB	0.205 (0.02)***	0.168 (0.03)***	0.039 (0.03)***
HML	-0.309 (0.02)***	0.021 (0.03)	-0.319 (0.03)
UMD	0.014 (0.01)	-0.018 (0.02)	0.033 (0.01)*
Obs.	1222	1220	1210
R2	0.909	0.883	0.139

Notes. Predicted Overconfident CEOs are chosen using cross-section nearest neighbor propensity-score matching with controls for Age, Age2, Female, MBA (dummy), Tenure (in n° of months), Cash Compensation, Founder (dummy), CEO owns majority (dummy), Chm., pres. & CEO, GIM index, ROA, ROE and Tobin's Q. The sample of overconfident CEOs and the one of predicted overconfident CEOs contains 278 individual observations each. The third column reports the results for the value weighted daily return of the portfolio that is long in firms with overconfident CEOs and short in firms with predicted overconfident CEOs. Alpha is the alpha from a four-factor model with the returns from a zero investment portfolio capturing market(RMRF),size(SMB),book-to-market(HML)and momentum (UMD)(see Fama and French (1993) and Carhart (1997) on the construction of these factors. The sample period is from the 3rd of January 2006 to the 31st of December 2010 (i.e. 1260 trading days). Absolute value of t-statistics in parentheses. * Significant at 10%.** Significant at 5%. *** Significant at 1%.

intercept coefficient "alpha" as the abnormal return in excess of what could have been earned by investing in the factors. The portfolio of "Overconfident - Predicted Overconfident CEOs" has a positive alpha value of roughly 25 basis points per month suggesting that firms with Predicted Overconfident CEOs underperform compared to firms with Overconfident CEOs. The results also show that the alpha is higher for a portfolio composed only by firms whose CEO revealed overconfidence during the sample period relative to a portfolio of firms whose CEOs remained realistic during the entire sample period.

Long-run stock market out-performance of firms with Overconfident CEOs is challenging to interpret. Whether investors misinterpret the CEOs positive forecasts and are persuaded by his positive attitude or they anticipate positive effect of the CEOs confidence regardless of the accuracy of his estimation is an open question. However, our results provide a meaningful insight to the debate concerning the market's reaction to CEOs who noticeably make overconfident forecasts of the firm's future.

5 The interaction effect of CEO Overconfidence and Corporate Governance

Thus far our results suggest that CEO overconfidence generally improves corporate performance. Furthermore, we argue that this bias is more likely to occur among powerful CEOs i.e. in firms where corporate governance weakly assures the protection of shareholders. Alongside, strong corporate governance has been shown to assure better financial performance (higher stock market returns) and an increase in the value of the firm (Gompers et al., 2003; Bebchuk et al., 2009).

Hence the next question of our analysis consists in looking at the joint effect of CEO overconfidence and corporate governance. In essence, along with incentivizing executives to work in the interest of shareholders, corporate governance mechanisms might groom the manager of the firm and prevent the emergence of overconfidence and other sorts of bias. In firms where corporate governance is strong, the CEO would be more conditioned to rationalizing and conservative decision making. However, eventually this increased discipline might lead to a lack of creativity and executive narrow-mindedness that would end up harming the interests of shareholders. This idea is strongly related to a larger debate in the corporate governance litera-

ture opposing two approaches of the relationship between management and shareholders, one of *control*, based on agency theory and one of *collaboration* building on notions from sociology and psychology. Surprisingly though the idea of the joint effects of a given firm’s quality of corporate governance and the psychological profile of its CEO has been quite scarcely explored and even less empirically addressed. Some recent empirical articles have argued that corporate governance can presumably “kill” the leader’s performance destroying traits or tendencies such as overconfidence (Banerjee et al., 2013). Others suggest that good corporate governance would allow a better monitoring and thus a more frequent replacement of extremely confident (optimistic) leaders (Campbell et al., 2011). The basic postulate of this literature is that executives overconfidence is value reducing and it is the role of corporate governance to “rationalize” the overconfident CEO whose biased predictions harm performance. This is however a questionable hypothesis since as previously shown the effects of overconfident beliefs on the CEO’s behavior might be valuable for shareholders. In such a case, reinforcing corporate governance in order to prevent the development of overconfident beliefs eventually reveals as an adverse strategy.

Several theoretical models have however defended the idea of CEO overconfidence as a belief that would lead to a reduction of the conflict of interest between executives and shareholders. Gervais et al. (2011) set forth the incentivizing effect of overconfidence when it comes to risky projects while De la Rosa (2011) study the motivational consequences of overconfidence that would guarantee the CEO implication and reduce the need of costly incentivizing remuneration, thus limiting the moral hazard problem. Building on this literature, we study the joint effect of CEO overconfidence and corporate governance, as two interrelated ways of aligning management and shareholders aspirations. As previously, we use the 24-items GIM index of Gompers et al. (2003) to measure the strength of corporate governance. As mentioned, a higher value of this index implies weaker shareholders rights. We take the 33rd percentile (corresponding to 10) and the 66th percentile (corresponding to 12) of the distribution of this index among firms in our sample, and use these values to separate the sample in three groups. Then we redo the entire analysis of the previous sections, by matching separately overconfident CEOs to their similar counterfactuals for each category of corporate governance. Unlike previously, we do not include corporate governance as a dependent variable in this new propensity score matching procedure since firms within each group all have similar levels of corporate governance.

Table 7: Performance of Overconfident CEOs by quality of corporate governance

	Strong governance (GIM<10)	(10≤GIM<12)	Weak governance (GIM≥ 12)
ΔROA[-1,+2]	0.243 (1.74) N=554	0.627 (0.91) N=599	4.470 (1.41)** N=844
ΔROE[-1,+2]	3.217 (4.76) N=536	4.836 (3.42) N=596	5.023 (5.02) N=867
Δlog of Tobin's Q [-1,+2]	0.121 (0.13) N=555	-0.056 (3.25) N=592	0.283 (0.09)** N=857
CAR (0, 250)	0.687 (0.29)** N=582	0.634 (0.26)** N=592	0.777 (0.24)** N=841
CAR (125, 375)	0.628 (0.29)* N=583	0.279 (0.28) N=593	0.726 (0.26)** N=841
CAR (250, 500)	0.377 (0.31) N=579	0.097 (0.30) N=594	0.460 (0.28) N=841

Notes. GIM is the governance index of Gompers et al. (2003). The 33rd and 66th percentiles of the distribution of the index among the firms in the sample (a GIM equal to ten and twelve respectively) are used to split the sample in three subgroups with different corporate governance quality. Predicted Overconfident CEOs are chosen using nearest neighbor propensity-score matching for each subgroup with controls for Age, Age2, Female, MBA (dummy), Tenure (in n of months), Cash Compensation, Founder (dummy), CEO owns majority (dummy), Chm., pres. & CEO, ROA[-1], ROE[-1] and Tobin's Q [-1]. Δ indicates difference between the end of the fiscal year before Overconfidence was revealed and the horizon of years after overconfidence is revealed shown in brackets. ROA is Operating income divided by Total Assets; ROE is Earnings divided by Total Equity. Tobin's Q is the ratio of market value of assets over book value of assets at the end of the fiscal year. Log values of Tobin's Q are reported in order to avoid extremes-driven results. Expected returns are calculated using a market model with the CRSP value weighted index as a proxy for market returns. Each firm's alpha and beta values are estimated by a 2 years estimation period ending at date 0. Event windows are in trading days with 0 as the first trading day of the year the CEO overconfidence was revealed. N is the total number of CEOs in each category. Absolute value of standard errors in parentheses. * Significant at 10%. ** Significant at 5%. *** Significant at 1%.

Table 7 presents the results for firms with strong corporate governance ($GIM < 10$), firms with intermediate level of corporate governance ($10 \leq GIM < 12$) and firms with weak corporate governance ($GIM \geq 12$). For brevity, we only expose results about long term operating performance and value of the firm (2 years after revealed overconfidence) as they were the most significant ones in the previous sections. Similarly, we only use one year cumulative abnormal returns for the analysis of the stock market performance.

The results of Table 7 indicate that the effect of overconfidence on corporate performance is not only more significant but also stronger for firms with poor corporate governance. We find that operational outperformance of firms with overconfident CEOs is only significant for firms with higher managerial protection ($GIM \geq 12$). Additionally, we confirm a significant difference in CARs between firms with overconfident CEOs and those with predicted overconfident CEOs. This difference increases in the last subsample reflecting a reinforcement of the positive effect of overconfidence when corporate governance is weak.

By this we support the idea that CEO overconfidence and Corporate Governance can be seen as substitutes. In other words, monitoring the CEO and framing his decisions would be less necessary when he has been identified as overconfident. Our results are also in line with the literature suggesting that corporate governance mechanisms reduce the effect of CEO overconfidence on performance (Banerjee et al., 2013). However, unlike this literature, in our framework this moderating role of corporate governance is not favored since CEO overconfidence is a performance enhancing factor.

6 Discussion and conclusion

The main message of this paper is that CEO overconfidence is an endogenously generated, nurtured belief that cannot be seen independently from firm specifics and executives' personal background. Whether overconfident beliefs are related to the working environment (strong power, weak corporate governance, positive past feedback) or to individual experiences (tenure, past performance, self-image), the fact that a CEO would reveal overconfident beliefs at a precise moment during his tenure in a given company is completely contingent to the corporate and professional context. This idea holds even if we admit that overconfidence is an innate quality. In such a case, it is the complexity of the CEO recruitment process, the choice of a CEO by a given

firm or the self-selection of CEOs when applying for a specific position that would assure that the coupling between CEOs and firms is not random. In turn, the performance of these CEOs as managers of their firms is undeniably interfered by selection bias.

We explored the operating and stock performance of firms with overconfident CEOs alleviating the selection bias issue through the construction of a control sample that only differed from the basic sample on the fact that these firms' CEOs, although with similar premises for the development of overconfidence remained realistic during a given sample year.

The results of this analysis have multiple implications. First, we show a positive effect of overconfidence on corporate performance. The evolution of the mean level of ROA and ROE of firms two years after their CEO became overconfident is significantly higher than the evolution of similar firms with realistic CEOs. This is also confirmed when we analyze the variation of firms' mean Tobin's Q as a proxy for the value of the firm. Moreover, investors seem to be aware of this positive effect of overconfidence on performance as they integrate CEO overconfidence in their valuation of the company's equity. In turn, firms with overconfident CEOs have higher cumulative abnormal returns than their counterparts. The analysis of the portfolios of firms with overconfident CEOs and the portfolios of those with realistic CEOs during the period from 2006 to 2010 confirmed these results suggesting a significant outperformance of firms managed by overconfident CEOs.

The consistency between the effects of CEO overconfidence on operational and market performance would imply that investors rightfully react to CEO overconfidence. However, whether this positive reaction is related to the anticipation of improved future operational performance due to the benefits of the overconfidence bias such as risk taking, higher motivation stronger persuasiveness and better leadership or it is the effect of the capacity of the CEO to convince investors that his forecasts are accurate and thus the stock is undervalued, remains an open question. In other words, our analysis does not allow discriminating whether the investors' reaction to overconfidence is driven by their belief that the CEO has better information and thus his (biased) forecasts are seen as accurate or by their belief that the demonstration of overconfidence by the CEO would lead to better performance in the future.

Beyond suggesting that firms with overconfident CEOs perform better than firms without overconfident CEOs, our results carry the question of the performance of firms that allow the emergence of overconfidence (through

governance, power allocation or recruitment choices) compared to firms that prevent the emergence of CEO overconfidence. Several important concerns such as the process of CEO selection and the quality of the firm's corporate governance are directly related to this idea. For example we have shown that weak corporate governance is a good predictor of the probability that the firm's CEO will form overconfident beliefs. Overconfidence, on the other hand, seems to assure better future performance the same way good corporate governance has been widely demonstrated as a performance enhancing mechanism. In this line of thought, rather than seeing governance mechanisms as ways of disciplining the CEO and limiting the losses related to his overconfident decision making, we suggest an alternative sight. We argue that firms with weak corporate governance adapt through the influence that the powerful and uncontested position of the CEO would have on his beliefs and behavior. This latest would thus behave in the interest of shareholders not because of rules and incentives but because of his core beliefs. Of course, this idea and the results that support it are so far in a merely exploratory phase and need more thorough testing and analysis. Nevertheless, the results of this study globally defend the postulate according to which overconfidence among corporate leaders is not only endogenously provoked but it can also be a part of a given internal corporate equilibrium assuring long term performance and stability.

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Appendix

Description of variables

Table A.1: List of variables

Variable name	Description
Founder	Dummy variable, equals 1 if the CEO was the founder of the company
Female	Dummy variable, equals 1 if the CEO is a woman
MBA	Dummy variable, equals 1 if the CEO has an MBA degree
Age	CEO's age
Age2	CEO's square age
Cash Compensation	Annual Salary plus Bonus plus Non-Equity Incentive Plan and All Other Cash Compensation (in K\$)
Tenure	Number of months the CEO spent on the CEO position
CEO owns majority	Dummy variable, equals 1 if the CEO owns the majority of the company's shares
Chm., pres.& CEO	Dummy variable, equals 1 if the CEO is the Chairman and the President of the Board
GIM index	A 24-items corporate governance index
Tobin's Q	The ratio of market value of assets over book value of assets at the of the fiscal year
Return on Assets	The ratio of Operating income over Total Assets
Return on Equity	The ratio of Earnings divided by Total Equity
Total Assets	Total value of assets at the end of the fiscal year (in K\$)
Market Capitalization	Market Capitalization is Common Stock times the share price at the end of the fiscal year (in K\$)
Book-to-market	Book equity over market capitalization.
Cash Flows (by capital)	Cash flow is earnings before extraordinary items plus depreciation normalized by capital
Capex to sales	Ratio of Capital expenditures over Sales at the end of the fiscal year
E-index	A 6-items corporate governance(entrenchment) index
Institutional blockholder	Dummy variable, equals 1 if there is an institutional shareholder who owns more than 5% of the firm's equity
Separate Chair	Dummy variable, equals 1 if there is a corporate rule to separate the CEO and the President of the Board function
Total Compensation	Cash Compensation plus Stock Awards Value plus All Other Incentive compensation (in K\$)
Finance Education	Dummy variable, equals 1 if the CEO's college major was in Finance
Technical Education	Dummy variable, equals 1 if the CEO's college major was in Engineering
Depression Baby	Dummy variable, equals 1 if the CEO was born between 1925 and 1935
CAR	Cumulative abnormal returns computed by comparing realized returns to expected returns as estimated with the 4-factors model

Table A.2: Correlation matrix

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>
1. HAT	1.00													
2. Founder	0.07*	1.00												
3. Female	-0.04	0.00	1.00											
4. MBA	0.13*	0.00	-0.02	1.00										
5. Age	-0.12*	-0.09*	0.01	-0.03	1.00									
6. Age2	-0.12*	-0.08*	0.01	-0.03	0.99*	1.00								
7. Cash Compensation	0.06*	-0.05	0.13*	0.05*	0.08*	0.07*	1.00							
8. Tenure	-0.02	0.19*	0.09*	-0.03	0.32*	0.33*	0.07*	1.00						
9. CEO owns majority	-0.05	0.19*	-0.01	-0.09*	0.14*	0.16*	-0.08*	0.29*	1.00					
10. Chm., pres.& CEO	-0.04	0.01	0.00	0.05*	0.07*	0.07*	-0.04	0.03	0.14*	1.00				
11. GIM index	0.09*	-0.01	0.01	0.03	-0.02	-0.03	0.08*	-0.07*	-0.17*	0.00	1.00			
12. Total Assets	-0.05*	0.03	0.05	0.17*	0.04	0.03	0.33*	0.01	-0.09*	0.00	-0.01	1.00		
13. Market Cap.	0.03	0.04	-0.04	0.09*	0.05	0.04	0.45*	0.04	-0.05	-0.06*	-0.03	0.52*	1.00	
14. Book-to-market	-0.01	-0.08*	0.00	0.02	0.02	0.02	0.01	-0.01	-0.02	-0.03	0.09*	0.04	-0.01	1.00
15. Cash Flows by K	-0.01	0.05	-0.01	-0.02	-0.06*	-0.05*	-0.06*	-0.01	0.00	0.02	-0.02	-0.01	-0.01	-0.02
16. Capex to sales	0.03	0.03	-0.01	0.06*	0.01	0.01	-0.03	-0.02	0.00	-0.02	-0.02	-0.01	-0.01	-0.02
17. E-index	0.08*	-0.01	-0.02	0.06*	-0.01	-0.01	0.05*	-0.03	-0.17*	0.00	0.77*	0.01	-0.05*	0.09*
18. Instit. blockholder	0.08*	-0.11*	-0.06*	0.16*	-0.01	-0.03	0.19*	-0.07*	-0.20*	0.04	0.15*	0.10*	0.09*	-0.03
19. Separate Chair	-0.01	-0.08*	0.02	-0.04	-0.18*	-0.19*	-0.17*	-0.112*	-0.21*	-0.40*	-0.05*	-0.06*	-0.06*	0.04
20. Total Compensation	0.02	0.00	0.00	0.01	-0.01	-0.01	0.01	-0.02	0.01	0.01	0.02	-0.02	0.02	0.00
21. Finance Education	0.06*	0.08*	-0.03	0.20*	-0.10*	-0.10*	0.07*	-0.09*	-0.08*	-0.02	0.03	0.17*	0.09*	-0.06*
22. Technical Education	0.16*	0.05	-0.02	0.05*	-0.06*	-0.06*	-0.04	-0.04	-0.04	0.03	0.02	-0.05*	0.01	-0.01
23. Depression Baby	-0.01	0.04	0.02	-0.02	0.46*	0.51*	-0.04	0.30*	0.19*	0.04	-0.09*	-0.03	-0.03	0.03
24. Tobin's Q	0.00	0.07*	-0.01	-0.02	0.01	0.00	-0.04	-0.01	0.00	0.01	-0.07*	-0.02	-0.02	-0.21*
25. ROA	0.01	-0.13*	0.02	0.02	0.01	0.01	0.14*	0.03	-0.04	0.03	0.09*	0.05	0.05*	0.20*
26. ROE	-0.01	-0.02	0.01	0.03	0.04	0.04	0.03	0.01	-0.03	0.00	0.02	0.01	0.02	0.01
27. CAR (0, 500)	0.02	0.02	0.01	0.01	-0.01	-0.01	0.02	0.01	0.00	0.02	0.01	0.01	0.00	0.00
15. Cash Flows by K	<u>15</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>	<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>	
16. Capex to sales	1.00	0.06*												
17. E-index	-0.03	-0.02	1.00											
18. Instit. blockholder	-0.01	-0.07*	0.14*	1.00										
19. Separate Chair	0.03	0.02	-0.03	-0.09*	1.00									
20. Total Compensation	0.01	-0.01	0.01	0.00	-0.02	1.00								
21. Finance Education	-0.01	-0.01	0.01	0.03	-0.02	0.01	1.00							
22. Technical Education	-0.01	0.00	0.04	0.05	0.02	-0.01	-0.18*	1.00						
23. Depression Baby	-0.01	-0.01	-0.06*	-0.09*	-0.12*	-0.00	-0.06*	0.02	1.00					
24. Tobin's Q	0.02	0.03	-0.08*	-0.10*	-0.01	0.01	0.06*	-0.02	-0.01	1.00				
25. ROA	-0.07*	-0.15*	0.13*	0.15*	0.02	-0.08*	-0.09*	0.03	0.03	-0.40*	1.00			
26. ROE	-0.01	0.00	0.01	0.09*	-0.02	0.01	0.02	-0.01	0.01	-0.00	0.03	1.00		
27. CAR (0, 500)	0.07*	0.00	0.01	-0.05	-0.02	-0.07*	-0.03	0.01	0.01	0.00	0.00	0.00	1.00	