ERASMUS UNIVERSITY ROTTERDAM
Erasmus School of Economics

Master Thesis Financial Economics

CEO Overconfidence and Compensation Incentives

Name student: Sydney Siahaija
Student ID number: 407104

Supervisor: Dr. Sebastian Pfeil
Second assessor: Dr. Sebastian Gryglewicz

Date final version: July 24, 2019

Abstract

I study the relation between chief executive officer (CEO) overconfidence and CEO compensation incentives. Using compensation data of US firms, I find that overconfidence positively affects pay-performance sensitivity (Delta) and negatively affects pay-volatility sensitivity (Vega). These results are consistent with normative advice from optimal contracting models. In addition, I investigate the interaction effects of overconfidence and compensation incentives in an acquisitions setting. Compensation incentives affect both the acquisition performance and acquisitiveness of overconfident CEOs differently compared to non-overconfident CEOs. These results suggest that optimal contracting is capable of accounting for CEO overconfidence to some extent. My findings add to our understanding of the influence of behavioral traits on executive compensation design.

Keywords: Executive compensation, overconfidence, incentives, Delta, Vega, mergers and acquisitions

Contents

1 Introduction

Do chief executive officer (CEO) compensation incentives account for overconfidence? This should be the case if overconfidence affects the optimal mix of incentives for a CEO. Ideally, overconfident CEOs receive adjusted incentives corresponding to the way overconfidence and compensation incentives interact. Unfortunately, our understanding of the relation between overconfidence and compensation incentives is limited, because executive compensation and behavioral biases are typically studied separately (Gervais, Heaton, & Odean, 2011).

This thesis empirically investigates whether the overconfidence of CEOs affects the compensation incentives they are awarded. In addition, I investigate whether any differences in compensation incentives to overconfident CEOs are normatively correct. To this end, I also study the interaction of CEO overconfidence and their compensation incentives in the context of acquisitions. My findings shed light on boards of directors' ability to identify overconfidence and incentivize an overconfident CEO accordingly.

The relationship between overconfidence and compensation incentives is complex for a number of reasons. First, overconfidence is a spectrum, rather than a binary behavioral bias. Theoretical models suggest that the relation between overconfidence and performance is non-monotonic, where mild overconfidence is beneficial and extreme overconfidence is detrimental to shareholder value (Goel & Thakor, 2008; Gervais et al., 2011). Therefore, the optimal balance of incentives for an overconfident CEO likely depends on their degree of overconfidence.

Second, the commonly applied classification of compensation incentives into stock and stock options is not sufficiently sophisticated. Although these are distinct forms of equity-based compensation, they provide overlapping incentives. Therefore, stock and stock options should be distilled into sensitivity to shareholder wealth, Delta, and sensitivity to shareholder wealth volatility, Vega. Theoretical models provide distinct predictions for the relations between overconfidence and Delta versus overconfidence and Vega.

Lastly, compensation design is not purely driven by shareholder value maximization, but by multiple forces: optimal contracting, rent extraction and institutional forces (Edmans, Gabaix, & Jenter, 2017). As these forces can offer contradicting empirical predictions, the effect of overconfidence on incentives depends on the relative dominance of these forces. Since the compensation design literature generally suggests that all forces play a role, empirical predictions are not self-evident.

I empirically test whether, and how overconfidence is accounted for in compensation design using a sample of 21,511 firm-year observations from 1993 to 2018. I construct overconfidence measures following the methodology originally developed by Malmendier and Tate (2005). These measures are based on the revealed beliefs of CEOs through their late option exercise behavior. Since CEOs have high idiosyncratic risk towards their own firm, portfolio theory dictates that CEOs should exercise executive stock options when they vest. Failure to exercise deep in-the-money options reveals the belief of a CEO in their ability to increase the stock price of their firm, indicating overconfidence.

I isolate compensation incentives Delta and Vega to examine the effect of overconfidence on these specific incentives. In addition, I investigate the interaction effects of Delta, Vega and overconfidence on acquisition performance and acquisitiveness. Acquisitions provide an effective setting to study the effects of compensation incentives, as acquisitions are major, externally observable, and discretionary investment decisions (Datta, Iskandar-Datta, & Raman, 2001). By studying these interactions, I determine whether the incentives that overconfident CEOs receive are normatively justifiable.

The study of executive compensation has been plagued by endogeneity concerns. Though compensation incentives are designed to affect performance, firms expecting good performance could also award more compensation incentives (see, for example, Yermack, 1997). I address the endogeneity problem using simultaneous equations modeling, following Coles, Daniel, and Naveen (2006).

I find that CEO overconfidence affects compensation incentives. Specifically, I find that overconfidence has a positive effect on Delta and a negative effect on Vega. These findings are consistent with normative advice from theoretical models that incorporate overconfidence and compensation incentives (Gervais, Heaton, & Odean, 2003; Gervais et al., 2011).

Next, I also investigate the interaction effects of Delta, Vega and overconfidence on acquisition performance. I find that the interaction effect of Delta and overconfidence is positive, consistent with Delta being a more effective incentive for overconfident CEOs. In contrast, the interaction effect of Vega and overconfidence is negative, suggesting that Vega induces excessive risk-taking in overconfident CEOs, leading to the destruction of shareholder value. These effects on acquisition performance are consistent with empirical predictions (e.g., Gervais et al., 2003).

Lastly, I examine the interaction effects of Delta, Vega and overconfidence on the acquisitiveness of a CEO. I find that Vega positively affects acquisitiveness, while the interaction effect of Vega and overconfidence is negative. This evidence suggests that Vega effectively incentivizes acquisitiveness in non-overconfident CEOs, yet is ineffective in doing so for overconfident CEOs. This finding highlights another drawback of awarding Vega to overconfident CEOs: even if it does not actively destroy value, awarding Vega still costs money (Gervais et al., 2003).

I contribute to the literature in two main ways. First, by investigating the effect of CEO overconfidence on their specific compensation incentives. Although a similar study was conducted by Humphery-Jenner, Lisic, Nanda, and Silveri (2016), I explicitly examine Delta and Vega, while Humphery-Jenner et al. only distinguish between options and stock. Measures based on the number or value of options or stock are noisy measures of the underlying incentives (i.e. Delta and Vega) that theoretical models suggest are important (Core & Guay, 2002). My findings that overconfident CEOs receive higher Delta and lower Vega contribute to the existing evidence of optimal contracting.

Second, I explore the interaction effects of Delta, Vega and overconfidence on acquisition performance and acquisitiveness. By my knowledge, these interaction effects have not been studied in the context of acquisitions. The signs of the interaction effects of overconfidence, Delta and Vega are consistent with my findings on the effect of overconfidence on Delta and Vega. Combined, my findings suggest that overconfident CEOs receive adjusted incentives that are appropriate for overconfident CEOs, consistent with optimal contracting.

These findings suggest that boards should continue to account for managerial behavioral traits such as overconfidence when designing executive compensation. Perhaps other characteristics such as age and educational background should also be considered. In addition, optimal contracting appears to drive current compensation practices to some extent, which should be somewhat reassuring to shareholders. However, shareholders should ensure that boards, and especially compensation committees, are sufficiently independent. By installing independent directors on compensation committees, shareholders can prevent CEOs from using their influence to distort the incentives they receive.

The remainder of the thesis is structured as follows. Section 2 discusses the relevant literature and develops the hypotheses. Section 3 provides a description of the data and explains the methodology. Section 4 contains the results, provides a discussion on the relation between overconfidence and compensation incentives and reports the robustness tests. Section 5 concludes.

2 Theoretical Background and Hypothesis Development

Executive compensation design is likely driven by three non-exclusive forces (Edmans et al., 2017). First, the intention behind the use of compensation incentives is to mitigate the agency problem between shareholders and managers in order to maximize shareholder value. This is commonly called optimal contracting.

Second, the rent extraction (managerial power) view suggests that executives have the power to influence their own pay (Bebchuk, Fried, & Walker, 2002; Bebchuk & Fried, 2003). In this view, CEOs use their influence to maximize their remuneration (i.e. extract rents). They only accept compensation incentives to camouflage their rent extraction, in order to avoid shareholder outrage.

Third, institutional forces such as legislation, taxation, accounting policies and social pressures likely affect executive compensation design as well. Empirical predictions on the relation between overconfidence and incentives thus depend on the relative strength between the three forces. However, since institutional forces do not generally differentiate between overconfident and non-overconfident CEOs, only optimal contracting and rent extraction should explain any observed differences between the two groups of CEOs. I therefore develop my hypotheses from the viewpoint of optimal contracting, while contrasting these predictions with those of rent extraction.

Regarding overconfidence, two main definitions are relevant, though overconfidence has been defined in various ways by the psychology and behavioral finance literatures. First, a CEO with excessive confidence about the accuracy of their information is 'miscalibrated', causing the CEO to underestimate risk (Ben-David, Graham, & Harvey, 2013). Second, a CEO who overestimates their ability (e.g. to create shareholder value) is subject to the 'better-than-average effect', leading to optimism and the illusion of control.

I use measures of overconfidence developed by Malmendier and Tate (2005, 2008), which are operationalizations of the better-than-average effect. However, I argue that, at least in the context of investment decisions, miscalibration and the better-than-average effect lead to roughly the same behavior: increased risk-taking. A miscalibrated CEO will underestimate the risk of an investment opportunity, while the better-than-average effect leads a CEO to overestimate their ability to make an investment successful. Alternatively, optimism induced by the better-than-average effect causes the CEO to overestimate the net present value of the investment opportunity. So for either definition of overconfidence, the CEO overestimates the risk-return relationship of the investment.

It is important to note here that risk attitude is a different personality trait. Even though the risk attitude of overconfident CEOs may be similar on aggregate to non-overconfident CEOs, overconfidence leads CEOs to behave *as though* they are more risk-seeking than their non-overconfident peers (Gervais et al., 2003). Since one objective of compensation incentives is to align CEO risk-taking behavior to the risk attitude of shareholders, it becomes apparent that overconfidence should affect optimal compensation design.

A CEO's compensation package includes a delicate balance of Delta, the dollar change in the value of the CEO's wealth for a 1% change in stock price, and Vega, the dollar change in the value of the CEO's wealth for a 0.01 change in stock return standard deviation (Core & Guay, 1999). As Delta ties CEO wealth to the stock price, it incentivizes the CEO to work harder and maximize shareholder value (Eisenhardt, 1989). However, Delta also increases a CEO's idiosyncratic risk, as higher Delta increases the portion of the CEO's personal portfolio that is tied to the firm (Coles et al., 2006). This idiosyncratic risk increases CEO risk aversion, hurting shareholder value. Vega is then used as a risk-taking incentive to counteract both delta-induced risk-aversion and a CEO's natural risk aversion (Smith & Stulz, 1985; Guay, 1999).

The inclusion of overconfidence in compensation design shifts the optimal balance of Delta and Vega. In the optimal contracting view, the empirical prediction for Delta is ambiguous. Since overconfident CEOs overestimate their own ability to increase the stock price of their firm, they will overestimate the value of Delta. Therefore, it is on the one hand possible that overconfident CEOs receive lower Delta, since the same level of effort can be elicited through lower Delta, which Humphery-Jenner et al. (2016) call the *weak-incentive hypothesis*. On the other hand, since the price of effort (Delta) is lower, Gervais et al. (2011) suggest that it is relatively inexpensive to offer strong incentives to an overconfident CEO, resulting in higher Delta. Humphery-Jenner et al. (2016) call this the *strong-incentive hypothesis*.

In sum, although Delta is more effective for overconfident CEOs, optimal contracting offers an ambiguous empirical prediction regarding the sign of the effect of overconfidence on Delta. In contrast, the optimal Vega of overconfident CEOs is lower on average than for non-overconfident CEOs (Gervais, Heaton, & Odean, 2003). The reason is that overconfident CEOs already behave as though they are more risk-seeking, so further incentivizing them through Vega would induce excessive risk-taking. Thus, I have the following hypotheses that reflect the predictions of optimal contracting:

Hypothesis 1a: *Overconfident CEOs receive different Delta from non-overconfident CEOs.*

Hypothesis 1b: *Overconfident CEOs receive lower Vega than non-overconfident CEOs.*

While lower Delta for overconfident CEOs would support the weak incentive hypothesis, higher Delta would support the strong incentive hypothesis. Both outcomes could be consistent with optimal contracting. Conversely, the rent extraction prediction is not ambiguous: since an overconfident CEO overvalues Delta, overconfident CEOs will demand more Delta on average than non-overconfident CEOs. As such, higher Delta would support both optimal contracting and rent extraction, while lower Delta would only support the weak incentive hypothesis, and thus a form of optimal contracting.

Though hypothesis 1a is thus no test of optimal contracting, hypothesis 1b is. The rent extraction view offers no reason for overconfident CEOs to desire Vega. Instead, any observed preference towards Delta or Vega depends only on the effectiveness of Delta and Vega as tools for camouflage. This effectiveness hinges on the public opinion of stock and stock options as advisable forms of compensation. As such, only optimal contracting predicts lower Vega for overconfident CEOs.

The remaining hypotheses consider the relation between compensation incentives and overconfidence in the context of acquisitions. To assess the complete effect of incentives on the behavior of overconfident CEOs in acquisitions, I investigate both acquisition performance and acquisitiveness. Delta and Vega should affect acquisition performance and acquisitiveness of overconfident CEOs differently than for non-overconfident CEOs. This difference should materialize empirically, since optimal contracting is imperfect in practice due to distortions and rent extraction.

Malmendier and Tate (2008) argue that the acquisitiveness (and, by extension, acquisition performance) of overconfident CEOs depends on the cash-flow availability of their firms. In cash-rich firms, overconfident CEOs are more acquisitive, because they overestimate the returns they can generate with an acquisition. In cash-poor firms, overconfident CEOs need to seek external financing to conduct an acquisition. However, overconfident CEOs overestimate future returns compared to market participants, and therefore find external financing too costly. Malmendier and Tate therefore argue that an overconfident CEO in a cash-poor firm will underinvest, forgoing valuable acquisition opportunities. The authors find that overconfident CEOs are more acquisitive than non-overconfident CEOs, both in cash-rich and cash-poor firms. As such, their evidence neither confirms nor rejects the influence of financial constraints on the behavior of overconfident CEOs in acquisitions.

If financial constraints do affect CEO decision-making in acquisitions, optimal Delta and Vega would also depend on financial constraints. Vega could be used to incentivize an overconfident CEO in a cash-poor firm to conduct a risky, yet valuable acquisition. Vega would push this CEO to accept the (in their opinion) costly external financing, by making the CEO personally benefit. In contrast, an overconfident CEO in a cash-rich firm should not be given Vega, because Vega would only exacerbate their already overly acquisitive behavior. Therefore, the interaction of Vega and overconfidence in constrained firms should be positive. Similarly, Vega should increase acquisitiveness for overconfident CEOs in constrained firms more than for non-overconfident CEOs, since rational CEOs are less affected by being constrained. However, since prior evidence does not suggest that financial constraints affect overconfident CEOs in acquisitions, I explore these predictions in the robustness tests of section 4.4.

Disregarding financial constraints, the interaction effects of overconfidence, Delta and Vega on acquisition performance follow the previously discussed reasoning from optimal contracting models. Incentivizing an overconfident CEO with Vega to take more risk will cause excess risk-taking and hurt acquisition performance. In contrast, Delta should be more effective at increasing the acquisition performance of overconfident CEOs, compared to non-overconfident CEOs. This is due to Delta's increased effectiveness as an effort incentive, as well as Delta-induced risk aversion curbing overconfident CEOs' overly risk-taking behavior. Thus, I have:

Hypothesis 2a: *Delta affects acquisition performance more positively for overconfident CEOs than for non-overconfident CEOs.*

Hypothesis 2b: *Vega affects acquisition performance more negatively for overconfident CEOs than for non-overconfident CEOs.*

Lastly, the interaction of Delta, Vega and overconfidence is also investigated for CEO acquisitiveness. Overconfident CEOs have been found to be more acquisitive than non-overconfident CEOs (Malmendier & Tate, 2008). Vega is designed to increase risk-taking, and by itself should increase acquisitiveness. However, multiple reasons exist for a negative interaction of overconfidence and Vega. An overconfident CEO who is also given high Vega could be limited by the availability of suitable targets or time required to conduct acquisitions. Alternatively, it is possible that the acquisitiveness of overconfident CEOs is less affected by Vega, because the marginal effectiveness of Vega decreases with higher risk-seeking behavior. In contrast, theory provides no empirical prediction for the interaction effect of overconfidence and Delta.

Hypothesis 3: *Vega affects acquisitiveness more negatively for overconfident CEOs than for non-overconfident CEOs.*

3 Data and Methodology

3.1 Data Collection

The sample consists of 1664 publicly-traded U.S. firms with 21,511 firm-years from 1993 - 2018. To be included in the sample, a firm needs to have conducted at least one corporate acquisition during the sample period. I use the Thomson One Mergers and Acquisitions database to obtain transaction data. Following related acquisition-based literature (e.g. Datta et al., 2001), I apply a number of restrictions to the selection of transactions. Transactions need to be: (1) listed as completed and have both announcement and effective/unconditional dates within the sample period, (2) identified as a merger or acquisition of majority interest (over 50%) by Thomson One (for mergers), (3) explicitly identified as tender offers by Thomson One, (4) greater than 1% of acquirer market capitalization. Additionally, I exclude firm-years from the sample if either executive compensation, stock return or firm financial data of the acquiring firm are not available.

The ExecuComp database provides executive compensation data on salary and compensation incentives which are also used to construct the overconfidence measures. ExecuComp further restricts the sample size, since it only includes (former) S&P 1500 firms. Since this thesis examines only CEOs, I only construct compensation incentives and overconfidence measures for CEOs. In some firm-years, ExecuComp fails to identify a CEO based on the *pceo* and *ceoann* variables, even though there is an executive who appears to be CEO based on the *becameceo* and *leftofc* variables. Following Coles et al. (2006), I classify such an executive as CEO in these years. Firm-years for which no CEO is identified are eliminated. Stock return and firm financial data, which are also used to construct financial constraint measures, are obtained from CRSP and Compustat respectively. Consistent with prior literature, I eliminate financial and utility firms (SIC codes 6000-6999 and 4900-4999 respectively).

Table 1 presents the distribution of deals and average deal values through time. The frequency distribution indicates no considerable clustering of deals throughout the sample period, but shows that stock acquisitions were more popular in the 90's, while cash financing became dominant after the burst of the dot-com bubble. The cyclicality of the merger market becomes apparent from the concentrations of higher average deal values around the dot-com bubble, the years prior to the financial crisis and the most recent surge from 2013 onward in the sample period.

3.2 Variable Construction

For each firm-year, I compute the CEO's compensation incentives Delta and Vega. Delta is the change in the dollar value of the CEO's wealth for a 1% change in the stock price of the CEO's firm. Vega is the change in the dollar value of the CEO's wealth for a 0.01 change in the annualized standard deviation of stock returns of the CEO's firm. I calculate Delta and Vega following the methodology of Guay (1999) and Core and Guay (2002). They use the Black-Scholes (1973) option valuation model as modified by Merton (1973) to account for dividends. See appendix B for the details of this process.

The overconfidence measures are constructed following the methodology of Malmendier and Tate (2005, 2008). They measure overconfidence as a CEO's failure to sell their vested stock options when they should be reasonably expected to do so. CEOs generally have large holdings

Table 1

Descriptive Statistics of Acquisitions, 1993-2018

This table provides descriptive statistics for my sample of 3897 acquisitions between January 1, 1993 and December 31, 2018, that meet the following criteria: (1) listed as completed and have both announcement and effective/unconditional dates within the sample period, (2) identified as a merger or acquisition of majority interest (over 50%) by Thomson One (for mergers), (3) explicitly identified as tender offers by Thomson One, (4) greater than 1% of acquirer market capitalization. Acquirers need to have executive compensation data in ExecuComp, financial statement data in Compustat and stock return data in CRSP. Mean deal values are inflation-adjusted for 2018 using the U.S. Consumer Price Index. The deal consideration is Cash (stock) when a deal is financed with cash (stock) and not with stock (cash). A hybrid consideration indicates that both cash and stock were used to finance the deal.

	Acquisitions N	Cash Offers N	Stock Offers N	Hybrid Offers N	Deal Value ($ Millions) Mean
1993	91	55	17	19	199
1994	106	70	18	18	319
1995	121	75	28	18	437
1996	150	84	37	29	671
1997	174	108	36	30	469
1998	180	112	42	26	829
1999	185	110	49	26	1832
2000	173	101	32	40	1226
2001	153	93	25	35	846
2002	180	127	10	43	738
2003	170	129	8	33	501
2004	183	149	6	28	516
2005	198	155	4	39	874
2006	177	143	7	27	977
2007	174	148	3	23	647
2008	165	139	5	21	502
2009	146	114	7	25	1645
2010	157	127	2	28	715
2011	174	154	3	17	668
2012	184	163		21	528
2013	132	112	6	14	882
2014	157	131	4	22	917
2015	133	102	1	30	1649
2016	126	103	1	22	1240
2017	101	79		22	962
2018	7	7			997
Total	3897	2890	351	656	841

of stock and stock options, as well as their human capital, tied to the firm they run. To ensure that these holdings incentivize the CEO over the long term, they are generally in the form of restricted stock and unvested options so that they cannot be immediately sold. Additionally, CEOs are prohibited from hedging the exposure that these incentives create.[1] As a result, CEOs tend to be heavily undiversified.

When a CEO's options finally vest, portfolio theory dictates that the CEO should exercise their options immediately. Malmendier and Tate (2005) argue that CEOs who fail to do so are overconfident, because they overestimate the future returns they can generate, and thus the value of their stock options. As such, Malmendier and Tate's overconfidence measures operationalize manifestations of overconfidence in the sense of the better-than-average effect. Following their methodology, I construct the Holder67 and Longholder measures of overconfidence. For the details of this procedure, see appendix C.

I construct the Kaplan and Zingales (1997) index of financial constraints (KZ-index), following the methodology of Lamont, Polk and Saá-Requejo (2001). The KZ-index is constructed based on the logit regression coefficients provided by Kaplan and Zingales in Lamont et al. (2001). The KZ-index is a linear combination of five accounting ratios: cash flow to total capital, market to book ratio, debt to total capital, dividends to total capital and cash holdings to capital. The KZ-index is higher for more financially constrained firms. Appendix A specifies the formula and data used to calculate the KZ-index.

Table 2 presents summary statistics on all variables used in my regression analysis. Consistent with prior literature (Coles et al., 2006; Armstrong and Vashishtha, 2012), I winsorize all non-binary variables at the first and 99th percentiles to mitigate the influence of outliers. The mean (median) Delta of $618,801 ($205,089) and Vega $118,661 ($44,253) are in line with previous studies (e.g. Coles et al., 2006; Liu & Mauer, 2011; Hirshleifer, Low, & Teoh, 2012). The means of overconfidence measures Holder67 (62%) and Longholder (42%) are in line with Malmendier and Tate (2005, 2015). These means show that approximately half of all firm-years has an overconfident CEO, based on either measure.

The selection of control variables is based on existing literature. Depending on the dependent variable, I include *Size* defined as CRSP market capitalization, *Leverage*, *Book-to-Market*, *Pre-acquisition Standard Deviation*, *Relative Size*, *Tender Offer* and the previously defined KZ-index. I also include CEO characteristics *Tenure*, *Age* and *Salary*. Appendix A provides detailed descriptions and sources of all variables.

[1]For example, Apple indicates the following in its 2018 proxy statement: "We prohibit short sales, transactions in derivatives of Apple securities, including hedging transactions, and pledging of shares by our named executive officers."

Table 2

Summary Statistics

This table presents descriptive statistics on the regression variables grouped according to *CEO characteristics*, *Firm characteristics* and *Transaction characteristics*. The sample contains 21,511 firm-years with nonmissing values for all necessary variables. See appendix A for detailed descriptions and sources of the variables. All continuous variables are winsorized at the first and 99th percentiles.

	Mean	Std. Dev.	10th Pctl.	50th Pctl.	90th Pctl.	Obs.
CEO characteristics						
Delta ($000s)	617.92	1304.14	28.80	205.09	1416.03	21511
Vega ($000s)	118.66	202.67	5.20	44.25	301.18	21511
Salary ($000s)	640.59	374.70	265.44	573.57	1050.00	21511
Tenure	8.79	7.06	1.00	7.00	19.00	21511
Age	54.05	7.40	45.00	54.00	63.00	19201
Holder67	0.62	0.48	0.00	1.00	1.00	21511
Longholder	0.42	0.49	0.00	0.00	1.00	9571
Firm characteristics						
Size ($ millions)	7189.11	23731.20	207.18	1292.97	13773.73	21511
Leverage	0.22	0.18	0.00	0.21	0.45	21511
Book-to-Market	0.50	0.37	0.15	0.42	0.92	21511
KZ-index	-1.18	4.39	-4.73	-0.03	1.77	19737
Transaction characteristics						
CAR (-1, 0)	0.00	0.05	-0.04	0.00	0.05	3897
Dealdummy	1.00	0.00	1.00	1.00	1.00	3897
Runup	0.21	0.40	-0.22	0.19	0.66	3355
Pre-acquisition Std. Dev.	0.19	0.10	0.10	0.17	0.32	3897
Relative Size	0.16	0.24	0.02	0.07	0.39	3897
Tender Offer	0.07	0.26	0.00	0.00	0.00	3897

3.3 Event-study Methodology

I conduct a short-horizon event-study to investigate how compensation incentives relate to overconfidence in determining the stock market reaction at acquisition announcements. The acquisition announcements are events (day 0) and the market model is used as the normal return model. The market model parameters are estimated over 205 days to 6 days prior to the event, following Moeller, Schlingemann, and Stulz (2004). The dependent variable in the short-run event-study is the cumulative abnormal return (CAR) over the two days surrounding the event date (-1, 0).

3.4 Endogeneity Concerns

Numerous studies have indicated that the relation between compensation incentives and (acquisition) performance may be jointly determined. For example, Yermack (1997) suggests that instead of firms with high-incentive CEOs performing better, firms expecting better performance give more incentives. In the context of acquisitions, it is plausible that CEOs request more incentive compensation prior to the announcement of an acquisition, because they either know that the acquisition will be received well (in which case they will request increased *Delta*) or they know that the acquisition will at least increase stock price volatility (in which case they will request increased *Vega*). From the optimal contracting perspective, if shareholders know that there are acquisition opportunities, or that there will be in the near future, shareholders should adjust compensation incentives to induce the CEO to conduct the right acquisitions.

Additionally, the now banned options backdating practice has increased endogeneity in the relation between stock options grants and subsequent performance. Lie (2005) found that more than 2000 companies used options backdating in some form in the period 1996-2002. Even though the Securities and Exchange Commission (SEC) put an end to this practice on August 29, 2002, it is prudent to methodologically tackle the endogeneity problem.

Not only are compensation incentives and acquisition performance endogenously related, but incentives Delta and Vega are as well. Vega is used to counteract Delta-induced risk aversion, which means the amount of Vega depends on the amount of Delta. More generally, if total compensation is a given amount, the allocation to each type of compensation depends on all other allocations. Since Delta and Vega are determined simultaneously as components of the same compensation package, they are jointly determined.

Since both Delta and Vega are endogenous with respect to acquisition performance and to each other, I use simultaneous equations models, following Coles et al. (2006). The system of equations has the CAR, and contemporaneous Delta and Vega as its jointly determined variables:

$$CAR = f\{Delta, Vega, Overconfidence, Controls\},$$
$$Delta = f\{CAR, Vega, Overconfidence, Controls\},$$
$$Vega = f\{CAR, Delta, Overconfidence, Controls\}.$$

4 Results and Discussion

4.1 The Effect of Overconfidence on Delta and Vega

Table 3 presents the results of OLS regression analyses regarding the effect of overconfidence on compensation incentives Delta and Vega. As previously hypothesized, I expect overconfidence to affect Delta with unclear sign, and affect Vega negatively. Year and industry (two-digit SIC) fixed effects are included in all specifications to control for time-variant trends in compensation incentives, as well as industry related differences. Controlling for firm fixed effects would reduce the power of the tests, since the overconfidence measures are largely time-invariant for a single firm. Reported *t*-statistics are based on robust standard errors throughout these and all further results. The natural logarithm of Delta is the dependent variable in models 1-5, while the natural logarithm of Vega is the dependent variable for models 6-10.

The main variables of interest are overconfidence measures Holder67 and Longholder, which have a positive effect on Delta, significant at the 1% level in all specifications. This is consistent with hypothesis 1a that overconfident CEOs receive different Delta. As previously discussed, higher Delta for overconfident CEOs does not unilaterally support optimal contracting or rent extraction. From the optimal contracting perspective, higher Delta for overconfident CEOs is consistent with the strong incentive hypothesis, supporting the notion of Gervais et al. (2011) that overconfident CEOs should be strongly incentivized, since it is relatively inexpensive to offer strong incentives to an overconfident CEO. In the rent extraction view, overconfident CEOs overvalue Delta relative to non-overconfident CEOs, and therefore have a reason other than camouflage to request Delta. My finding of higher Delta for overconfident CEOs is in line with Humphery-Jenner et al. (2016), who found that overconfident CEOs receive more stock than non-overconfident CEOs.

In contrast, Holder67 and Longholder have a negative effect on Vega, significant at the 1% level in all specifications. This is consistent with hypothesis 1b that overconfident CEOs receive lower Vega. This finding supports the optimal contracting view, since theoretical models suggest that overconfident CEOs should receive less Vega than non-overconfident CEOs (Gervais et al. 2003; Gervais et al. 2011). Since the rent-extraction view offers no reason for overconfident CEOs to want different Vega from non-overconfident CEOs, this finding does not support the rent-extraction view. The results are economically significant. Overconfident CEOs have 61% higher Delta (Model 3) and 30% lower Vega (Model 8) than non-overconfident CEOs. These findings suggest that Delta and Vega are indeed adjusted for overconfidence in a manner that is consistent with optimal contracting.

Table 3

Multivariate Regression Analysis: Effect of Overconfidence on Delta and Vega

The table presents OLS regressions of Delta and Vega on overconfidence measures and controls. The dependent variables are the natural logarithms of Delta (Models 1-5) and Vega (Models 6-10). Delta is the dollar change in the value of the CEO's wealth for a 1% change in stock price. Vega is the dollar change in the value of the CEO's wealth for a 0.01 change in stock return standard deviation. Holder67 and Longholder are dummy measures of overconfidence. All variables are as defined in appendix A. Within parentheses are t-statistics based on robust standard errors. Statistical significance at the 10%, 5% and 1% levels is indicated by *, **, and *** respectively.

	Delta(ln)					Vega(ln)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Holder67		1.0683***	0.6090***		0.6099***		0.3190***	-0.3013***		-0.3121***
		(51.78)	(40.24)		(37.72)		(13.86)	(-16.13)		(-15.58)
Longholder				0.2534***					-0.1535***	
				(13.37)					(-6.03)	
Vega(ln)	0.6219***		0.3804***	0.3977***	0.3790***					
	(71.04)		(37.81)	(32.65)	(35.78)					
Delta(ln)						0.6973***		0.5535***	0.7358***	0.5548***
						(108.40)		(50.05)	(47.07)	(47.83)
Leverage			-0.2737***	-0.0959*	-0.3018***			0.2082***	-0.0578	0.2431***
			(-6.29)	(-1.67)	(-6.54)			(4.16)	(-0.77)	(4.52)
Size(ln)			0.2854***	0.2763***	0.2828***			0.2148***	0.1426***	0.2106***
			(36.00)	(27.36)	(33.93)			(24.82)	(11.88)	(23.07)
Book-to-Market			-0.1841***	-0.2122***	-0.1987***			0.2452***	0.1638***	0.2505***
			(-7.93)	(-6.91)	(-8.15)			(10.38)	(4.58)	(10.13)
Salary(ln)			0.1442***	0.1818***	0.1517***			0.6058***	0.4690***	0.6143***
			(6.07)	(5.54)	(6.08)			(23.49)	(13.30)	(22.44)
Tenure			0.0497***	0.0650***	0.0492***			-0.0122***	-0.0300***	-0.0120***
			(41.03)	(34.69)	(39.10)			(-8.40)	(-11.80)	(-7.97)
Age			0.0109***	0.0069***	0.0110***			-0.0101***	-0.0011	-0.0094***
			(9.97)	(4.70)	(9.67)			(-8.25)	(-0.56)	(-7.30)
KZ-index					0.0048					-0.0045
					(1.26)					(-1.14)
KZ-index*Holder67					-0.0026					-0.0078*
					(-0.62)					(-1.72)
Constant	6.3383***	11.2975***	4.8172***	4.4177***	4.8276***	0.5993	8.6971***	-2.4965***	-3.7131***	-2.5741***
	(17.90)	(46.55)	(16.31)	(16.25)	(16.24)	(1.60)	(31.31)	(-5.12)	(-7.42)	(-5.23)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.501	0.220	0.673	0.724	0.673	0.501	0.127	0.584	0.607	0.584
Observations	21511	21511	19140	9449	17601	21511	21511	19140	9449	17601

* p<0.1, ** p<0.05, *** p<0.01

The selection of control variables is based on similar regressions in prior literature, such as those using options and stock as dependent variables (e.g. Otto, 2014; Humphery-Jenner et al., 2016). Tenure and Age are positively associated with Delta, but negatively associated with Vega. Both Size and Salary are positively associated with both Delta and Vega. Leverage and Book-to-market are negatively associated with Delta, but positively associated with Vega. Both Delta and Vega are positively associated with each other.

As final control variables, the Kaplan-Zingales index (KZ-index) of financial constraints and its interaction effect with overconfidence are included in models 5 and 10. Since the investment decisions of overconfident CEOs are sensitive to cash flows (Malmendier & Tate, 2005), it is possible that financial constraints also affect acquisition performance and acquisitiveness differently for overconfident CEOs. Vega could be more effective for overconfident CEOs in constrained firms to overcome the underinvestment problem.

However, I find a weakly significant negative interaction of KZ-index and Holder67, suggesting that Vega is lower for overconfident CEOs in constrained firms. This negative interaction adds to the individual negative effects of overconfidence and financial constraints. This finding could be explained by boards being unable to identify either overconfidence or financial constraints. However, this is unlikely since boards appear to incentivize overconfident CEOs appropriately when disregarding financial constraints and financial constraints should be visible to boards. Another explanation is that boards prefer not to incentivize an overconfident CEO in a constrained firm to take risk. This could suggest that the overconfidence-induced underinvestment problem in constrained firms either does not exist or is of lesser importance in compensation design.

4.2 Acquisition Performance

I now investigate the interaction effects of compensation incentives and overconfidence on acquisition performance. Table A1 in appendix D contains OLS regressions, showing that Delta, Vega, and their interaction effects with overconfidence are insignificant. In contrast, control variables are largely significant and their signs are consistent with prior literature. The insignificant coefficients of Delta and Vega could result from bias, supporting the possibility that Delta, Vega and acquisition performance are jointly determined. I therefore use simultaneous equations models estimated using three-stage least squares (3SLS) to address this endogeneity problem.

Table 4 contains two models with the same endogenously determined variables: Delta, Vega and Cumulative Abormal Return (CAR). The CAR is a market response proxy of acquisition performance. All effects in these two models regarding variables of interest are significant at 1%.

Table 4

Simultaneous Equations (3SLS): Explaining the Two-day (-1,0) Cumulative Abnormal Returns (CARs)

The table presents simultaneous equations of CAR, Delta and Vega. In Panel A, the dependent variable is the two-day (-1,0) cumulative abnormal return (CAR) to the acquiring shareholders. In Panel B, the dependent variable is Delta, the dollar change in the value of the CEO's wealth for a 1% change in stock price. In Panel C, the dependent variable is Vega, the dollar change in the value of the CEO's wealth for a 0.01 change in stock return standard deviation. Holder67 and Longholder are dummy measures of overconfidence. All variables are as defined in appendix A. Within parentheses are t-statistics based on robust standard errors. Statistical significance at the 10%, 5% and 1% levels is indicated by *, **, and *** respectively.

	Model 1			Model 2		
	CAR	Delta(ln)	Vega(ln)	CAR	Delta(ln)	Vega(ln)
Delta(ln)	-0.1175***		0.5523***	-0.0125*		-0.1550**
	(-6.88)		(20.70)	(-1.79)		(-2.27)
Vega(ln)	0.1329***	0.4433***		0.0282***	-0.1535***	
	(7.02)	(25.47)		(3.05)	(-5.38)	
Holder67	-0.1362***	0.6582***	-0.4325***			
	(-4.98)	(14.67)	(-8.11)			
Delta*Holder67	0.1413***					
	(8.10)					
Vega*Holder67	-0.1435***					
	(-7.79)					
Leverage	-0.0004	-0.3102**	0.0698	0.0224***	-0.3514*	-0.9802***
	(-0.06)	(-2.29)	(0.46)	(2.83)	(-1.70)	(-2.92)
Size(ln)	-0.0145***	0.3300***	0.1653***	-0.0145***	0.7228***	0.6731***
	(-8.52)	(15.50)	(6.73)	(-8.25)	(19.63)	(12.59)
Book-to-Market	-0.0186***	-0.0646	0.1735**	-0.0153***	0.1638	0.4809***
	(-4.92)	(-0.92)	(2.19)	(-3.65)	(1.46)	(2.74)
Runup	0.0214***			0.0158***		
	(7.73)			(3.87)		
Relativesize	0.0035			0.0030		
	(0.93)			(0.79)		
TenderOffer	-0.0071**			-0.0018		
	(-2.53)			(-0.66)		
Cashoffer	0.0076***			0.0008		
	(4.02)			(0.37)		
Longholder				-0.1123***	0.1641**	0.0262
				(-4.92)	(2.42)	(0.24)
Delta*Longholder				0.0196***		
				(2.84)		
Vega*Longholder				-0.0120		
				(-1.40)		
CAR(-1,0)		13.0551***	-8.5471**		23.5293***	26.1376***
		(3.54)	(-2.12)		(3.86)	(2.80)
Pre-acquisition SD		0.2158	0.3518		-0.1703	0.4762
		(1.16)	(1.51)		(-0.54)	(1.12)
Tenure		0.0471***			0.0787***	
		(17.25)			(17.06)	
Salary(ln)			0.6146***			0.5733***
			(10.97)			(4.23)
Constant	0.0238	4.7263***	-2.2054***	-0.0404	7.4708***	3.0653**
	(0.67)	(9.26)	(-3.58)	(-1.20)	(10.75)	(2.44)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	-2.300	0.500	0.492	-0.375	-0.005	-0.081
Observations	3348			1489		

* p<0.1, ** p<0.05, *** p<0.01

Delta has a negative effect on CAR, which is inconsistent with Delta incentivizing the maximization of shareholder value, but consistent with Delta-induced risk aversion decreasing valuable risk-taking in acquisitions. Vega has a positive effect on CAR, suggesting that Vega induces valuable risk-taking in acquisitions. Overconfidence measures Holder67 and Longholder have negative coefficients, consistent with earlier research (e.g. Malmendier and Tate, 2008), suggesting that overconfident CEOs conduct acquisitions that are perceived more negatively by the market.

The main variables of interest are the interaction variables of Delta and Vega with Holder67 and Longholder. The interactions of Delta and Holder67/Longholder are positive, consistent with hypothesis 2a that Delta is a more effective incentive for overconfident CEOs than for non-overconfident CEOs. This finding does not rule out rent extraction as the driver of the earlier finding that overconfident CEOs receive higher Delta. However, regardless of whether optimal contracting or rent extraction drives higher Delta for overconfident CEOs, the result is beneficial to shareholders. Together, these findings suggest that overconfident CEOs receive more Delta because Delta is a more effective incentive for overconfident CEOs. This supports both rent extraction that actually benefits shareholders and the strong incentive hypothesis of optimal contracting.

The interactions of Vega and Holder67/Longholder have a negative effect on acquisition performance. This supports hypothesis 2b that the effect of Vega on acquisition performance is more negative for overconfident CEOs. This negative interaction effect is consistent with optimal contracting driving the earlier result that overconfident CEOs receive lower Vega. Hence, these combined results suggest that overconfident CEOs receive less Vega, because awarding Vega to overconfident CEOs results in excessive risk-taking which destroys shareholder value.

The signs of the control variables are consistent with prior acquisition-based literature (e.g. Datta et al., 2001; Moeller et al., 2004; Malmendier & Tate, 2008). Table 4 also provides results on the simultaneously estimated equations with dependent variables Delta and Vega. The selection of control variables for these equations is based on Guay (1999), Core and Guay (1999) and Coles et al. (2006). Delta and Vega are significantly positively associated with each other, consistent with Guay (1999), but inconsistent with Coles et al. (2006). CAR has a positive effect on Delta, supporting the rent extraction view that CEOs who expect a valuable acquisition request more Delta to personally benefit. From the optimal contracting perspective, boards that observe a valuable acquisition opportunity might increase Delta to ensure that the CEO has 'skin in the game' and is incentivized to conduct the acquisition.

CAR negatively affects Vega, possibly because a CEO expecting a valuable acquisition requests Delta instead of Vega. Conversely, when a CEO knows an acquisition will be poorly received, they will be inclined to request Vega instead of Delta in order to benefit from the increased volatility.

Holder67 has a positive effect on Delta and a negative effect on Vega, consistent with Table 3.

4.3 Acquisitiveness

Table 5 presents the results of logistic regressions investigating the effects of compensation incentives and overconfidence on acquisitiveness. The dependent variable in all specifications is a dummy variable equal to 1 if the firm announced at least one acquisition that was eventually completed in a given year. This dummy is a proxy for the acquisitiveness of the CEO, following Malmendier and Tate (2008) and Yim (2013). Holder67 has a positive effect on acquisitiveness, significant at the 1% level. This suggests that overconfident CEOs are more acquisitive than non-overconfident CEOs, consistent with existing studies (e.g. Brown & Sarma, 2007; Malmendier & Tate, 2008). The Longholder measure of overconfidence is excluded due to limited observations.

The effect of Delta is insignificant, except when Holder67 is ignored in model 2. Since I found in Table 3 that overconfidence has a positive effect on Delta, it is possible that the coefficient of Delta suffers from omitted variable bias when overconfidence is omitted. Theory provides no strong empirical prediction for the sign of the effect of Delta on acquisitiveness. Increased effort due to Delta could lead to more acquisitions, though Delta-induced risk aversion could decrease acquisitiveness. Additionally, Delta could decrease empire building by CEOs and thus their acquisitiveness by aligning their interests with shareholder value creation.

The effect of Vega on acquisitiveness is negative and significant at the 5% level when the interaction effects of Delta and Vega with overconfidence are included (Models 4 and 5). Since the interaction effect of Vega and Holder67 is negative, the opposite sign of the effect of Vega, it becomes apparent why the effect of Vega is insignificant without the inclusion of the interaction effect. The effect of Vega is positive for a non-overconfident CEO, suggesting that Vega is effective at increasing their acquisitiveness. However, Vega is ineffective at increasing acquisitiveness for overconfident CEOs, consistent with hypothesis 3.

One explanation is that overconfident CEOs already behave as though they are more risk seeking than non-overconfident CEOs, and are therefore less influenced by Vega. Other explanations could be time or opportunity constraints. Since overconfident CEOs are already more acquisitive, incentivizing them to do even more acquisitions could have a limited effect because they do not have enough time available to conduct more acquisitions, or there simply are not enough targets. Regardless of cause, these findings provide further evidence for the notion of Gervais et al. (2003) that awarding unadjusted Vega to overconfident CEOs not only induces excessive risk-taking, but is also a waste of money.

The signs of the control variables are largely consistent with existing literature. Size and Book-

Table 5

Logistic Regression Analysis: CEO Acquisitiveness

The dependent variable is a dummy variable equal to 1 if the firm made at least one acquisition that was eventually completed in a given year. Only deals with a deal size greater than 1% of the acquiring firm's market capitalization are considered. Delta is the dollar change in the value of the CEO's wealth for a 1% change in stock price. Vega is the dollar change in the value of the CEO's wealth for a 0.01 change in stock return standard deviation. Kaplan Zingales (KZ-) index is a measure of financial constraints. Holder67 is a dummy measure of overconfidence. All variables are as defined in appendix A. Within parentheses are t-statistics based on robust standard errors. Statistical significance at the 10%, 5% and 1% levels is indicated by *, **, and *** respectively.

	(1)	(2)	(3)	(4)	(5)
Leverage	0.5025***	0.4928***	0.5027***	0.5033***	0.5656***
	(4.48)	(4.38)	(4.47)	(4.47)	(4.62)
Size(ln)	0.0653***	0.0431**	0.0464***	0.0440**	0.0454**
	(5.12)	(2.50)	(2.68)	(2.54)	(2.52)
Book-to-Market	0.2080***	0.1906***	0.2061***	0.2080***	0.2388***
	(3.87)	(3.54)	(3.82)	(3.85)	(4.24)
Tenure	-0.0027	-0.0034	-0.0047	-0.0044	-0.0031
	(-0.94)	(-1.10)	(-1.51)	(-1.42)	(-0.96)
Age	-0.0079***	-0.0085***	-0.0084***	-0.0086***	-0.0088***
	(-2.97)	(-3.14)	(-3.13)	(-3.17)	(-3.07)
Holder67	0.1590***		0.1392***	0.8268**	0.9754***
	(3.68)		(3.10)	(2.50)	(2.82)
Delta(ln)		0.0502**	0.0311	0.0123	0.0198
		(2.54)	(1.51)	(0.37)	(0.56)
Vega(ln)		-0.0040	0.0026	0.0661**	0.0772**
		(-0.23)	(0.15)	(2.12)	(2.35)
Delta*Holder67				0.0217	0.0186
				(0.56)	(0.45)
Vega*Holder67				-0.0887**	-0.0995***
				(-2.50)	(-2.67)
KZ-index					0.0098
					(1.02)
KZ-index*Holder67					-0.0117
					(-1.12)
Constant	-1.1558	-1.4200**	-1.3632*	-1.8103**	-1.8821**
	(-1.64)	(-2.00)	(-1.92)	(-2.45)	(-2.52)
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
R-squared					
Observations	19161	19161	19161	19161	17613

* p<0.1, ** p<0.05, *** p<0.01

to-market have positive effects, consistent with Malmendier and Tate (2008) and Yim (2013). Tenure is insignificant, while Age is negative, consistent with Yim (2013). Malmendier and Tate

(2008) found that overconfident CEOs are unconditionally more acquisitive than non-overconfident CEOs. However, they found no significant difference between cash-rich and cash-poor firms for this effect. Using the KZ-index and its interaction effect with Holder67, I also find no significant effects.

4.4 Robustness

Here I discuss robustness checks and additional results which are either untabulated or added to appendix D to conserve space.

First, the interaction effects of Delta, Vega and overconfidence on acquisition performance are robust to variations in the event-study methodology used. I find similar results using an estimation window of (-200,-60), as used by Datta et al. (2001), or an event window of (-1, +1) as used by Moeller et al. (2004) or Malmendier and Tate (2008). I exclude deals for which the estimation window does not consist of independent observations (i.e. if deal A takes place in the estimation window of deal B, deal B is excluded). Disregarding this independency of observations by including all deals also yields qualitatively similar results.

Second, I once again consider the effects of financial constraints, this time in conjunction with incentives and overconfidence on acquisition performance. As discussed in section 2, Malmendier and Tate (2005, 2008) proposed that overconfident CEOs in cash-rich firms overinvest, because they overestimate the risk-return prospects of investment opportunities. In contrast, overconfident CEOs in cash-poor firms underinvest, because they overestimate the value of their own firm and are reluctant to raise external financing.

This underinvestment problem could be mitigated by awarding Vega to overconfident CEOs in constrained firms. Although such CEOs are reluctant to seek external financing, they could be pushed to do so by increasing their personal benefits from the acquisition. The negative interaction effect of overconfidence and Vega which I found previously would not apply, because the CEO underinvests in this scenario. As such, the interaction of Vega and overconfidence should be positive for constrained firms. I therefore include the KZ-index and its interaction effects to the specification of Table 4 Model 1, and I report this model as Table 2A in appendix D.

In contrast to the empirical predictions, Table 2A shows that the effect of the KZ-index and its interactions are insignificant. A likely reason is that there are too many confounding factors distorting the proposed relationship between incentives, overconfidence and financial constraints to observe the predicted effects. Another explanation is that the KZ-index employed does not actually measure financial constraints, as suggested by Farre-Mensa and Ljungqvist (2016). I therefore conduct the same regression using three other measures of financial constraints: Net

Cash Flow, Interest Coverage Ratio and Dividend Payout Ratio, based on the methodology of Lamont et al. (2001). In unreported regressions, replacing the KZ-index and its interactions with any of these measures yields similarly insignificant results.

5 Conclusion

I investigate whether, and how the design of compensation incentives accounts for CEO overconfidence. My empirical analysis consists of three main steps. First, I examine the effect of overconfidence on the compensation incentives that a CEO receives. Consistent with optimal contracting models, I find that overconfident CEOs receive more Delta and less Vega.

Second, I investigate the interaction effects of Delta, Vega and overconfidence on acquisition performance. I find that Delta more positively affects the acquisition performance of overconfident CEOs than non-overconfident CEOs. I also find that Vega more negatively affects the acquisition performance of overconfident CEOs than non-overconfident CEOs. From the optimal contracting view, this empirical evidence is consistent with the effects of overconfidence on Delta and Vega. The combined results suggest that overconfident CEOs receive higher Delta, because Delta is more effective for overconfident CEOs, and receive lower Vega, because Vega induces excessive risk-taking in overconfident CEOs.

Lastly, I find that Vega more negatively affects the acquisitiveness of overconfident CEOs than for non-overconfident CEOs. This suggests that Vega is ineffective at incentivizing acquisitiveness for overconfident CEOs, while it is effective at doing so for non-overconfident CEOs. Combined with the interaction of Vega and overconfidence on performance, the results suggest that giving Vega to overconfident CEOs worsens their acquisition performance, but does not substantially increase their acquisitiveness. The poor performance in acquisitions induced by Vega is thus not further amplified by higher acquisitiveness. Nonetheless, these findings suggest that awarding Vega to overconfident CEOs is often costly and ineffective.

The contributions of this thesis are as follows. First, by examining the effects of overconfidence on Delta and Vega specifically, instead of equity-based compensation in aggregate, I can more accurately describe the relation between overconfidence and compensation incentives. Second, I tackle the endogeneity problem using simultaneous equations models to mitigate biases that were potentially unaddressed in previous studies. Third, my findings suggest that boards are to some extent capable of identifying overconfidence and award an overconfident CEO with appropriate incentives. The evidence I present supports boards' capacity to contribute in managing the agency problem, even in the face of managerial attributes such as behavioral biases that make compensation design more complex. Fourth, I show that the CAR, commonly used in acquisition-related event-studies, significantly depends on overconfidence, compensation incentives and their interaction effects. My findings therefore suggest that any such study should consider controlling for these variables.

Like all studies, mine has limitations. First, I disregard short-term compensation incentives such as yearly bonusses. Murphy (2013) suggests that annual and multi-year accounting-based bonus plans may affect the behavior of a CEO to the same degree as equity-based compensation. In fact, bonus plans often award cash each year if targets are met, a more tangible reward than stock price based incentives that offer a payoff further into the future. However, bonus plans can create perverse incentives, for which the solution is generally to implement a bonus plan sensitive to shareholder wealth which also disregards market movements (i.e. indexed stock). Thus, the imperfections of bonus plans as incentives complicate studying their relation with overconfidence.

Second, the methodology of Malmendier and Tate (2005) that I use to operationalize overconfidence is limited to identifying CEOs who exhibit the better-than-average effect. Although I argued earlier that the better-than-average effect and miscalibration definitions of overconfidence could result in similar behavior in investment decisions, this is not necessarily true for all aspects of managerial decision-making. Replicating my study using an operationalization of miscalibrated CEOs and comparing the results would be an interesting avenue of future research.

Another limitation of the overconfidence measures I use is that overconfidence is likely a range rather than a binary behavioral trait. Therefore, the relationship between overconfidence and other variables such as Delta and Vega could be non-monotonous (Goel & Thakor, 2008; Gervais, Heaton, & Odean, 2011). To address this, some studies have employed categorical or even continuous measures of overconfidence based on the Malmendier and Tate methodology. However, these more continuous adaptations are noisy because moneyness is highly dependent on past stock price performance. Moreover, the conventional psychological methodology of a survey with personal questions is difficult to apply to a sample of CEOs. Nonetheless, if a more accurate continuous measure of overconfidence is developed, it would be worthwhile to re-examine the results of this study.

Overconfidence has often been attributed to CEOs, both because overconfident individuals are more likely to become CEO (Goel & Thakor; Gervais et al., 2011) and because the job could lead one to become overconfident (Daniel, Hirshleifer, & Subrahmanyam; Gervais & Odean, 2001). In psychology and behavioral finance, CEOs have also been associated with other traits such as narcissism (e.g. Resick Whitman, Weingarden & Hiller, 2009) and psychopathy (e.g. Boddy, 2017). Since I show that behavioral traits should be accounted for in executive compensation design, it would be worthwhile to investigate how far optimal contracting can and should go. In addition, individual characteristics such as age and educational background could affect the optimal incentive package for a particular CEO as well.

My findings have important implications for compensation design and corporate governance. The process of compensation design should continue to account for managerial attributes such as overconfidence. Shareholders should therefore ensure the presence of independent directors, especially on the compensation committee. Boards should remain vigilant against rent extraction and observant of the fact that many variables determine the optimal compensation for a particular CEO.

References

Apple Inc. (2017). Notice of 2018 Annual Meeting of Shareholders and Proxy Statement. Retrieved from https://www.sec.gov

Armstrong, C. S., & Vashishtha, R. (2012). Executive stock options, differential risk-taking incentives, and firm value. *Journal of Financial Economics, 104*(1), 70-88.

Bebchuk, L. A., Fried, J. M., & Walker, D. I. (2002). Managerial power and rent extraction in the design of executive compensation (No. w9068). National Bureau of Economic Research.

Bebchuk, L. A., & Fried, J. M. (2003). Executive compensation as an agency problem. *Journal of Economic Perspectives, 17*(3), 71-92.

Ben-David, I., Graham, J. R., & Harvey, C. R. (2013). Managerial miscalibration. *The Quarterly Journal of Economics, 128*(4), 1547-1584.

Black, F., & Scholes, M. (1973). The pricing of options and corporate liabilities. *Journal of Political Economy, 81*(3), 637-654.

Boddy, C. R. (2017). Psychopathic leadership: a case study of a corporate psychopath CEO. *Journal of Business Ethics, 145*(1), 141-156.

Brown, R., & Sarma, N. (2007). CEO overconfidence, CEO dominance and corporate acquisitions. *Journal of Economics and Business, 59*(5), 358-379.

Campbell, T. C., Gallmeyer, M., Johnson, S. A., Rutherford, J., & Stanley, B. W. (2011). CEO optimism and forced turnover. *Journal of Financial Economics, 101*(3), 695-712.

Coles, J. L., Daniel, N. D., & Naveen, L. (2006). Managerial incentives and risk-taking. *Journal of Financial Economics, 79*(2), 431-468.

Coles, J. L., Daniel, N. D., & Naveen, L. (2013). Calculation of compensation incentives and firm-related wealth using Execucomp: Data, Program, and Explanation (July 19, 2013).

Core, J., & Guay, W. (1999). The use of equity grants to manage optimal equity incentive levels. *Journal of Accounting and Economics, 28*(2), 151-184.

Core, J., & Guay, W. (2002). Estimating the value of employee stock option portfolios and their sensitivities to price and volatility. *Journal of Accounting Research, 40*(3), 613-630.

Daniel, K., Hirshleifer, D., & Subrahmanyam, A. (1998). Investor psychology and security market under-and overreactions. *The Journal of Finance, 53*(6), 1839-1885.

Datta, S., Iskandar-Datta, M., & Raman, K. (2001). Executive compensation and corporate acquisition decisions. *The Journal of Finance, 56*(6), 2299-2336.

Edmans, A., Gabaix, X., & Jenter, D. (2017). Executive compensation: A survey of theory and evidence. In: The Handbook of the Economics of Corporate Governance (Vol. 1, pp. 383-539). North-Holland.

Eisenhardt, K. M. (1989). Agency theory: An assessment and review. *Academy of Management Review, 14*(1), 57-74.

Farre-Mensa, J., & Ljungqvist, A. (2016). Do measures of financial constraints measure financial constraints? *The Review of Financial Studies, 29*(2), 271-308.

Gervais, S., & Odean, T. (2001). Learning to be overconfident. *The Review of Financial Studies, 14*(1), 1-27.

Gervais, S., Heaton, J. B., & Odean, T. (2003). Overconfidence, investment policy, and executive stock options. *Rodney L. White Center for Financial Research Working Paper, 15*(02).

Gervais, S., Heaton, J. B., & Odean, T. (2011). Overconfidence, compensation contracts, and capital budgeting. *The Journal of Finance, 66*(5), 1735-1777.

Goel, A. M., & Thakor, A. V. (2008). Overconfidence, CEO selection, and corporate governance. *The Journal of Finance, 63*(6), 2737-2784.

Guay, W. R. (1999). The sensitivity of CEO wealth to equity risk: an analysis of the magnitude and determinants. *Journal of Financial Economics, 53*(1), 43-71.

Hirshleifer, D., Low, A., & Teoh, S. H. (2012). Are overconfident CEOs better innovators? *The Journal of Finance, 67*(4), 1457-1498.

Humphery-Jenner, M., Lisic, L. L., Nanda, V., & Silveri, S. D. (2016). Executive overconfidence and compensation structure. *Journal of Financial Economics, 119*(3), 533-558.

Kaplan, S. N., & Zingales, L. (1997). Do investment-cash flow sensitivities provide useful measures of financing constraints? *The Quarterly Journal of Economics, 112*(1), 169-215.

Lamont, O., Polk, C., & Saá-Requejo, J. (2001). Financial constraints and stock returns. *The Review of Financial Studies, 14*(2), 529-554.

Lie, E. (2005). On the timing of CEO stock option awards. *Management Science, 51*(5), 802-812.

Liu, Y., & Mauer, D. C. (2011). Corporate cash holdings and CEO compensation incentives. *Journal of Financial Economics, 102*(1), 183-198.

Malmendier, U., & Tate, G. (2005). CEO overconfidence and corporate investment. *The Journal of Finance, 60*(6), 2661-2700.

Malmendier, U., & Tate, G. (2008). Who makes acquisitions? CEO overconfidence and the market's reaction. *Journal of Financial Economics, 89*(1), 20-43.

Malmendier, U., & Tate, G. (2015). Behavioral CEOs: The role of managerial overconfidence. *Journal of Economic Perspectives, 29*(4), 37-60.

Malmendier, U., Tate, G., & Yan, J. (2011). Overconfidence and early-life experiences: the effect of managerial traits on corporate financial policies. *The Journal of Finance, 66*(5), 1687-1733.

Merton, R. C. (1973). Theory of rational option pricing. *Theory of Valuation*.

Moeller, S. B., Schlingemann, F. P., & Stulz, R. M. (2004). Firm size and the gains from acquisitions. *Journal of Financial Economics, 73*(2), 201-228.

Murphy, K. J. (2013). Executive compensation: Where we are, and how we got there. In Handbook of the Economics of Finance (Vol. 2, pp. 211-356). Elsevier.

Otto, C. A. (2014). CEO optimism and incentive compensation. *Journal of Financial Economics, 114*(2), 366-404.

Resick, C. J., Whitman, D. S., Weingarden, S. M., & Hiller, N. J. (2009). The bright-side and the dark-side of CEO personality: examining core self-evaluations, narcissism, transformational leadership, and strategic influence. *Journal of Applied Psychology, 94*(6), 1365.

Smith, C. W., & Stulz, R. M. (1985). The determinants of firms' hedging policies. *Journal of Financial and Quantitative Analysis, 20*(4), 391-405.

Yermack, D. (1997). Good timing: CEO stock option awards and company news announcements. *The Journal of Finance, 52*(2), 449-476.

Yim, S. (2013). The acquisitiveness of youth: CEO age and acquisition behavior. *Journal of Financial Economics, 108*(1), 250-273.

Appendices

Appendix A Variable Definitions

This appendix presents the detailed definitions of the variables and their sources.

Acquisition-based dependent variables		
Cumulative Abnormal Return (CAR)	The sum of the abnormal returns of acquiring firm *i* in event-window (-1, 0) surrounding an acquisition on day (0) of year *t*. The market model is used as the normal return model, while the parameters of the normal return model are estimated over estimation window (-204, -5).	*CRSP*
Dealdummy	This dummy variable equals 1 if a firm conducts an acquisition in year *t*.	*Thomson One*
Overconfidence Measures, following Malmendier and Tate (2005)		
Holder67	This dummy variable equals 1 from the year of the first failed exercise to the end of a CEO's tenure if the CEO fails to exercise executive stock options that are at least 67% in-the-money at least two times. For more details on the construction of Holder67, see appendix C.	*ExecuComp*
Longholder	This dummy variable equals 1 for all years of a CEO's tenure if the CEO at least once during their tenure holds an option that is at least 40% in-the-money until its year of expiration. For more details on the construction of Longholder, see appendix C.	*ExecuComp*
Compensation Incentives, following Guay (1999) and Core and Guay (2002)		
Delta	Delta is the change in the dollar value of the CEO's wealth for a 1% change in the stock price of the CEO's firm in year *t*. For a more detailed construction of Delta, see appendix B.	*ExecuComp, Compustat, & Federal Reserve*

Vega	Vega is the change in the dollar value of the CEO's wealth for a 0.01 change in the annualized standard deviation of stock returns of the CEO's firm in year *t*. For a more detailed construction of Vega, see appendix B.	*ExecuComp, Compustat, & Federal Reserve*
Firm Control Variables		
Size	Market Capitalization in millions of dollars in year *t*.	*CRSP*
Leverage	= [Long-term Debt(Total) + Debt in Current Liabilities] / Total assets in year *t*.	*Compustat*
Book to Market	= Common/Ordinary Equity(Total) / Average Market Capitalization in year *t*.	*Compustat & CRSP*
Runup	The buy-and-hold return in the 250 trading days prior to the acquisition in year *t*.	*CRSP & Thomson One*
Kaplan-Zingales Index (KZ-index)	= -1.001909 * [(Income Before Extraordinary Items + Depreciation and Amortization) / Property, Plant and Equipment] + 0.2826389 * [(Liabilities and Stockholder's Equity(Total) + CRSP Market Equity - Common Equity(Total) - Deferred Taxes(Balance Sheet)) / (Liabilities and Stockholder's Equity(Total)] + 3.139193 * [(Long Term Debt(Total) + Debt in Current Liabilities) / (Long Term Debt(Total) + Debt in Current Liabilities + Stockholder's Equity(Total))] - 39.3678 * [(Dividends(Common) + Dividends(Preferred)) / Property, Plant and Equipment] - 1.314759 * [Cash and Short-Term Investments / Property, Plant and Equipment] in year *t*.	*Compustat & CRSP*
CEO Control Variables		
Age	Age of a CEO in years in year *t*.	*ExecuComp*
Salary	Salary of a CEO in millions of dollars in year *t*.	*ExecuComp*
Tenure	Tenure of a CEO in years in year *t*.	*ExecuComp*
Deal Control Variables		
Pre-acquisition standard deviation	The standard deviation of the acquiring firm in (-120, -60) days prior to the acquisition in year *t*.	*CRSP & Thomson One*

Relative Size	= ValueofTransactionmil / Market Capitalization.	*Thomson One & CRSP*
Cash Offer	This dummy variable equals 1 if the deal is financed with cash and without equity.	*Thomson One*
Stock Offer	This dummy variable equals 1 if the deal is financed with equity and without cash.	*Thomson One*
Hybrid Offer	This dummy variable equals 1 if the deal is financed with cash and equity.	*Thomson One*
Tender Offer	This dummy variable equals 1 if the deal is a tender offer.	*Thomson One*

Appendix B Calculation of Delta and Vega

Delta and Vega are commonly computed following the methodology developed by Core and Guay (2002). However, Core and Guay only show how to compute these measures using ExecuComp data in the pre-2006 period. The Financial Accounting Standards Board, which has the responsibility to set accounting standards for public companies in the United States, introduced FAS 123R in 2004, changing the format for accounting for equity-based compensation. The most pertinent of these changes was that equity-based compensation must be expensed at fair value on the grant date. As a result, ExecuComp changed its reporting format for some firms in 2006 and all firms in 2007. I refer to the old reporting format as pre-2006 and the new reporting format as post-2006.

I follow the approach of Coles, Daniel, and Naveen (2013), which is based on Core and Guay (2002) and Coles et al. (2006), but also adapts this methodology for the post-2006 reporting format. I supplement the ExecuComp data with data from the Federal Reserve on market yields of U.S. Treasury securities at constant maturities to proxy for the risk-free rate. Since only the rates for 1, 2, 3, 5, 7 and 10 year Treasury securities are available, the 4, 6, 8 and 9 year rates are obtained through linear interpolation from the available rates. For stock option grants with maturities longer than 10 years, the 10-year risk-free rate is used.

Since ExecuComp only provides Black-Scholes inputs *bs_volatility* and *bs_yield* for the pre-2006 period, I manually calculate supplementary data for these variables following the ExecuComp methodology. For the *bs_volatility* variable, I calculate stock volatility as follows: I (1) take the annualized standard deviation of CRSP stock returns estimated over the prior 60 months, (2) require at least 12 months of return data, and use mean volatility of all observations of a firm if 12 months of return data are not available, (3) winsorize the calculated volatilities at the 5% level. For the *bs_yield* variable, I take the average of current-year and prior two years of ExecuComp variable *divyield*, winsorized at the 5% level.

Of the compensation incentives reported in ExecuComp, I only take into account vested and unvested shares and options. I do not include unearned awards (unvested shares and options for which vesting is contingent on future performance). Although ignoring unearned awards will understate true Delta and Vega, the data to calculate Delta and Vega for these awards are not available. Additionally, I ignore stock Vega, as Guay (1999) shows that option Vega is many times higher than stock Vega. As a result, Delta is the sum of stock Delta and stock option Delta, while Vega is equal to stock option Vega.

Stock Delta is relatively straightforward to estimate, as it is represents a CEO's stock holdings. The variable *shrown_excl_opts* contains both restricted and unrestricted stock. I calculate stock Delta as *shrown_excl_opts* × *prccf* × 0.01. For stock option Delta and Vega, the Delta and Vega of a single option are calculated using the Black-Scholes (1973) option pricing model, as modified by Merton (1973) to account for dividends.

$$Option\ value = \left[Se^{-dT}N(Z) - Xe^{-rT}N\left(Z - \sigma T^{(1/2)}\right)\right]$$

Where

$Z = \left[\ln(S/X) + T\left(r - d + \sigma^2/2\right)\right]/\sigma T^{(1/2)}$,

N = cumulative probability function for the normal distribtion
S = price of the underlying stock
X = exercise price of the option
σ = expected stock-return volatility over the life of the option
r = natural logarithm of risk-free interest rate
T = time to maturity of the option in years
d = natural logarithm of expected dividend yield over the life of the option

$$\begin{aligned}
\text{Delta} &= \text{the sensitivity of the option value with respect to a 1\% change in stock price} \\
&= [\partial(\text{option value})/\partial(\text{stock price})] \times (\text{stock price/100}) \\
&= e^{-dT}N(Z) \times (S/100) \\
\text{Vega} &= \text{the sensitivity of the option value with respect to a 0.01 change in stock volatility} \\
&= [\partial(\text{option value}))/\partial(\text{stock volatility})] \times 0.01) \\
&= e^{-dT}N'(Z) \times S\sqrt{T} \times 0.01
\end{aligned}$$

Where $N'(d_1)$ is the normal density function.

The inputs for the Black-Scholes model need to be calculated separately for four groups of options. The pre-2006 period consists of three groups: (1) previously-granted unvested options, (2) previously-granted vested options, (3) current year's option grants. Lastly, all stock option holdings in the post-2006 period form the fourth group.

I first list the Black-Scholes inputs that are shared among all four groups of options. These inputs are grant-specific or reflect the weighted average of multiple grants, depending on availability of data in ExecuComp:

$$S = prccf$$

$$\sigma = bs\_volatility$$

$$r = \ln(1+y)$$

$$d = \ln(1+(bs\_yield/100))$$

Where y is the market yield on a U.S. Treasury security with a maturity that corresponds to the rounded maturity of the option. The risk-free rate data is obtained from the Federal Reserve website.

I now list the Black-Scholes inputs that differ by group for the four groups of options.
Group 1: Pre-2006 Previously-granted unvested options. Inputs are calculated at the CEO-year level.

$$X = prccf - \frac{(opt\_unex\_unexer\_est\_val - \sum_{g=1}^{G}(prccf_g - expric_g) * numsecur)}{(opt\_unex\_unexer\_num - option\_awards\_num)}$$

$$T = \frac{\sum_{t=g}^{G}(exdate_g - year_g) * numsecur_g}{\sum_{g=1}^{G} numsecur_g} - 1$$

Where g denotes a stock option grant. *Exdate* is transformed to a year-variable. T equals the weighted average maturity of current-year option grants minus one, or nine years if no options were granted in the current year.

Group 2: Pre-2006 Previously-granted vested options. Inputs are calculated at the CEO-year level.

$X = prccf - (opt\_unex\_exer\_est\_val / opt\_unex\_exer\_num)$

$$T = \frac{\sum_{g=1}^{G} (exdate_g - year_g) * numsecur_g}{\sum_{g=1}^{G} numsecur_g} - 4$$

Where g denotes a stock option grant. T equals the maturity of the previously-granted unvested options (Group 1) minus three.

Group 3: Pre-2006 Current-year option grants. Inputs are calculated at the grant level.

$X = expric$

$T = exdate - year$

Group 4: Post-2006 Vested and unvested current and previously-granted option grants. Inputs are calculated at the grant level.

$X = expric$

$T = exdate - year$

The single option Delta and Vega calculated using the above inputs are subsequently multiplied by the number of stock options for the CEO-year (for groups 1 and 2) or the number of stock options in the grant (for groups 3 and 4). Total Delta per grant is then summed by CEO-year. The summed Deltas and Vegas of the groups yield total stock option Delta and Vega by CEO-year. Stock option Delta is then added to stock Delta to arrive at total Delta, while stock option Vega equals total Vega. I drop all observations where Delta or Vega are 0, since I investigate the interaction of compensation incentives and overconfidence and there is no possibility of interaction when a CEO receives no incentives.

Appendix C Construction of Overconfidence Measures

Various authors have constructed the Malmendier and Tate measures of overconfidence using pre-2006 ExecuComp data (e.g. Campbell, Gallmeyer, Johnson, Rutherford, & Stanley, 2011; Hirshleifer, Low, & Teoh, 2012). In the pre-2006 period, ExecuComp provides executive compensation data at the executive-year level, but not at the individual stock option grant level. As a result, individual grant dates, expiration dates and strike prices are not known and aggregates must be used. Researchers typically approximate a measure of "average moneyness" of a CEO's stock options in a given year. Nonetheless, Malmendier, Tate, and Yan (2011) show that ExecuComp data works well after controlling for past stock return performance. Additionally, Campbell et al. (2011) show that overconfidence measures based on ExecuComp data generate results similar to those in Malmendier and Tate (2005), who used a different dataset.

For the pre-2006 period, I follow the methodology of Campbell et al. (2011). I calculate the realizable value per option by dividing ExecuComp variable *opt_unex_exer_est_val* by the number of exercisable options: *opt_unex_exer_num*. I then subtract this realizable value per option from the stock price at the fiscal year end: *prccf*. This yields an estimated average exercise price of a CEO's options in a given year. Although Malmendier and Tate (2005, 2008) only classify CEOs as overconfident who failed to exercise 67% in-the-money options with 5 years or less duration, ExecuComp data distinguishes between vested and unvested options. I can therefore omit this criterion which proxies for exercisability.

Holder67 identifies CEOs as overconfident if they fail to exercise 67% in-the-money exercisable (vested) options at least twice. For CEOs who meet this criterion, Holder67 equals 1 from the first year the CEO has average moneyness over 67% and remains 1 until the end of the CEO's tenure. The minimum of two failed exercises is chosen to measure "permanent" overconfidence rather than "transitory" overconfidence. The threshold of 67% follows Malmendier and Tate (2005), who based their thresholds of option exercise on the Hall and Murphy (2002) framework, assuming constant relative risk aversion (CRRA) of three and diversification. The Longholder variable cannot be constructed using pre-2006 ExecuComp data, since the required data only became available after FAS123R.

For the post-2006 period, I use the methodology of Malmendier and Tate (2015). In this period, ExecuComp provides an increased level of detail through transaction level-data, which increases the accuracy of the overconfidence measures. Both the Holder67 and Longholder measures can be constructed in the post-2006 period. Holder67 is constructed similar to the pre-2006 period, using grant-level maturities and exercise prices. Longholder is a dummy variable equal to 1 if a CEO holds options at least 40% in-the-money entering the final year in which those options expire. If a CEO is identified as a Longholder, the Longholder variable equals 1 in each year of the CEO's tenure.

Appendix D Additional Results

Table A1: Multivariate Regressions Explaining the Two-day (-1,0) Cumulative Abnormal Returns (CARs)
The table presents OLS regressions of CAR on Delta, Vega, overconfidence measures and controls. The dependent variable is the two-day (-1,0) cumulative abnormal return (CAR) to the acquiring shareholders. Delta is the dollar change in the value of the CEO's wealth for a 1% change in stock price. Vega is the dollar change in the value of the CEO's wealth for a 0.01 change in stock return standard deviation. Holder67 and Longholder are dummy measures of overconfidence. All variables are as defined in appendix A. Within parentheses are t-statistics based on robust standard errors. Statistical significance at the 10%, 5% and 1% levels is indicated by *, **, and *** respectively.

	(1)	(2)	(3)	(4)	(5)
Holder67	0.0025	0.0032*	0.0032	0.0047	
	(1.49)	(1.72)	(1.57)	(0.30)	
Delta(ln)		-0.0001	-0.0006	-0.0001	-0.0004
		(-0.10)	(-0.75)	(-0.05)	(-0.26)
Vega(ln)		-0.0020***	-0.0001	-0.0006	0.0005
		(-3.10)	(-0.13)	(-0.41)	(0.38)
Leverage			0.0219***	0.0220***	0.0146*
			(3.47)	(3.47)	(1.70)
Size(ln)			-0.0030***	-0.0030***	-0.0028**
			(-3.55)	(-3.49)	(-2.39)
Book-to-Market			-0.0060*	-0.0059*	-0.0084*
			(-1.70)	(-1.70)	(-1.66)
Runup			0.0075**	0.0075**	0.0121***
			(2.52)	(2.52)	(2.78)
Relativesize			-0.0099*	-0.0099*	0.0030
			(-1.66)	(-1.66)	(0.28)
TenderOffer			-0.0039	-0.0039	-0.0023
			(-1.31)	(-1.31)	(-0.48)
Cashoffer			0.0063***	0.0063***	0.0051
			(2.68)	(2.67)	(1.21)
Delta*Holder67				-0.0008	
				(-0.42)	
Vega*Holder67				0.0007	
				(0.41)	
Longholder					0.0162
					(0.64)
Delta*Longholder					-0.0015
					(-0.66)
Vega*Longholder					0.0006
					(0.32)
Constant	0.0009	0.0232***	0.0140	0.0133	0.0008
	(0.64)	(3.33)	(1.29)	(0.95)	(0.05)
Year FE	No	No	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes	Yes
R-squared	0.001	0.005	0.051	0.051	0.089
Observations	3897	3897	3355	3355	1492

* p<0.1, ** p<0.05, *** p<0.01

Table A2: Simultaneous Equations (3SLS): Explaining the Two-day (-1,0) Cumulative Abnormal Returns (CARs)
The table presents simultaneous equations of CAR, Delta and Vega. In Panel A, the dependent variable is the two-day (-1,0) cumulative abnormal return (CAR) to the acquiring shareholders. In Panel B, the dependent variable is Delta, the dollar change in the value of the CEO's wealth for a 1% change in stock price. In Panel C, the dependent variable is Vega, the dollar change in the value of the CEO's wealth for a 0.01 change in stock return standard deviation. Holder67 and Longholder are dummy measures of overconfidence. Kaplan Zingales (KZ-) index is a measure of financial constraints. All variables are as defined in appendix A. Within parentheses are t-statistics based on robust standard errors. Statistical significance at the 10%, 5% and 1% levels is indicated by *, **, and *** respectively.

	Model 1			Model 2		
	CAR	Delta(ln)	Vega(ln)	CAR	Delta(ln)	Vega(ln)
Delta(ln)	-0.0970***		0.6989***	-0.0383***		0.4716***
	(-5.24)		(23.61)	(-4.07)		(9.38)
Vega(ln)	0.1086***	0.6162***		0.0425***	0.2569***	
	(5.43)	(30.21)		(3.68)	(9.69)	
Holder67	-0.1290***	0.6601***	-0.5255***			
	(-4.84)	(11.75)	(-8.50)			
Delta*Holder67	0.1242***					
	(6.61)					
Vega*Holder67	-0.1259***					
	(-6.47)					
KZ-index	0.0028			0.0019		
	(1.23)			(0.77)		
KZ-index*Holder67	-0.0025					
	(-0.98)					
KZ-index*Vega(ln)	-0.0001			-0.0002		
	(-0.51)			(-0.83)		
KZ-index*Vega(ln)*Holder67	0.0000					
	(0.18)					
Leverage	-0.0007	-0.4831***	0.2714	0.0259***	-0.0653	-0.7241***
	(-0.10)	(-2.83)	(1.52)	(2.88)	(-0.38)	(-3.07)
Size(ln)	-0.0113***	0.2424***	0.0840***	-0.0089***	0.4163***	0.2962***
	(-6.89)	(9.75)	(3.02)	(-4.80)	(14.37)	(7.94)
Book-to-Market	-0.0165***	-0.0869	0.1451	-0.0183***	-0.1218	0.4200***
	(-3.94)	(-0.98)	(1.56)	(-3.79)	(-1.29)	(3.35)
Runup	0.0177***			0.0306***		
	(6.08)			(6.89)		
Relativesize	0.0052			0.0094*		
	(1.57)			(1.74)		
TenderOffer	-0.0065**			-0.0002		
	(-2.54)			(-0.05)		
Cashoffer	0.0044**			-0.0010		
	(2.41)			(-0.30)		
Longholder				-0.1483***	0.2079***	-0.1957**
				(-4.55)	(3.66)	(-2.56)
Delta*Longholder				0.0466***		
				(4.95)		
Vega*Longholder				-0.0394***		
				(-3.59)		
KZ-index*Longholder				0.0006		
				(0.20)		
KZ-index*Vega*Longholder				-0.0001		
				(-0.20)		
Constant	0.0194	4.0318***	-2.6455***	0.0657*	5.9297***	-2.5332***
	(0.54)	(6.44)	(-3.77)	(1.65)	(10.33)	(-2.78)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Delta and Vega Controls	No	Yes	Yes	No	Yes	Yes
R-squared	-1.606	0.151	0.258	-0.531	0.596	0.530
Observations	3040			1353		

* p<0.1, ** p<0.05, *** p<0.01