Does CEO's Holding of Vested Options Measure Overconfidence?

Ali Bayat, Reza Salehnejad, Peter Kawalek
Alliance Manchester Business School

Abstract

Option-exercise measure of overconfidence is the most widely used proxy for overconfidence in the corporate finance literature. Overexposure of CEO's wealth to firm's idiosyncratic risk has been taken as a sign of CEO overconfidence. Different accounts of the measure have been used to study most importantly the effect of managerial overconfidence on corporate investment, financial policy, innovation, merger and acquisition. The hypothesis is that overconfident CEOs behave quite differently. We trace CEOs across firms, investigating their option exercise decisions. We question the validity of option-based measures of overconfidence. Utilising both traditional econometrics methods and new Machine Learning techniques, we provide evidence that CEOs decision to hold or exercise vested options is considerably driven by firm and market conditions. We reject the view that repeated holding of well in-the-money options measure overconfidence.

Keywords: Managerial Biases, CEO Overconfidence, CEO option exercise

1. Introduction

Overconfident CEOs invest more when they have access to internal funds and forgo value increasing investment projects when they need to seek external financing(Malmendier and Tate, 2005). Compared to their peers, they undertake more value-destroying mergers(Malmendier and Tate, 2008), use less external financing(Malmendier, Tate, and Yan, 2011), hold more cash (Aktas, Louca, and Petmezas, 2015; Huang-Meier, Lambertides, and Steeley, 2015), pay less dividend (Deshmukh, Goel, and Howe, 2013) and are better at exploiting innovative growth opportunities (Hirshleifer, Low, and Teoh, 2012). The empirical adequacy of these results - among many other - hinge on the validity of the option-based measure of overconfidence. The influential role of the measure merits a critical scrutiny. This paper investigates the justification behind the measure, examining whether it ably instantiate overconfident CEOs. If CEOs persistent holding of in-the-money options measures a habitual tendency such as overconfidence, the CEO should always demonstrate similar behaviour regardless of firm and market condition . We follow the option exercise behaviour of executives when they switch firms. Does CEOs persistent failure to exercise vested options reflect overconfidence? The answer is No.

The formalised definition of overconfidence that synthesises the fragmented finding of the past research relies on CEO's perception of its own abilities and the amount of value it can create. Overconfident CEOs overestimate their own abilities and have an upward-biased view about the value of the internal and external project they pick. furthermore, they think that the firm's asset is undervalued by the market and hence external financing is costly. As a result, CEO's decisions on firm policies such as investment and mergers are shaped by a tradeoff between misperceived gains from investment (or merger) and the costs of external financing (Malmendier and Tate, 2015). [1]

CEO option-exercise measure of overconfidence is the most widely used proxy in the literature (Malmendier and Tate, 2015). It is first introduced by Malmendier and Tate (2005). They see the overexposure of CEO's wealth to firm's idiosyncratic risk as a sign of CEO overconfidence. A large portion of CEOs' compensation is tied to option contracts and a risk averse and an under-diversified CEO should exercise the option in their contract whenever the options become exercisable and hence reduce the risk. Repeated holding of vested options, delaying option exercise or buying more shares of the same firm (despite already being exposed to the risk via option contracts), as they argue, can send signals that the CEO is overconfident. The use of option-based measure of overconfidence has become

---

[1]Unlike its conception, there is no consensus on the implications of CEO overconfidence. Does CEO overconfidence benefit firms? There is no straightforward answer. For a discussion of this see, Malmendier and Tate (2015)

a common practice in the literature that studies the effect of executives overconfidence on firm policies ever since.

Despite its widespread use, less attention is paid to the validity of option-based measure of overconfidence. Previous research touched on the issue only partially and indirectly. In a first attempt to support the validity of the measure, Malmendier and Tate (2008) introduced another overconfidence measure based on CEOs' press portrayals and argued that this measure correlate with the option-based proxy. More recently, Otto (2014) utilised a new measure of overconfidence based on a firms voluntary earnings forecasts. He finds a correlation between his measure and option-based measures of overconfidence. Yet, finding relationships between different measures of overconfident does not necessarily confirm validity. Hill, Kern, and White (2014) compare seven measures of overconfidence and find existing measures are not measuring the same construct. In this study, we provide a direct examination of option-based measure of overconfidence.

Persistence is at the heart of the option-based measure of overconfidence. Malmendier and Tate (2005) distinguish overconfidence as an explanation for CEO option exercise behaviour from private information in that overconfidence is persistent and the measure of overconfidence captures a permanent trait or a habitual tendency of CEOs. The basic idea is that overconfidence drives the CEOs decision whether to exercise or hold vested options. If a CEO fails to persistently exercise options, it is an indicator that overconfidence drives the decision. A logical consequence of such a position is that an overconfidence CEO will behave similarly when she moves from one firm to another. We argue that the Malmendier and Tates measures of overconfidence fail to capture a permanent trait. We subsample and trace CEOs and executives in our dataset who worked in two different firms. We show that the Holder67 measure of overconfidence identifies a considerably large portion of those CEOs and executives as overconfident in one firm and non-overconfident in the other. This goes against the view that the measure captures a permanent trait.

If CEOs decision to hold vested options is the result of overconfidence, firms features may not correlate systematically with the decision of a CEO to exercise in-the-money options when he switches firms. We argue that firm features correlate systematically with the decision of CEOs to keep vested options when executives switch firms. This undermine the claim that the large heterogeneity in firm practices is the result of overconfidence (captured by the option-based measure). We trace CEOs across firms, investigating their option exercise decisions. Our data reveal a systematic pattern that as firm characteristics change, the decision of a single executive on whether to exercise the option or not changes systematically too. Beyond this, key firm characteristics well explain variation in both the level of moneyness of options and the frequency of holding in the money options. The view emerging from the

2

analysis suggests that exercise decision is endogenous to firm characteristics. It is not quite valid to take failure to exercise as a sign of overconfidence; firm features drive the exercise decision.

We exploit a rich panel of executives data over the period of 1996-2014. The purpose of this research is to study executives overconfidence in general. Hence, our data includes all the top five executives of S&P 1500 companies for the period. To allow for the comparability of our result with previous studies, we also consider a subset in our data that includes CEOs. Prior research on overconfidence has not addressed the endogeneity issue. The claim in the literature is that the observed firm heterogeneity is the result of overconfidence as measured by CEO option exercise behaviour. It can be argued that the underlying overconfidence feature helped the firms to perform greatly, which justified keeping the option. On the other hand, it might be that firm heterogeneity drives CEOs option exercise behaviour. To overcome endogeneity issue, we select and investigate a subsample of executives and CEOs who worked at least in two firms. Furthermore, we deploy fixed effect panel regression and panel count models to check if the variation in executive option-exercise behaviour can be explained by firm heterogeneity. Finally, we borrow from the emerging Machine Learning literature and utilise unbiased conditional panel regression trees to intuitively present the interaction between various firm features in explaining executive option exercise.

Our study contributes to a well-developed line of empirical work in behavioural finance that points to the importance of managerial biases for firm policies. Viewing investors as rational agents, this literature takes behavioural biases of the managers seriously. Managers may be overconfident and overestimate their own abilities (Heaton, 2002; Malmendier and Tate, 2005, 2008). They may prefer to pursue a quiet life, forgoing risky but promising investment projects (Bertrand and Mullainathan, 2003), they may pursue empire-building (Baumol, 1959), engage in actions that boost stock prices in the short run with detrimental effects in the long run (short-termism) (Narayanan, 1985; Stein, 1988; Bebchuk and Stole, 1993) or may simply follow the decisions of their peers (herding) (Scharfstein and Stein, 1990). Our research sheds light on the effect of overconfidence on firm policies.

In a more specific sense, our research contributes to two lines of research. To begin with, our research complements prior empirical research on measuring managerial overconfidence and the effect of overconfidence on firm policies. Even though, a handful of recent works on managerial overconfidence have used other approaches to measure overconfidence (Malmendier and Tate, 2008; Otto, 2014; Hribar and Yang, 2015; Ben-David, Graham, and Harvey, 2007, 2013), the use of option-based measure of overconfidence is ubiquitous in the literature. Previous research used various versions of the option-based overconfidence measure to study the effect of this managerial bias on various firm policies most notably

investment (Malmendier and Tate, 2005; Campbell, Gallmeyer, Johnson, Rutherford, and Stanley, 2011), financial policy (Malmendier et al., 2011; Huang-Meier et al., 2015; Aktas et al., 2015), innovation (Hirshleifer et al., 2012; Galasso and Simcoe, 2011), merger and acquisition (Malmendier and Tate, 2008), dividend payout (Deshmukh et al., 2013) and accounting practices (Schrand and Zechman, 2012; Ahmed and Duellman, 2013). Secondly, our research touches on research studying the determinants of executive option exercise behaviour by providing a new explanation for executive option exercise.

The rest of the paper is organized as follows. Section 2 summarises the data and the measures. Section 3 introduces the framework for testing the validity of overconfidence measure and predictions of overconfidence hypothesis. Section 4 describes the empirical results. Section 5 presents the robustness checks. And section 6 concludes the paper and provide recommendation for future research.

2. Data and Measures

We draw on three databases to put our sample together. The sample comes mainly from Standard & Poors' Execucomp database. [2] We consider S&P 1500 companies' Executives over the period 1996-2014. The S&P 1500 index includes all the stocks in S&P 500, S&P 600 and S&P 400 and covers 90% of the market capitalization of U.S. stocks. We match this data with the financial variables of the companies using Compustat database. As the aim is to study managerial overconfidence in general, our main sample contains a panel of all executives in Execucomp database. To be close to the previous research on CEO overconfidence, we construct a subset of the main sample considering only CEOs. In total, this gives us an unbalanced panel with 137209 executive-year observations and an sub-sample of 22525 CEO-year observations. We use these two samples to run our regressions. To check the validity of overconfidence measure, we track CEO option-exercise behaviour when they switch firms. It requires that we select executives with available data on both firms. An executive or a CEO should have at least 3 years of data in each firm to be included in these subsamples. This will further reduce the executive and CEO samples to 6828 and 348 data points respectively. Finally, we collected data on Analyst forecast of earning and actual earning from Thomson Reuters I/B/E/S database. We consider the average value of forecasts made 9 months prior to the release of that years fundamentals.

Malmendier and Tate (2005) propose two option-based measures of overconfidence, Holder67 and LongHolder. A risk averse and undiversified CEO should exercise in-the-money options.

---

[2]ExecuComp provides compensation data including yearly salary and holdings of stock and option for the five highest paid executives in the list of S&P 1500 companies.

Holder67 identify executives as overconfident if they repeatedly fail to exercise in the money options. LongHolder find executives to be overconfident if they hold in the money options until the last year of expiration. [3] Holder67 is the main measure of overconfidence in this study. We select a subset of executives that worked in two firms and had at least 3 years of data for each firm. Because Execucomp do not provide detailed option grants data for the full sample period, we chose Execucomps data items OPT_UNEX_EXER_EST_VAL and pccr_f to construct average exercise price and options in-the-money percent. [4] The use of Longholder measure however seems to be almost impractical. For example, Execucomp offers detailed executive option grants data starting from 2006. We filtered executives who worked in two firms during 2006-2014 . This gave us a subset of 1060 executives. Among them, we were able to identify 12 executives that kept options (which were 40% in the money the year before expiration) until the last years of expiration. Overall, options usually expire in a ten year period and tracking a executive over two firms demands that the executives work and stay in two firms for a long period of time and the data for that executive would be available.

Along with measure of overconfidence, we construct and utilise a number of firm related measures. We measure cash flow as income before extraordinary items (item 18) plus depreciation (item 14). Investment is capital expenditures (item 128). Firm investment opportunities is proxied by Tobins Q and measured as market value to book value of asset. Firm Size is natural logarithm of firms total asset (item 6). Firm age is measured considering firms birth as the year firm first listed on a stock exchange.. [5] Following Baker, Stein, and Wurgler (2003), leverage is defined as total debt (Item 9 + item 34) divided by total debt plus total stockholder equity (item 144). Dividend payout is sum of preferred and common dividend (Item 19 + item 21). Cash holding is considered as Cash and Short-Term Investments (item 1). Sales growth is defined as the percentage change in sale calculated as sale (item 2) divided by beginning of the year value of sale minus one. Finally, we construct a measure of stock return by subtracting end of the year stock price from beginning of the year stock price and normalise it by beginning of the year stock price.

3. Methodology

We trace the option-exercise behaviour of individual CEOs across firms. This allows assessing whether the overconfidence status of a CEO remains the same across firms and

---

[3]Full details of Holder67 and LongHolder can be found in Malmendier and Tate (2005).

[4]We follow the model to estimate the average exercise price of the aggregated option put forward by Core and Guay (2002) and used by Campbell et al. (2011) and Hirshleifer et al. (2012)

[5] Following the literature we take the listing year as the year firms have non-missing stock price in Center for Research in Security Prices (CRSP) dataset.

thus the option-based measure of overconfidence captures a habitual tendency. Further, the methodology helps understand whether changes in a CEO's overconfidence status coincide with differences in the characteristics of the firms where she serves (firm heterogeneity). The approach helps shed light on whether it is overconfidence that drives option exercise decisions or firm characteristics.

Having dealt with the endogeneity issue, we examine if firm heterogeneity and market conditions can account for variation in executives' option-exercise behaviour. We first run a fixed-effects model with the in-the-money measure as the left hand side variable and firm age and beginning of the year value of firm investment, cash flow, q, cash holding, leverage, dividend and size as independent variables. In-the-money is a direct function of the stock price. We include stock return to control for the variation in stock prices. Our base model is as follows:

$$\text{Moneyness}_t = \alpha + \frac{\text{StockReturn}_{t-1}}{\text{Asset}_{t-2}} + \frac{\text{Investment}_{t-1}}{\text{Asset}_{t-2}} + \frac{\text{CashFlow}_{t-1}}{\text{Asset}_{t-2}} + Q_{t-1} + \frac{\text{FirmSize}_{t-1}}{\text{Asset}_{t-2}} +$$

$$\frac{\text{FirmAge}_t}{\text{Asset}_{t-2}} + \text{Leverage}_{t-1} + \frac{\text{Dividend}_{t-1}}{\text{Asset}_{t-2}} + \frac{\text{CashHolding}_{t-1}}{\text{Asset}_{t-2}} + \text{SaleGrowth}_{t-1} + \epsilon$$

To check if changes in market conditions influence a CEO's option exercise behaviour, we divide our sample into three segments around the financial crisis; before the crisis 2002-2007, the crisis period 2008-2009 and after crisis 2010-2014. We run the same model on these three samples. We also consider an alternative dependent variable to explain the frequency at which a CEO fails to exercise in-the-money options.

4. Empirical Analysis

4.1. CEOs option exercise behaviour and overconfidence

Out of 35 CEOs who served in two different firms and had three years of available data in each firm, the measure identifies 57% as overconfident in one firm and non-overconfident in the other. The pattern is similar for the executives. 258 out of 635 executives are identified as overconfident in one firm and non-overconfident in the other. The change in behavior suggests that either the decision not to exercise does not reflect overconfidence or

overconfidence is not a permanent trait. In either case, the decision whether to exercise, as any other CEO's decision, calls for an explanation. To understand possible drivers of option exercise decisions, we compare the characteristics of the firms where the individual executives have served. Table 1 reports the mean differences between firm characteristics for executives who are identified as overconfident in the first firm and non-overconfidence in the second firm they worked for. Table 2 compares the mean difference of firm characteristics for CEOs who were identified as non-overconfident in first firm and overconfident in the second firm in which they worked. Table 3 provides a general comparison of differences in firm characteristics for firms with overconfident and non-overconfident CEOs with no-time order restriction.

In all these cases, the tests reject mean equality in the levels of cash flow, q and leverage between firms with CEOs identified as overconfident and non-overconfident. Executives tend to hold exercisable options in firms with higher growth opportunities and exercise in firms with low growth opportunities. CEOs keep their options in firms where q, cash flow, cash holding and investment are high and leverage is low. They exercise options in firms where q, cash flow, cash holding and investment are low and leverage is high. The pattern that the CEO sells options when the firm's prospect is weak but keeps options when the firm has great potentials casts doubt on the claim that Holder67 captures an exogenous permanent trait. CEOs tend to keep their options when the firm performs strongly and exercise when the firm performs poorly. Controlling for CEOs across firms, the data points to the endogeneity of exercise options decisions.

[Insert Table 1 near here]

[Insert Table 2 near here]

[Insert Table 3 near here]

4.2.   Firm heterogeneity and executives option exercise behaviour

Does firm heterogeneity account for the variation in executives option-exercise behaviour? Table 4 reports the result of our fixed effect models. The regression results for the CEOs and executives are presented in Model (1) and Model (2) respectively. Factors that relate to firm performance are both most economically and statistically significant. Investment opportunities (q), investment, cash flow and expected earnings predict the in-the-money

7

percent. Past firm characteristics explain some of the variations in the in-the-money measure. The overall picture is similar among CEOs and Executives.

We run through tests for three sample periods: before crisis 2002-2007, during the crisis 2008-2009 and after crisis 2010-2014. Model (3), Model (4) and Model (5) present the results for these three subsamples respectively. A considerable portion of variability in option exercise behaviour is explained by firm heterogeneity. Assuming overconfidence refers to a habitual tendency, the overconfidence view predicts that the patterns of coefficient estimates should remain invariant across the three sub-periods. Yet, the coefficient estimates for most firm characteristics either lose significance or change during the financial crisis. Lagged cash flow is no longer statistically significant. Nor is lagged holdings. The economic significance of q has decreased to 0.269 (significant at 0.01 percent) and the coefficient estimate of earning forecast has turned negative. And the variable sale growth has become significant. Our alternative hypothesis that suggest market conditions may drive decisions whether to exercise stock options overall better explains the pattern of coefficient estimates during the crisis. Consider earning forecasts. If the market forecasts lower earnings, a rational CEO would likely hold her options for longer to send a positive signal. Selling options in the time of systemic risk will send a wrong signal to investors. Or in the time of systemic risk or uncertainty, the CEO would pay less attention to cash flow. Indeed, consistent with the estimates, in the environment of systemic risk, the more cash flow declines, the more likely that the CEO holds to her stocks or stock options in the firm. Such considerations well explain the negative coefficient estimates for both earnings and cash flow.

[Insert Table 4 near here]

The overconfidence literature suggests taking persistent failure in exercising in the money options as a sign of overconfidence. The overconfidence hypothesis is consistent with occasional failure to exercise in the money options. To assess whether firm characteristics explain the persistence, we extend the analysis to account for the frequency at which a CEO holds exercisable options beyond the theoretical threshold. We define a dummy variable (VAR1) with the value 1 if the amount of moneyness of the options exceed the 67% threshold for each year during the sample and 0 otherwise. We next create a count variable (VAR2) measuring the number of times an executive fails to exercise options which are 67% in-the-money. To better estimate possible influence of firm characteristics on the frequency at which a CEO holds exercisable options, we replace firm performance features with dummy variables that take value 1 when the value of the variable in question exceeds its industry average. We regress VAR2 on these dummy variables using a panel poisson count model. We include stock return as a control variable. Table 5 reports the results. The firm performance measures

8

appear as statistically significant, suggesting that firm features matter for the frequency of holding well in-the-money options.

[**Insert Table 5 near here**]

It is plausible to conjecture that interactions among various firm characteristics critically influence a CEO's option exercise decisions. The traditional panel regression methods are not effective at revealing complex interactions among variables. We borrow the unbiased REEM-tree estimator from the emerging Machine Learning literature to understand how interactions among a firm's features predict the number of times a CEO holds in the money options. Regression trees provide an intuitive and easy-to-understand approach for making sense of data. We use similar specifications to model (2). Figure 1 gives the panel regression tree, when the frequency of option exercises above the threshold (the frequency at which a CEO fails to exercise her exercisable options) serves as the dependent variable. A firm's growth potential, captured by Tobins q, appears at the root of the panel regression tree, suggesting that a firm's investment opportunities is the most important predictor of the frequency at which a CEO keeps options. The second set of predictively important variables are investment and firm age. The highest frequency of maintaining exercisable options occur in firms with q above 1.655, an incorporation age below 45 but with a high level of actual earning. Consistent with the earlier results, the lowest frequency of keeping exercisable options occur in firms with q lower than 1.13, low investment and small firm size. The subset represents firms that are small but does not have growth potentials.

[**Insert Figure 1 near here**]

[**Insert Figure 2 near here**]

5. Discussions

A possible objection to our findings relate to the procedure we have followed in defining the subsamples that drive the results. To construct our subsamples, we primarily include executive with three years of available data in each firm. To ensure the robustness of the results, we further create the same subsamples including executives with four, five, six and seven years of data in each firm. The stylized facts remain the same in all these samples. A considerable fraction of CEOs are identify as overconfident in one firm and non-overconfident

in the other.[6]

Another objection may be that when executives switch firms, they do not have exercisable options is the first few years. This might drive the results. We create a new sample for executives who worked in two firms, considering the years where the value of unexercised exercisable options were not zero.[7] 80 out of 180 executives and 7 out of 15 CEOs classified as overconfident in one firm and non-overconfident in the other. Our primary results survive.

Further, it might be argued that our test on the effect of market condition on executive's option exercise behaviour is driven by the changes in stock prices. After all, the dependent variable is a direct function of stock prices. In our original regressions, we control for the variation in stock prices by including a measure of stock return. Malmendier and Tate (2015) argue that popularity of options might affect CEO's decision to sell or keep the options. We controlled for the popularity of the options in all of our models and it was not significant.

6. Conclusion

Our analysis reveals two stylized facts: CEOs behave differently when they switch between firms. In some firms, they fail to exercise their exercisable options. In others, they exercise. Second, the decision to exercise or hold vested options is highly correlated with firm characteristics. The managers keep vested options in firms with high q, high holdings and high cash flow while they sell in firms with comparatively low q, low holding and low cash flow. The switching and the associated patterns of firm characteristics point to the endogeneity of option exercise decisions. Firm characteristics drive the decisions, not necessarily overconfidence. For this reason, it would be questionable to think that the option based measure captures overconfidence as a habitual tendency. Consequently, one should treat with caution the empirical results in the literature on the impact of overconfidence, including the celebrated investment-cash flow sensitivity. We are still in need of a satisfactory measure of overconfidence to understand how and to what extent overconfidence shape corporate policies.

---

[6]specifically, 140 out 325 (43%) are classified as overconfident in one firm and non-overconfident in the other if we select executives with four years of data in each firm. If we consider executives with five, six and seven years of data in each firm, we will have 42%, 38% and 41% of executives with different overconfident status in each firm respectively.

[7]We only consider positive values of the variable OPT_UNEX_EXER_EST_VAL which measure the value of unexercised exercisable options. Considering the years where the value was larger that zero makes sure that the executives had some exercisable options in that year.

References

Ahmed, A. S., Duellman, S., 2013. Managerial overconfidence and accounting conservatism. Journal of Accounting Research 51, 1–30.

Aktas, N., Louca, C., Petmezas, D., 2015. Is cash more valuable in the hands of overconfident ceos? Available at SSRN .

Baker, M., Stein, J. C., Wurgler, J., 2003. When does the market matter? stock prices and the investment of equity-dependent firms. Quarterly Journal of Economics 118 (3): 969-1005 118, 969–1005.

Baumol, W. J., 1959. Business behavior, value and growth. New York 32.

Bebchuk, L. A., Stole, L. A., 1993. Do short-term objectives lead to under-or overinvestment in long-term projects? The Journal of Finance 48, 719–730.

Ben-David, I., Graham, J. R., Harvey, C. R., 2007. Managerial overconfidence and corporate policies. Tech. rep., National Bureau of Economic Research.

Ben-David, I., Graham, J. R., Harvey, C. R., 2013. Managerial miscalibration. Tech. rep.

Bertrand, M., Mullainathan, S., 2003. Enjoying the quiet life? corporate governance and managerial preferences. Journal of political Economy 111, 1043–1075.

Campbell, T. C., Gallmeyer, M., Johnson, S. A., Rutherford, J., Stanley, B. W., 2011. Ceo optimism and forced turnover. Journal of Financial Economics 101, 695–712.

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, 613–630.

Deshmukh, S., Goel, A. M., Howe, K. M., 2013. Ceo overconfidence and dividend policy. Journal of Financial Intermediation 22, 440–463.

Galasso, A., Simcoe, T. S., 2011. Ceo overconfidence and innovation. Management Science 57, 1469–1484.

Heaton, J. B., 2002. Managerial optimism and corporate finance. Financial management pp. 33–45.

Hill, A. D., Kern, D. A., White, M. A., 2014. Are we overconfident in executive overconfidence research? an examination of the convergent and content validity of extant unobtrusive measures. Journal of Business Research 67, 1414–1420.

Hirshleifer, D., Low, A., Teoh, S. H., 2012. Are overconfident ceos better innovators? The Journal of Finance 67, 1457–1498.

Hribar, P., Yang, H., 2015. Ceo overconfidence and management forecasting. Contemporary Accounting Research .

Huang-Meier, W., Lambertides, N., Steeley, J. M., 2015. Motives for corporate cash holdings: the ceo optimism effect. Review of Quantitative Finance and Accounting pp. 1–34.

Malmendier, U., Tate, G., 2005. Ceo overconfidence and corporate investment. The journal of finance 60, 2661–2700.

Malmendier, U., Tate, G., 2008. Who makes acquisitions? ceo overconfidence and the market's reaction. Journal of financial Economics 89, 20–43.

Malmendier, U., Tate, G., 2015. Behavioral ceos: The role of managerial overconfidence. The Journal of Economic Perspectives 29, 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, 1687–1733.

Narayanan, M., 1985. Observability and the payback criterion. Journal of Business pp. 309–323.

Otto, C. A., 2014. Ceo optimism and incentive compensation. Journal of Financial Economics 114, 366–404.

Scharfstein, D. S., Stein, J. C., 1990. Herd behavior and investment. The American Economic Review pp. 465–479.

Schrand, C. M., Zechman, S. L., 2012. Executive overconfidence and the slippery slope to financial misreporting. Journal of Accounting and Economics 53, 311–329.

Stein, J. C., 1988. Takeover threats and managerial myopia. The Journal of Political Economy pp. 61–80.

Appendix A.   Tables and Figures

Table 1

Mean differences of firm variables for executives identified as overconfident in the first firm and non-overconfidence in the second

	Overconfident	Nonoverconfident	ttest
Investment	0.061	0.042	0.000
Q	2.681	1.853	0.000
Firm Size	7.471	7.889	0.000
Firm Age	26.353	20.779	0.000
Cash Flow	0.117	0.090	0.000
Leverage	0.748	0.829	0.000
Cash Holding	0.166	0.173	0.454
Dividend	0.008	0.013	0.000
Observations	671	541	

This table reports mean differences of firm-level variables for executives who were identified as overconfident in the first firm and non-overconfidence in the second firm. Investment is lagged value of capital expenditure. Q is beginning of the year value of Tobin's Q measured as market to book value of asset. Firm Size is natural logarithm of firms total asset taken at the beginning of the year. Firm age is the year firm first listed on a stock exchange. Cash flow is the lagged value of income before extraordinary items plus depreciation. leverage is total debt divided by total debt plus total stockholder equity. Cash holding is the lagged value of Cash and Short-Term Investments. Dividend payout is sum of preferred and common dividend.

Table 2

Mean differences of firm variables for executives identified as non-overconfident in the first firm and overconfidence in the second

	Nonoverconfident	Overconfident	ttest
Investment	0.057	0.055	0.391
Q	1.773	2.150	0.000
Firm Size	7.556	7.685	0.098
Firm Age	29.228	22.347	0.000
Cash Flow	0.084	0.115	0.000
Leverage	0.793	0.823	0.049
Cash Holding	0.117	0.165	0.000
Dividend	0.011	0.011	0.384
Observations	561	917	

This table presents mean differences of firm-level variables for executives who were identified as non-overconfident in the first firm and overconfidence in the second firm. Investment is lagged value of capital expenditure. Q is beginning of the year value of Tobin's Q measured as market to book value of asset. Firm Size is natural logarithm of firms total asset taken at the beginning of the year. Firm age is the year firm first listed on a stock exchange. Cash flow is the lagged value of income before extraordinary items plus depreciation. Leverage is total debt divided by total debt plus total stockholder equity. Cash holding is the lagged value of Cash and Short-Term Investments. Dividend payout is sum of preferred and common dividend.

Table 3

Mean differences of firm variables for executives identified as overconfident in one firm and non-overconfidence in the other

	Nonoverconfident	Overconfident	ttest
Investment	0.049	0.057	0.000
Q	1.810	2.360	0.000
Firm Size	7.719	7.594	0.042
Firm Age	24.210	23.563	0.524
Cash Flow	0.087	0.116	0.000
Leverage	0.810	0.791	0.083
Cash Holding	0.145	0.166	0.001
Dividend	0.012	0.009	0.000
Observations	1,102	1,588	

This table reports mean differences of firm-level variables for for executives identified as overconfident in one firm and non-overconfidence in the other (no time order). Investment is lagged value of capital expenditure. Q is beginning of the year value of Tobin's Q measured as market to book value of asset. Firm Size is natural logarithm of firms total asset taken at the beginning of the year. Firm age is the year firm first listed on a stock exchange. Cash flow is the lagged value of income before extraordinary items plus depreciation. leverage is total debt divided by total debt plus total stockholder equity. Cash holding is the lagged value of Cash and Short-Term Investments. Dividend payout is sum of preferred and common dividend.

Table 4

Fixed-effect regression models to explain the level of moneyness of stock options hold by executives and CEOs

	(1)	(2)	(3)	(4)	(5)
Stock Return (beginning of the year)	0.0974	0.0286*	0.0342	0.0845	0.0177
	(1.89)	(2.10)	(0.58)	(1.40)	(0.84)
Earning (beginning of the year)	0.00890	-0.0106	-0.0615*	-0.00785	-0.000454
	(0.70)	(-1.45)	(-2.15)	(-1.25)	(-0.07)
Investment (beginning of the year)	0.637	0.861**	1.234*	-0.472	0.144
	(1.02)	(2.65)	(2.23)	(-1.16)	(0.32)
Cash Flow (beginning of the year)	0.203	0.328**	0.393*	0.0273	0.0270
	(1.16)	(2.74)	(2.02)	(0.32)	(0.21)
Q (beginning of the year)	0.592***	0.537***	0.516***	0.357***	0.645***
	(16.12)	(20.50)	(14.93)	(5.47)	(18.56)
Sales Growth (beginning of the year)	0.402*	0.131	0.136	0.229	0.00437
	(2.22)	(1.42)	(1.14)	(0.94)	(0.04)
Firm Size (beginning of the year)	0.331***	0.295***	0.429***	0.487**	0.704***
	(5.08)	(6.58)	(4.16)	(2.94)	(10.14)
Cash Holding (beginning of the year)	-0.165	0.126	0.306	0.417	0.249
	(-0.90)	(0.87)	(1.72)	(1.41)	(1.83)
Earning Forecast	0.0203	0.0173	0.0429**	-0.0172	0.0104
	(1.28)	(1.88)	(3.00)	(-1.39)	(1.37)
Firm Age	-0.0605***	-0.0546***	-0.0626	0.0145	0.00461
	(-4.69)	(-5.82)	(-1.70)	(0.46)	(0.58)
Options Percent	-1.225	-1.018	-1.510	-0.832	1.126
	(-1.07)	(-1.09)	(-1.46)	(-0.41)	(1.52)
R^2	0.265	0.238	0.158	0.158	0.308
Adj. R^2	0.263	0.237	0.157	0.157	0.308
Observations	9958	49613	18266	7970	16654

This table reports the coefficients of the fixed-effect regression models. Model 1 presents the coefficients for the CEO subsample. Column 2 reports the estimates for executives (complete dataset). Model 3 to 5 are the models for subsamles of three periods 2002-2007, 2008-2009 and 2010-2014 respectively. The dependent variable is in-the-money percent measured as stock price over option's exercise price. Stock return is the difference between stock price and beginning of the year stock price normalised by beginning of the year stock price. Earning is firm earning. Investment is lagged value of capital expenditure. Cash flow is the lagged value of income before extraordinary items plus depreciation. Q is beginning of the year value of Tobin's Q measured as market to book value of asset. Sales growth is percentage change in sales in each year calculated at beginning of the year. Firm Size is natural logarithm of firms total asset taken at the beginning of the year. Cash holding is the lagged value of Cash and Short-Term Investments. Earning forecast is analyst's forecast of firm earning. Firm age is the year firm first listed on a stock exchange. Option percent is the percentage of stock options in executives total compensation package each year calculated at the industry level. The reported standard errors are clustered at the firm level.

Table 5

Fixed-effect Poisson Models explaining number of times executives held options which were above 66% in-the-Money

|	Poisson	Poission (zero truncated)
Stock Return	0.000	-0.000
	(0.000)	(0.000)
Firm Size	-0.012*	-0.014**
	(0.007)	(0.007)
Cash Holding (beginning of the year(BoY))	0.002	-0.002
	(0.015)	(0.014)
Firm Age	-0.002	-0.004
	(0.003)	(0.002)
Above Industry Sales Growth (BoY)	0.001	0.000
	(0.001)	(0.001)
Above Industry Q (BoY)	0.013***	0.011***
	(0.003)	(0.002)
Above Industry Cash Flow (BoY)	0.009***	0.005**
	(0.002)	(0.002)
Above Industry Earning Forecast (BoY)	-0.002	-0.001
	(0.002)	(0.002)
Above Industry Earning (BoY)	-0.002	-0.002
	(0.002)	(0.002)
Above Industry Investment (BoY)	-0.001	-0.001
	(0.003)	(0.002)
Option Percent	0.083	0.071
	(0.056)	(0.055)
Dummy Year	Yes	Yes
Observations	62047	57241

This table reports the coefficients of two fixed-effect Poisson models. Reported standard errors are robust. The source of excessive zeros are identifiable. Model 2 is similar to model 1 except that it uses the subsample that does not contain observations with 0 value for unexercised exercisable options. The dependent variable is number of times executives held options which were above 66% in-the-Money. Stock return is the difference between stock price and beginning of the year stock price normalised by beginning of the year stock price. Firm Size is natural logarithm of firms total asset taken at the beginning of the year. Cash holding is the lagged value of Cash and Short-Term Investments. Firm age is the year firm first listed on a stock exchange. Sales growth, q, cash flow, analyst earning forecast, earning and investment are all calculated by subtracting the value from corresponding industry average and are considered at the beginning of the year. Investment is lagged value of capital expenditure. Cash flow is the lagged value of income before extraordinary items plus depreciation. Q is beginning of the year value of Tobin's Q measured as market to book value of asset. Sales growth is percentage change in sales in each year calculated at beginning of the year. Earning forecast is analyst's forecast of firm earning. Option percent is the percentage of stock options in executives total compensation package each year calculated at the industry level. The variables marked as "Above Industry" are dummy variables with the value 1 if the value of the variable is above the industry median and zero otherwise. The reported standard errors are robust to serial correlation, heteroskedastisity and overdispersion.

Figure 1: Conditional Panel Regression Tree for Executives
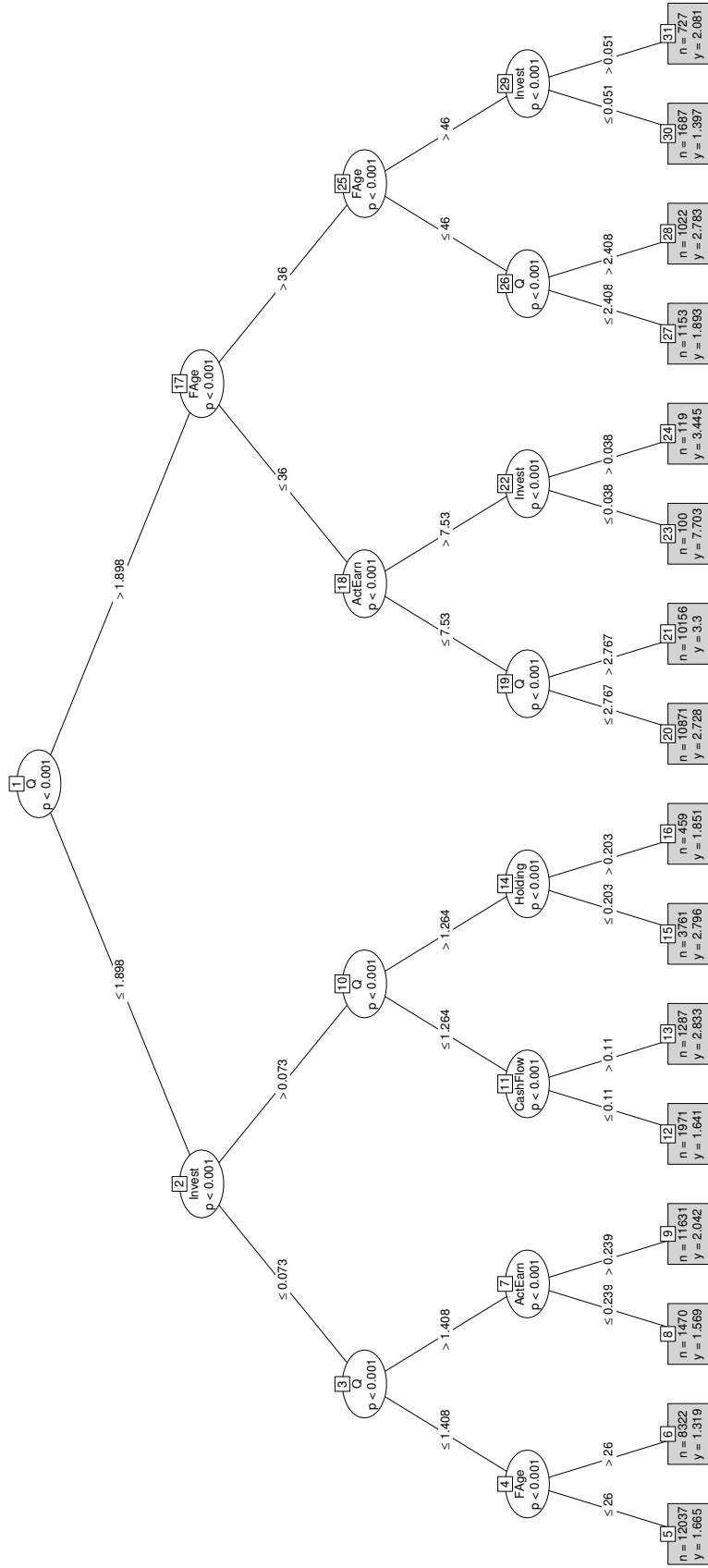
This figure presents the result of the conditional panel regression tree for executives. The dependent variable is the number of times an Executive hold options which were 67% in the money. The dependent variable is represented by "y" and reported in the lower ends of the tree for each segment. Q is beginning of the year value of Tobin's Q measured as market to book value of asset. Invest represents investment and is calculated as lagged value of capital expenditure. Cash flow is the lagged value of income before extraordinary items plus depreciation. Fsize is Firm Size as natural logarithm of firms total asset taken at the beginning of the year. Holding is Cash holding and measured as the lagged value of Cash and Short-Term Investments. FAge is Firm age and measured as the year firm first listed on a stock exchange. ActEarn is firm actual earning.

18

Figure 2: Conditional Panel Regression Tree for CEOs
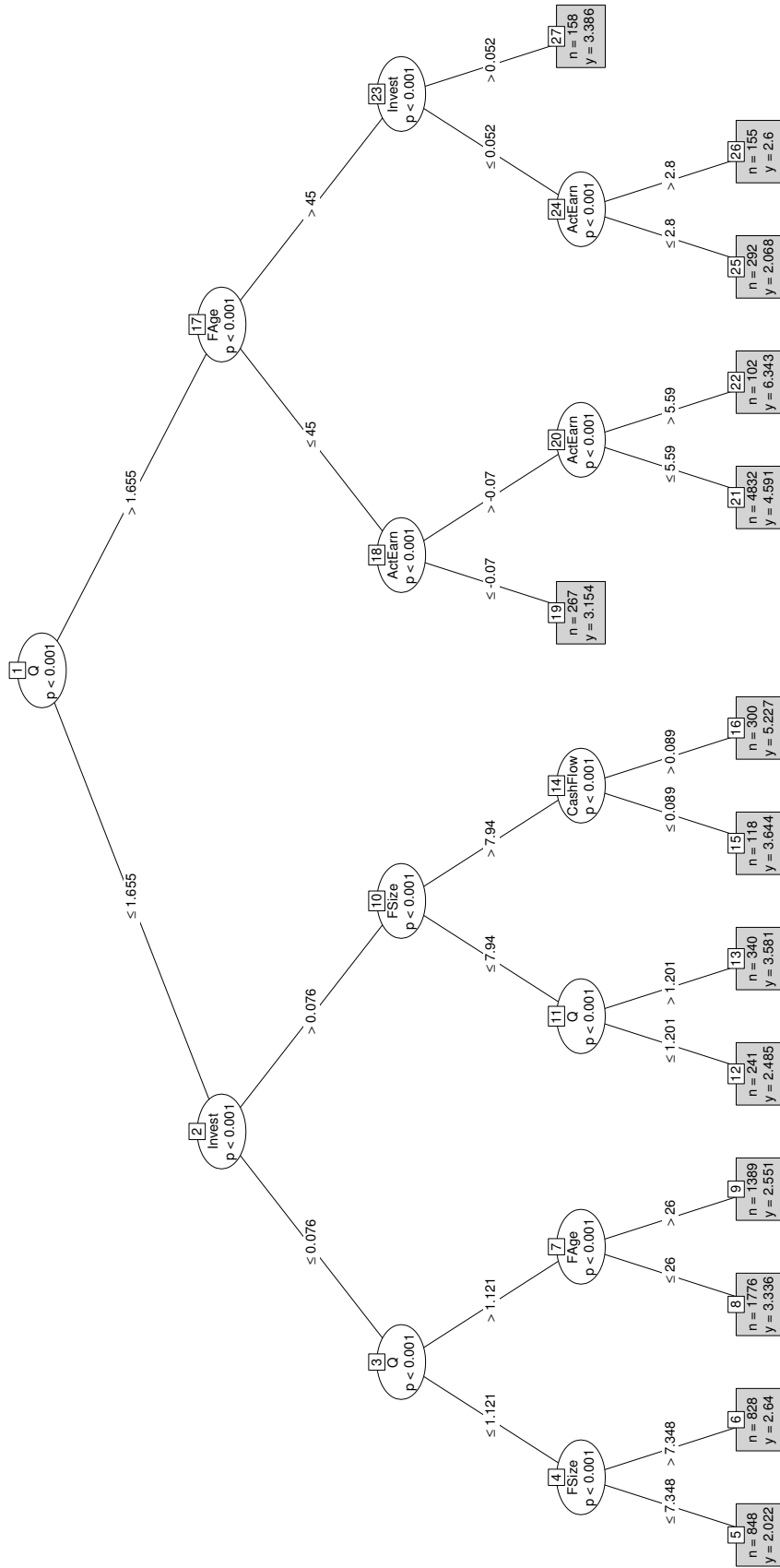
This figure presents the result of the conditional panel regression tree for CEOs. The dependent variable is the number of times an Executive hold options which were 67% in the money. The avarage value of the dependent variable is represented by "y" and reported in the lower ends of the tree for each segment. Q is beginning of the year value of Tobin's Q measured as market to book value of asset. Invest represents investment and is calculated as lagged value of capital expenditure. Cash flow is the lagged value of income before extraordinary items plus depreciation. Fsize is Firm Size as natural logarithm of firms total asset taken at the beginning of the year. Holding is Cash holding and measured as the lagged value of Cash and Short-Term Investments. FAge is Firm age and measured as the year firm first listed on a stock exchange. ActEarn is firm actual earning.