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The Self-attribution Bias and Shifting CEO Overconfidence

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ABSTRACT

In this paper, it is argued that the likelihood of a CEO holding unto options In-The-Money above any rational threshold is not just dependent on a time-invariant element of overconfidence, but also susceptible to a time-variant component linked to self-attribution inducing recent relative operational performance. This time varying hypothesis of managerial overconfidence is tested through data on fundamentals about the S&P 1500 firms and the personal portfolios of their CEOs. The findings of this paper indicate that the likelihood of a CEO holding unto heavily In-The-Money options is dependent on recent relative operational performance, especially when working for a firm where operational performance is an important determinant of success.

This paper argues that outperforming similar firms induces CEOs to hold vested options in the money above any rational threshold. To be precise, the probability that a CEO holds onto these options in a given year is dependent on whether he or she performed better than peers similar in size and industry in the same year in terms of operational performance. The empirical evidence presented in this study points towards a significant relationship between relative operational performance and holding unto options far above any rational threshold.

Malmendier & Tate (2005a) focus solely on the time-invariant aspect of overconfidence, where a CEO is revealed to be overconfident if he holds unto options above a certain threshold of In-The-Moneyness multiple times and link this to investment-to-cashflow sensitivity. To build the argument of why some CEOs might be overconfident, Malmendier & Tate (2005a) quote the work of Miller & Ross (1975) on the self-attribution bias. However, in this paper it will be argued that the self-attribution bias is actually a determinant of the time-variant component of overconfidence and that through this psychological phenomenon above average performance tends to exacerbate overconfidence. In research focused on market sentiment, investors tend to be described as dynamic actors who can vary in their overconfidence based on biased self-attribution (Hirshleifer & Subrahmanyam, 1998) or experience over time (Gervais & Odean, 2001). Baker & Wurgler (2002) go even further than that by arguing that rational managers time their equity issuances and buybacks to profit from temporary fluctuations in market value. Here, the manager is rational and tries to profit from market sentimentality, even to the benefit of the current shareholders. Malmendier & Tate (2015) explain that this theory of rational managers benefiting from investor sentiment need not be in violation of their theory of managerial overconfidence. They argue that overconfident CEOs consistently value their firm above its true worth, but that the firm's valuation

by investors ebbs and flows below and above both the true value and its management valuation. Simply put, even overconfident managers think the market overestimates their stock valuation sometimes. The fundamental question this unifying theory ought to raise is why market sentiment is assumed to be volatile, while managerial sentiment is modelled as consistently overconfident. In order to determine a time-variant aspect of managerial overconfidence two ingredients are necessary. Firstly, a tried and tested proxy of managerial overconfidence to be made the dependent variable and secondly a variant of recent performance that ought to induce overconfidence through the self-attribution bias. This paper seeks the answer through Malmendier & Tate's (2005a) proxies for overconfidence. They utilise the models of Hall & Murphy (2002) to approximate for overconfidence by assessing whether a CEO held unto vested stock options in the money above various rational thresholds that depend on their risk aversion and non-diversified wealth. Their main proxy, Holder 67, has the value of 1 if the CEO held vested options in the money 67% at least 2 times during a tenure of at least 5 years. However, the next question to ask is what type of "good" performance might influence overconfidence through the self-attribution bias.

Thankfully the work of Tversky & Kahneman (1974) lights the way. Especially important for the self-attribution bias are the availability and the representativeness heuristics. The determinants chosen in this paper ought to be predominant in both these dimensions of judgement under uncertainty. A natural way to measure your own performance to evaluate your skills is to look at how well that performance holds up when compared to other firms. The availability and representativeness heuristic will predict that these firms chosen for comparison will be similar in their most salient characteristics to the firm of the CEO in question. This paper assumes those characteristics to be industry and size. The next step is to look for the exact performance measure that ought to be most dominant in the CEOs calculations for self-evaluation. The phenomenon known as the "illusion of control" as put forward by Langer (1975) points towards the difficulty of separating luck from skill. Certain factors in a given situation can make a person more likely to believe that the probability of success is dependent mostly on their own skills, while the importance of chance is underestimated. The most important factors for this research are familiarity, involvement and choice. This helps pin down earnings before taxes, interest and depreciation as the determinant performance measure which ought to influence the overconfidence proxies the most. Factoring in the illusion of control and judgement under uncertainty I am left with the operational performance measure of EBITDA, controlled for size and industry, as the independent variable that is hypothesized to induce the strongest influence on the various overconfidence proxies. The main hypotheses are: 1) that a CEO is more likely to hold options ITM above the rational thresholds if he performed above average when compared to industry peers in terms of

operational performance in that same year and 2) that a CEO will be more or less likely to hold his options ITM above the rational thresholds according to his relative operational performance in that same year. To test these hypotheses, a sample based on available data concerning firms included in the S&P 1500 from 2006 till 2017 and the equity holdings of their CEOs will be utilized. In order to find a link between the proxies of overconfidence and the constructed variable of relative operational performance I utilize binary choice models attuned for longitudinal data such as the Random Effects logistic model and the Conditional, or Fixed Effects, logistic model. Apart from controlling for unobserved heterogeneity I also include control variables such as, but not limited to, the book to market deciles (Jenter, 2002) and insider information about future stock offerings and repurchases (Jackson, 2018).

The statistical analysis indicates a significant relationship between a firms recent above average relative operational performance and the probability of a CEO holding a vested option package in the money above any of the rational thresholds. It does so in two dimensions, the first one is that it matters if you beat your peers and the second one is that it matters by how much. In addition the sensitivity of holding unto options above the rational threshold to relative operational performance seems to be especially prominent amongst CEOs working for firms small in size and higher in their value of the Book-to-Market ratio. These findings have important implications that add to the existing literature. First of all it gives evidence that the overconfidence proxies suggested by Malmender & Tate (2005) are valid. However, the second implication is that treating overconfidence as a constant factor neglects its shifting component. What influences this shifting component is found in this paper to be determinant on how success is perceived in the environment of the CEO and the manner in which results reveal themselves.

This paper is organized in the following manner. Section I explains the theories of overconfidence & the self-attribution bias by reviewing relevant literature. Section II details the dataset. Section III explains the basic model, plus how the main variables are constructed and formulates the hypotheses. Section IV provides evidence for the influence of recent above average performance on the CEOs decision to hold options in the money above the rational threshold. Section V tests the robustness of this paper's findings by controlling for unobserved heterogeneity and whether negative information is self-attributed. Section VI concludes.

I. Literature Review

A. Overconfidence

The behavioural bias known as overconfidence has gained a certain amount of traction in the financial academic world since Malmendier & Tate's (2005a) research into its connection with heightened investment-to-cashflow sensitivity. They formulate three proxies of overconfidence based on the equity holdings of a firm's CEO. From the work of Hall & Murphy (2002) they deduct that overconfident CEOs will hold unto in-the-money exercisable options even when they are already overexposed their firm's idiosyncratic risk.[1] Because other types of compensation, such as bonuses and restricted stock grants, are already heavily dependent on a firm's future performance. Following this they mark a CEO as overconfident if he does so twice after the average vesting period of 5 years at 67% in-the-money, then they regress this indicator with how sensitive investment is to cash flow.[2] A secondary option based overconfidence proxy called "longholder" is constructed by looking at whether a CEO ever held options until the year of expiration at least 40% in the money. A third proxy is built by looking at whether a CEO was a habitual buyer of stock for the first 5 years of his tenure. All these different overconfidence proxies are tested separately on investment-to-cashflow sensitivity. By finding a positive and significant connection they add to the literature that tries to explain the reason why firms' level of investment tends to be so dependent on its cash flows, like asymmetric information (Myers and Majluf, 1984) and principal-agent interest misalignment (Jensen, 1986). They also theorize that overconfident managers tend to think that their firm is undervalued by the market. In line with their hypothesis, Malmendier & Tate (2005a) also find evidence that the effect of overconfidence on investment-to-cashflow sensitivity is especially pronounced among equity dependent firms (p. 2692).

In a follow up study, Malmendier & Tate (2005b) tested the relationship once more but with a different proxy based on press coverage. In their new model they essentially replace the option based measure in the model (2005a) with one constructed by counting how many times a CEO was mentioned in the press and if he was mostly portrayed as confident by a number of predefined terms. The positive press-based variable was found to have a significant effect on heightened investment-to-cashflow sensitivity. Malmendier & Tate (2008) utilised both the press coverage measure and the "Longholder" proxy to connect overconfidence with the likelihood of a

[1] Lie (2005) provides evidence that options tend to be awarded just before positive abnormal returns, which gives an explanation why so many options are in-the-money but not why CEOs continue to hold unto them.
[2] This 67% In-the-moneyness rational threshold comes from Hall & Murphy's (2002) calibrations for a CEO with a CRRA of 3 and undiversified wealth in their firm of 67%.

CEO making a lower-quality diversifying acquisition if, much like with internal investments, his firm has plenty of internal resources.

Not all is doom and gloom when it comes to overconfidence however, as some possible beneficial effects have been observed as well. Hirshleifer, Low and Hong Teoh (2012) utilize both an option exercise anda press coverage based measure. They associate overconfidence with more risk taking, more innovative investment and greater innovation as measured by patent applications and citations.[3] They do conclude however that this association is solely present in innovative industries.[4] Galasso and Simcoe (2011) found a similar connection during an earlier time period. They conclude however that it is important to note that filling an above average amount of patents does not necessarily imply positive future performance (p. 1483).

Overconfidence does have far more implications than just on investment and its subsequent results. Ben-David, Graham and Harvey (2007) research the effects of overconfidence on CFO corporate policy decision making. They differentiate from Malmendier & Tate (2005a) and identify a CFO as overconfident if he underestimates the volatility of his firm's future cash flows. Amongst the many faces of overconfidence, this type tends to be predominant (Healy, 2008)[5]. They find evidence that CFO overconfidence goes hand in hand with paying less dividends, higher levels of investments, more acquisitions and their firms tend to have higher debt ratios and rely more on long-term debt. Malmendier & Tate (2009) also found that overconfident managers are less likely to issue equity then other CEOs and in lieu of internal funds they tend to utilise debt more to finance investments. In addition they add that some early life experiences tend to influence future corporate policies like how CEOs or "depression babies" who experienced the great depression tend to avoid external capital markets.

Overconfidence in behavioural corporate finance literature tends to be seen in a similar light as the "depression babies", namely a predetermined constant effect. However, it also mentions the self-attribution bias as a determinant of overconfidence, which depends on time-variant positive feedback. The question this raises is how constant managerial overconfidence really is and whether time-variant positive feedback might exacerbate it. A first sign that this might be the case can be found in the research of Doukas and Petmezas (2007) who found that a positively received initial acquisition tends to correlate with future negatively received acquisitions.

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[3] They differ slightly in their option exercise based overconfidence measure however from both Malmendier & Tate (2005a) and this research, as they require the average yearly in-the-moneyness to be 67% in the money.

[4] They assume an industry is innovative if the amount of total citations for that industry is higher than the whole sample average.

[5] This is also commonly called "miscalibration", whereas overestimating mean future returns is called "optimism". Moore & Healey (2008) further decouple the better-than-average effect from overall optimism.

Their main line of reasoning is that if the first acquisition is positively received by the market the manager will self-attribute its success and be more likely to engage in more deals to the detriment of the firm. Billet & Qian (2008) provide similar evidence and even find that CEOs net purchase of stock is greater preceding these subsequent deals.

B. Investor Psychology and Market Timing

Unlike managerial overconfidence, investor sentiment tends to be modelled with a fluctuating component. Seeking to explain various market anomalies such as momentum (Jegadeesh & Titman, 1993) and long-term reversals (De Bondt & Thaler, 1985), Daniel, Hirshleifer & Subrahmanyam (1998) model some investors as overconfident when it comes to private information, but include variations due to positive feedback based on biased self-attribution. They build on the work of Einhorn (1980) who found evidence that overconfidence is more predominant for tasks that involve judgment than for purely mechanical tasks and that immediate feedback can curb overconfidence. Gervais & Odean (2001) map out their own multi-period model in which an investor becomes overconfident through good initial performance and only learns to correct it through experience. On the other side of behavioural corporate finance stands the research on market timing that tries to profit from this perceived investor sentiment. Market timing is defined as a firm repurchasing stock when management perceives its market value to be low and issuing stock if they perceive the opposite. Baker & Wurgler (2002) test this theory and even go beyond that by providing evidence that it is an important determinant of a firm's capital structure.[6] More important for this paper's research however is the work of Jenter (2005) who looked at how managers try to time the market when it comes to their personal portfolio. He finds that the lower the book-to-market ratio decile a firm belongs to the more likely a manager is to actively buy shares in his or her own firm. He theorized that these managers believe their firm to be undervalued and bet on future appreciation of its stock, specifically they treat the value factor as a result of mispricing and not as Fama & French (1992) argue a systemic risk factor. On the surface these findings seem to be in contradiction of Malmendier & Tate (2005) where managers always treat their firm as undervalued. However, Malmendier & Tate (2015) indicate in a later study that the persistent managerial overvaluation due to overconfidence can sometimes be eclipsed by investor sentiment (p. 56). Simply put, sometimes even the most overconfident managers think their firm is overvalued by the market.

[6] Its importance has however been brought into question in later research. For example, Alti (2006) found that firms that experience hot-market IPO's initially use this hot-market to decrease their leverage ratio by issuing more equity, but that this effect dissipates by the end of the second year post IPO.

B. Self-Attribution Bias

When explaining the self-attribution bias both research into investor sentiment (Daniel et all, 1998) and managerial overconfidence (Malmendier & Tate, 2005) tend to utilise the work of Miller & Ross (1975). Interestingly enough, in their survey of empirical psychological research they make the case that biased self-attribution is not as clear-cut as it seems. In a traditional sense, the self-attribution bias describes people to be overly dispositional when it comes to positive events in their lives and overly dismissive when it comes to negative events in their lives. We attribute the good to our own capabilities and wave away the bad, this is called the "ego-protective bias of attribution". Miller & Ross (1975) however find little evidence for ego-protective bias of attribution, but subtract from previous empirical research that people tend to expect improvement when they intend so. Put in other words, success is expected and if it happens it is attributed to oneself. Expectations of success and failure are naturally linked with the amount of effort a person might decide on giving for a task and in turn influence self-attribution.

Other research takes this further and finds that the expectations drive attribution, and that unexpected outcomes tend to be attributed to external factors (McMahan 1973). However negative results are not neglected, since the perceived covariation between behaviour and outcome remains important (Kelley 1971). When comparing previous research that tested self-attribution of either success or failure they still found little evidence that people forgo personal responsibility when faced with failure and in addition that they took on even more responsibility when they failed at cooperative games (Wolosin et al. 1973). Not blaming the rest of the "team" for failure tends to be preferred. On the whole, people tend to find negative outcomes less valuable in terms of information when assessing control. Weiner & Kukla (1970) find evidence that high-achievement motivation influences the tendency to make self-attributions, both on the positive and negative end. Feather & Simon (1971) point out that the self-attribution of success depends on whether success was expected, otherwise, positive results will be attributed to variable environmental factors. In essence, psychological research into the self-attribution bias tends to point towards many important exceptions, especially on the dismissal of negative outcomes. Proper feedback seems to be the most clear antidote against biased self-attribution, Malmendier & Tate (2005) for example include a control variable for the number of outside directors in the board of a firm as a measure of corporate governance. However Taylor & Fiske (1975) point out that depending on one's point of view results tend to be linked with probable causes through the most salient piece of information. This attribution error points towards an overall inclination of people to attribute dispositional traits as a cause for behaviour while diminishing environmental influences. Hayward, Rindova and Pollock (2004) build on these psychological findings and map out a model in which

an environmental actor, the press, could play a role in the theatre of a CEO's grandeur. Einhorn & Hogarth (1978) subtract from psychological research that learning from experience can be difficult because people do not look for or test disconfirming evidence, ignore environmental effects and use unaided memory for storing outcome information (p. 413).

C. Illusion of control

Whether and how people, or a CEO in the case of this paper, self-attribute past outcomes to one's own capabilities is the first step in determining how the self-attribution bias influences measurable managerial overconfidence. The next step is to determine how this self-attribution influences decision making about future events. Intuitively one might say that positive past results are no guarantee for the future, even if viewed in a biased manner, due to elements of chance. However, a biased self-attribution lens with which one looks at past events is interdependent with how much control one perceives to have about future events. In a sense, biased self-attribution is nothing more than an overestimation of how much control one had over past events.

Langer (1975) points towards an overall inclination for people to dismiss the importance of chance in events. Langer (1975) maps out the case for the "illusion of control", a bias where people are unable to distinguish controllable from random events under certain circumstances. These circumstances are competition, an element of choice and familiarity with the process and outcomes of the task. The more a chance task looks like a skill-oriented task, the higher the perceived control. A CEO's core task, increasing shareholder value, is dependent on both skill and chance but predominant in elements that induce an illusion of control. Thus the illusion of control also makes the case that a CEO will perceive future events whose outcome is dependent on elements of both chance and skill to be overly dependent on the later.

D. Summary

Two main lessons are derived from the literature. The first one is that in behavioural corporate finance research overconfidence tends to be seen as a character trait that "reveals" itself and is constant in its influence on managerial decision-making. Whilst on the other hand both research in market timing and investor sentiment tends to describe overconfidence as a fluctuating influence on investor decision-making. Secondly, the psychological literature points towards many exceptions and rules when it comes to a self-serving attribution bias and only limited evidence that negative signals are ignored. These lessons identify the need to test the influence of self-attribution inducing time-variant relative performance on overconfidence at both the negative and positive end.

II. Data

In this paper I analyze a sample of 2186 unique CEO-firm combinations across 1595 firms who have been included at least once in the S&P 1500 index during the period from 2006 to 2017.[7] The S&P 1500 index roughly encapsulates most of the total market capitalization in the United States of America. I identify the firms who fulfilled this requirement by utilizing the Index Constituents section of the Compustat database. The exact firm-level data comes from the Annual Fundamentals section of the Compustat database. The CEO-level data comes from the Execucomp database. Due to the inclusion of future values of certain variables in the model the sample used is indirectly restricted to CEO's who have at least two years of tenure under their belt.

The Execucomp database solely looks at directors of S&P 1500 firms, so any gaps in the data tend to be from firms dropping in and out of this index. I start by retrieving the unique CEO-firm identifiers from the Annual Compensation section, where I also retrieve data about number of personal characteristics, total share ownership and information about their overall compensation. The personal characteristics include gender, age and the date at which his or her tenure started. By knowing the exact date at which a person started his or her tenure as CEO I can calculate for each CEO-firm year observation the exact number of years he or she has been in office. Unfortunately the Execucomp database does not include information about the type of education a CEO might have.

With the unique CEO-firm identifiers in hand I retrieve precise information about their option packages from the Outstanding Equity Awards section. This precise information consists of data about the expiration date, exercise price and the amount of vested options. This data enables me to calculate whether a CEO held options in the money above the various rational thresholds for each year, plus an weighted average of In-The-Moneyness for each CEO-firm year. From the Annual Fundamentals section of the Compustat database I retrieve a number of important variables like Total Assets and Earnings Before Interest, Depreciation and Amortization, henceforth abbreviated to AT and EBITDA. It is important to note that I also retrieve data on AT for the year 2005 since I will need to normalize EBITDA by the value of AT the year before, as this will help save many observations. For my research I also need data from Compustat in order to calculate the Book-to-Market ratio and the Price-to-Earnings ratio. Naturally the Book-to-Market ratio is defined as book equity divided by market equity. Book equity is calculated by the sum of Book value of stockholders' equity and balance sheet deferred taxes and investment tax credit (if

[7] This does not change the significance of the effect Holder67 has on Investment-to-cash flow sensitivity can be seen In my replication of Malmendier & Tate (2005a) main research in table VIII.

available), minus the book value of preferred stock. Market equity is calculated as common shares outstanding times the stock price at fiscal year-end. Negative Book-to-market observations are dropped from the sample. The Price-to-Earnings ratio I calculate by dividing the stock price at fiscal year-end by the earnings per share excluding extraordinary items for the same year. In order to construct an approximate for insider information about future stock repurchases and offerings I retrieve data about these variables as well from the Annual Fundamentals section of the Compustat database.

The industry identifiers used in this paper are the Fama-French 48[8] which I retrieve through the Standard Industrial Classification codes found in the Annual Fundamentals section of the Compustat database. In Table I the summary statistics for Firm-level and CEO-level data can be found, as well as the distribution of observations across the Fama-French 48 industry sectors. Purely looking at the data one can already see that in 71% of firm-year observations a CEO held options In-the-Money at the 40%. In Table II the correlations between the sets of variables can be found, which show pairwise t-test results of significance at the .1 level.

III Methodology & Hypotheses

A. Proxies of Overconfidence and Self-attribution inducing performance.

Before any hypothesis can be formed on the effect the self-attribution effect might have on overconfidence two types of variables are required, the first type are the proxies that imply overconfidence. Malmendier & Tate (2005a) utilize many different rational thresholds based on the model of Hall & Murphy (2002) to mark a CEO as overconfident but most predominant in their paper is that of Holder 67. For the sake of robustness I will also include regressions on the Holder 40 and Holder 100 proxies. These proxies are slightly different from the originals however, since Malmendier & Tate (2005a) only mark a CEO as overconfident if he postpones exercising the above threshold options twice. They do so because they model overconfidence as a permanent rather than transitory effect, which is precisely the assumption I seek to put to the test. To construct the overconfidence proxies the In-The-Moneyness of each option package is calculated. For this step, data on the price of the option package is necessary as well as the year end stock price in the same year. Then if a vested option package in a given is above the threshold the value of the proxy for that year will be 1 and 0 if below. The threshold levels chosen are 40%, 67% and 100%.

[8] The 48 industry sectors are defined on Kenneth French's site, (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_48_ind_port.html).

Table I
Summary Statistics

The sample contains all unique yearly person-firm observations for CEOs who led a S&P 1500 firm during the 2006 to 2017 period for which data could be found.

Panel A. Firm Data Summary Statistics
Number of unique firms = 1595

Variables	Obs.	Mean	Median	St.Dev	Min	Max
Assets ($M)	8642	19755.481	2367.0015	122625.75	3.568	2573126
Cashflow ($M)	8642	1185.1147	241.6565	3756.4302	-21913	61385
Cashflow norm. by lagged Assets	8642	.1348	.1266	.111	-.6954	1.2603
Market Equity	8642	9070.6988	1958.1691	23446.41	2.9069	366301.6
Book Equity	8642	4416.7778	951.945	14189.457	.839	233932
B/M Ratio	8642	.6248	.5037	.6031	.004	23.0076
P/E Ratio	8642	18.3889	17.3769	156.3107	-4320	7697
Value of Stock Repurchases ($M)	8516	284.6185	11	1063.5232	-1	25220
Value of Equity Offerings ($M)	8596	89.9987	8.206	488.3247	-139	21976
Fiscal year-end close stock price	8642	40.9997	30.965	49.0616	.1511	1643

Panel B. CEO Data Summary Statistics
Number of unique CEO-firm combinations = 2186

Variables	Obs.	Mean	Median	St.Dev	Min	Max
Holder 40	8642	.7115	1	.4531	0	1
Holder 67	8642	.6021	1	.4895	0	1
Holder 100	8642	.4896	0	.4999	0	1
Max	8642	.5953	1	.4909	0	1
Vested options (x1000)	8642	724.3423	363.625	1364.7252	.001	49425
Female	8642	.0356	0	.1854	0	1
Executive's Age	8642	55.6243	55	6.9373	29	87
Tenure	8642	7.9051	6	7.0853	0	49
Relative Operational Performance	8642	.0171	-.0784	.8097	-3.129	3.7596
Above Average Performance	8631	.4356	0	.4959	0	1
Share ownership (%)	8642	1.7758	.373	4.632	0	63.47
Fair Value of Option Grants (x1000)	8633	1185.0691	381.996	2954.6429	0	90693.4
Fair Value of Stock Grants (x1000)	8634	2167.2627	965.2315	3824.917	0	111915
Total Compensation	8627	5736.1261	3979.865	6550.2805	0	128706.1

Panel C: Frequency distribution of Firm-year observations across the Fama-French 48 industry groups

Fama-French industry code (48 industries)	Freq.	Percent	Cum.
Agriculture	18	0.21	0.21
Food Products	168	1.94	2.15
Candy & Soda	23	0.27	2.42
Beer & Liquor	30	0.35	2.77
Recreation	56	0.65	3.41
Entertainment	62	0.72	4.13
Printing and Publishing	42	0.49	4.62
Consumer Goods	138	1.60	6.21
Apparel	139	1.61	7.82
Healthcare	133	1.54	9.36
Medical Equipment	352	4.07	13.43
Pharmaceutical Products	379	4.39	17.82
Chemicals	253	2.93	20.75
Rubber and Plastic Products	37	0.43	21.18
Textiles	13	0.15	21.33
Construction Materials	175	2.02	23.35
Construction	156	1.81	25.16
Steel Works Etc	112	1.30	26.45
Machinery	363	4.20	30.65
Electrical Equipment	97	1.12	31.78
Automobiles and Trucks	122	1.41	33.19
Aircraft	56	0.65	33.83
Shipbuilding, Railroad Equipment	16	0.19	34.02
Defense	12	0.14	34.16
Non-Metallic and Industrial Metal Mining	42	0.49	34.64
Coal	12	0.14	34.78
Petroleum and Natural Gas	321	3.71	38.50
Utilities	235	2.72	41.22
Communication	176	2.04	43.25
Personal Services	118	1.37	44.62
Business Services	864	10.00	54.62
Computers	273	3.16	57.78
Electronic Equipment	601	6.95	64.73
Measuring and Control Equipment	198	2.29	67.02
Business Supplies	84	0.97	67.99
Shipping Containers	33	0.38	68.38
Transportation	281	3.25	71.63
Wholesale	303	3.51	75.13
Retail	474	5.48	80.62
Restaurants, Hotels, Motels	112	1.30	81.91
Banking	746	8.63	90.55
Insurance	403	4.66	95.21
Real Estate	17	0.20	95.41
Trading	305	3.53	98.94
Almost Nothing	92	1.06	100.00
Total	8642	100.00	

Table II
Pairwise Correlations

Panel A: Overconfidence and CEO characteristics

Variables	Holder 40	Holder 67	Holder 100	Max	Age	Share ownership	Vest. Options	Female	Tenure
Holder 40	1.0000								
Holder 67	0.791*	1.0000							
Holder 100	0.631*	0.798*	1.0000						
Max	0.279*	0.239*	0.203*	1.0000					
Age	0.0060	0.0020	-0.0100	0.034*	1.0000				
Share ownership (%)	0.0170	0.031*	0.049*	-0.035*	0.089*	1.0000			
Vested options (x1000)	0.080*	0.087*	0.088*	-0.0160	0.046*	0.083*	1.0000		
Female	-0.0020	-0.0050	-0.0140	-0.0030	-0.054*	-0.052*	-0.0100	1.0000	
Tenure	0.079*	0.085*	0.091*	0.0110	0.391*	0.373*	0.123*	-0.070*	1.0000

Panel B: Overconfidence and Firm Fundamentals

Variables	Holder 40	Holder 67	Holder 100	Cashflow	Assets	B/M Ratio	P/E Ratio	ROP	AAP	Equity Offerings	Stock Repurchases
Holder 40	1.0000										
Holder 67	0.791*	1.0000									
Holder 100	0.631*	0.798*	1.0000								
Cashflow ($M)	0.0090	-0.0050	-0.038*	1.0000							
Assets ($M)	-0.039*	-0.037*	-0.056*	0.712*	1.0000						
B/M ratio	-0.273*	-0.246*	-0.220*	-0.0190	0.049*	1.0000					
P/E ratio	0.033*	0.034*	0.041*	0.0030	0.0020	-0.034*	1.0000				
ROP	0.202*	0.200*	0.193*	0.046*	-0.058*	-0.252*	0.038*	1.0000			
AAP	0.194*	0.199*	0.196*	0.0140	-0.082*	-0.243*	0.0210	0.657*	1.0000		
Equity offerings ($M)	-0.037*	-0.032*	-0.036*	0.319*	0.464*	0.0210	0.0040	-0.0150	-0.023*	1.0000	
Stock Repurchases ($M)	0.043*	0.033*	0.0020	0.665*	0.413*	-0.053*	0.0030	0.047*	0.029*	0.398*	1.0000

* *p<0.1*

The second type of variable needed is one that ought to induce self-attribution and thus have an influence on the proxies of overconfidence. Any CEO will receive plenty of information about firm performance that he might self-attribute, the question is which information is deemed important enough to link to one's influence on future firm performance. The calculation of this later variable, one's influence on firm performance, is one drenched in uncertainty and possible biased decision making. Thankfully the work of Tversky & Kahneman (1974) will help dissect which information a CEO might judge to be an important factor in the self-attribution of success. In their work they explain a number of heuristics that influence how we tend to make decisions when dealing with uncertainty. Two of these are especially applicable to this research, namely the Representativeness and Availability heuristics. The Representativeness heuristic makes people believe that the probability of an uncertain event is dependent on how similar it is in characteristics to other events. In a sense the event is compared to its prototype, which in the case of this paper is that a firm which beats its competitors tends to be successful. This pushes away considerations of the influence of chance on an event. The availability heuristic on the other hand causes people to assess probabilities by how easy it is to bring such instances to mind. This heuristic thus causes people to overestimate the importance of salient personal experiences simply because of familiarity. A natural way to measure your own performance to evaluate your skills is to look at how well that performance holds up when compared to other firms and that this performance is indicative of one's impact on future performance. The availability and heuristic will predict that these firms chosen for comparison will be similar in their most salient characteristics to the firm of the CEO in question. I assume these salient characteristics to be size and industry, defined by the value of assets and the Fama-French 48 industry indicator a firm belongs to. The representativeness heuristic in turn will cause that beating one's competitors in these dimensions will be seen as a success for the firm.

The next step is to look for the exact performance measure that ought to be most dominant in the CEOs calculations for self-evaluation. The phenomenon known as the "illusion of control" as put forward by Langer (1975) points towards the difficulty of separating luck from skill. Certain factors in a given situation can make a person more likely to believe that the probability of success is dependent mostly on their own skills, while the importance of chance is underestimated. The most important factors for this research are familiarity, involvement and choice. This helps pin down earnings before taxes, interest and depreciation as the determinant performance measure which ought to influence the overconfidence proxies the most. Taxes, interest, depreciation and amortization tend to depend on external factors such as changes in tax law. Management can certainly influence the levels of taxes, interest, depreciation and amortization, but this influence is

mostly dependent on the past and current input of the CFO. Thus profit or EBIT ought to be less dominant in the CEOs self-evaluating calculations.

Factoring in the illusion of control and judgement under uncertainty I am left with the operational performance measure of EBITDA, controlled for size and industry, as the independent variable that is hypothesized to induce the strongest influence on the various overconfidence proxies. From this I construct the main variable named Relative Operational Performance, henceforth abbreviated to ROP.

First I calculate the normalized version of year end (t) EBITDA per firm (i) as a fraction of Assets at the start of the year (t-1).

$$\text{Norm. Ebitda}_{it} = \frac{Ebitda_{it}}{Assets_{i,t-1}} \qquad (1)$$

Then I calculate an equally weighted average of normalized EBITDA for each industry (j) per year (t).

$$\text{Industry Average}_{jt} = \frac{\sum_{i=1}^{N} Norm.Ebitda_{ijt}}{Number\ of\ firms\ in\ Industry\ j\ at\ time\ t} \qquad (2)$$

Then the Relative Operational Performance, ROP, is calculated in the following form:

$$\text{ROP}_{it} = \frac{Norm.\ Ebitda_{ijt} - Industry\ Average_{jt}}{Industry\ Average_{jt}} \qquad (3)$$

Through this measure I control for both industry and size. For example, with this measure I hypothesize that on average a CEO who has an AT normalized EBITDA of 10% versus 5% for his industry peers will be more likely to retain above rational threshold ITM options. Observations with negative industry average values are multiplied by -1 to prevent worse than industry performance having a positive sign.[9] I prefer controlling for size through this method rather than picking a few firms close to firm *i* in terms of its value of assets because of the difference in firm-year observations per industry as can be seen in Panel C of Table I. Some CEOs in smaller industries might compare themselves to their whole industry, whilst other CEOs in larger industries pick only a fraction of their respective industry peers for comparison due to bounded rationality. I also derive from ROP a dummy variable called AAP, Above Average Performance, which takes the value of 1 if ROP has a value above 0 to properly test the hypotheses.

[9] This is only the case for 85 observations.

B. Hypotheses on the effect of self-attribution inducing performance

The lessons learned from the literature allow the formulation of two broad predictions. The first one is that the proxies that indicate overconfidence by CEOs are dependent on a fluctuating element that exacerbates their confidence through the self-attribution bias. This prediction is based on the diversion between finance research analyzing managerial behavior and that of finance research analyzing investor behavior in how overconfidence is modelled. The second prediction is that the self-attribution bias is a double edged sword where negative events are not necessarily attributed to external factors if the event is systematic and transparent. These broad predictions are narrowed down in empirically testable hypotheses precisely defined in the following manner;

Hypothesis 1:

A CEO is more likely to hold onto his options In-The-Money above the rational thresholds in a given year if he performed above average in terms of operational performance when compared to similar peers in that same year.

Hypothesis 2:

A CEO will be more or less likely to hold his options In-The-Money above the rational thresholds in a given year according to his relative-to-industry operational performance in that same year.

C. Control variables

A few variables indicating personal characteristics are added for control, as well as a variable indicating to which Book-to-market decile the firm belongs to is added in. The deciles were included due to research by Jenter (2005) who found that directors belonging to value firms tended to buy more stock in their own company when compared to fellow directors belonging to growth firms. He explained this relationship as directors betting on their firm being undervalued by the market, believing that the B/M ratio indicates market mispricing instead of systemic risk factors. This belief in undervaluation might trigger CEOs to go long with their option packages.

A commonly heard critique of stock repurchases is that they simply enrich the CEOs of the firms who do so by increasing the value of their option packages. For example Useem (2019) makes the case that only one type of shareholder really benefits from a firm's stock buybacks, their managers. SEC commissioner Robert J. Jackson Jr. found evidence that insiders sell far less stock just before a stock repurchase announcement and five times more than that in the days following the announcement (Jackson, 2018). As Jackson (2018) points out this is not technically illegal

since the action itself, trading the stock, is done post-announcement when the information is revealed to the public. Therefore it is somewhat similar to CEOs holding unto options due to information about next year's stock repurchases or the opposite for next year's equity offerings. In the dilemma under analysis in this paper this might make a CEO postpone exercising highly In-the-money options because he believes that a stock repurchase next year might increase the value of those options even further. This belief needs not be fully rational, it might even play into the choice and involvement aspects of the illusion of control bias. The CEO in question might overestimate the importance of his insider information about repurchases or offerings on next year's stock price and underestimate the influence of possible external factors. Or he might not, in both the rational and the irrational case the effect is predicted to be the same. The reverse is naturally the case when the chief executive knows a new stock offering is coming.

In order to control for insider information about future stock repurchases or offerings the value of next years (t+1) stock repurchases and offerings are added in. Including these controls for insider information does mean that the model makes two presumptions. Firstly that the CEO roughly knows the value of next year's stock repurchases and offerings and secondly that the announcement has not been made yet in the current year.

Other behavioral factors that might influence managerial stock option exercise decisions need also be accounted for. Heath, Huddart and Lang (1999) analyzed a sample of 50,000 employees at 7 different firms and found that employees exercise in response to price trends where long term trends negatively impact exercise and short term trends positively. They also found that, consistent with the reference points element of prospect theory, employees exercise more if the stock price moves above the maximum price attained last year. Therefore,the price trend of the current year will be included in the model as well as thelast year to account for the influence of long term trend extrapolation and a dummy variable that indicates if the maximum price attained in the current fiscal year is higher than the one of last year.

D. Random Effects versus Fixed Effects logit

With the variables calculated and ready their significance can be tested. This is done through the various binary choice models available for longitudinal data. Random effects models of both the logit and probit persuasion have two main advantages but one big disadvantage when compared to a fixed effects, or conditional, logit model. The advantages are that data about CEOs who always or never held their options in the money above the rational thresholds can be included and that we can test the significance of time-invariant characteristics such as gender. In a fixed effects logistic model this is impossible because it purely looks at within-individual differences,

but this also gives it the significant advantage that it controls for all time-invariant effects of heterogeneity. The possible risk of unavailable data about individual characteristics influencing the dependent variable is thus eliminated in the conditional, or fixed effects, logit model. In either model outliers have even more than normal tendency to disrupt statistical analysis. Therefore, I winsorize the observations based on the 1th and 99th percentile of ROP. The transformation test by Box & Tidwell (1962) was used to make sure that the relationship between ROP and the logit of the likelihood of the dependent variables is robust to any non-linearity concerns.

IV Self attribution of Relative Operational Performance

A. Results for the random effects binary choice regressions

Table III describes the results of a longitudinal random effects logit regression of the self-attribution variables and a number of control variables on the independent variables that approximate for overconfidence. Results are given in the odds ratio, meaning values above 1 indicate a positive relationship and below 1 a negative relationship. If the dummy variable indicating Above Average Performance takes the value of 1 a CEO is 1.59x times more likely to hold options above 40% in-the-money, 1.74x times more to hold options 67% in-the-money and 1.89x times more likely to hold options 100% in-the-money. These values are as expected and statistically significant at the 1% level. These significant relationships provide evidence that a CEO bases his decision to not exercise above rational threshold held vested options on whether he performed above average in terms of relative operational performance when compared to industry peers. If we move on from the binary variable of AAP to the continuous variable of ROP we see that the estimator also increases in its coefficients the higher the threshold of the dependent variable. If a CEO outperforms his industry peers based on normalized-by-assets EBITDA by 100% he is roughly 1.8 times more likely to hold unto options 100% ITM then a similar CEO who did not do so. This provides evidence that the CEO cares not just about performing above average, but also by how much he did so. The same variables stay significant if the probit model is utilized, as can be seen in Table 9.

The Pseudo R-squared used in this paper is the McKelvey & Zavoina (1975) version that has been shown to best explain the estimated variance in various Monte Carlo studies (DeMaris, 2002) (Langer, 2002). Based on the Pseudo R-squared values, the ROP variable seems to explain variation better than the basic AAP dummy variable.

The control variables provide some interesting information. Tenure has a positive and significant relationship with the likelihood of holding options in-the-money above all the rational

thresholds. This is probably partially due to the necessity of first being compensated with options before they even vest in the first place and achieve a high enough level of in-the-moneyness. Age has an expected but non-significant negative effect on likelihood. The dummy variable indicating whether the CEO is female finds no significant relationship, whilst its estimator is positive. The amount of female CEOs in the sample is possibly too low to dissect any meaningful influence, as in table I where I summarize the various variables one can find that in only 3.6% of the yearly observations the firm was led by a woman. The Price-to-Earnings ratio of the firm and the percentage of stock owned by the CEO both seem to have no relationship with the likelihood of holding options in the money above any of the thresholds. The first variable was a control for a CEO trading on a firms perceived over or undervaluation, the second a control for acting on possible private benefits of control. As expected the value of next year's stock repurchases increases the likelihood that the CEO will keep holding onto his heavily ITM options, whilst the value of next year's stock offerings decreases its likelihood. However only the latter is significant and its estimator increases in influence as the Holder proxy becomes higher in its required In-the-moneyness.

Another interesting find however is the positive and significant effect the Book-to-Market deciles have on the likelihood of a CEO holding options in-the-money above the rational thresholds. This effect is perhaps the complete opposite of what one might predict - from Jenter (2005). This contrasts with what one can find in column 2 of table III, where a CEO in the 1st decile of B/M is 94x times more likely to hold options at least 40% in-the-money then a CEO leading a firm in the 10th decile of B/M. The decision to buy stocks and hold options in-the-money above the rational thresholds seem to differ completely with their relationship to the Book-to-Market ratio.

The dummy variable MAX, indicating that the maximum price attained in the current fiscal year exceeded the maximum price of last year, is interestingly enough positive in its coefficient. This might be due to the fact that Heath, Huddart & Lang (1999) focus on the scale of option exercise instead of the postponement of exercising heavily In-The-Money options.[10] The variables that control for the influence of possible long-term trend extrapolation behave as expected, indicating a positive relationship between recent returns and the likelihood that a CEO might hold onto options whose In-The-Moneyness is above any of the rational thresholds.

[10] They approximate for rational reasons of exercise through Barone-Adesi & Whaley's (1987) method of assessing the value of American options.

Table III
Random Effects Logit Regression of the Overconfidence Proxies on Above Average Performance

The dependent variable, Holder, in the regressions is a dummy indicating whether the CEO held an option in-the-money above the rational threshold in question in that year. These thresholds of in-the-moneyness are respectfully 40%, 67% and 100%. Relative Operational Performance is defined as the relative deviation of earnings before interest, depreciation and amortization from its industry average normalized by value of total assets at the start of the year. If this relative deviation is above 0, the dummy for Above Average Performance takes the value of 1. The Price-to- Earnings Ratio is defined as the stock price at fiscal year-end divided by the earnings per share before extraordinary items of the same year. The B/M deciles are derived from the Book-to-Market ratio, defined as book equity divided by market equity. The base value by which B/M decile influence is calculated is the 10^{th} one. MAX is a dummy variable equal to 1 if the highest price of the current fiscal year was greater than the year before. Price trend indicates the relative change in stock price over year t. Industry fixed effects are utilized using the Fama-French 48 indicators. Year fixed effects are also included. The standard errors are robust to within CEO heteroskedasticity. Observations indicate the total of CEO-year observations used in the regression. Results are given in the odds-ratio

	Overconfidence Proxies					
Variable	Holder 40		Holder 67		Holder 100	
	(1)	(2)	(3)	(4)	(5)	(6)
Above Average Performance	1.5923***		1.7379***		1.8903***	
	(.1937)		(.1832)		(.2059)	
Relative Operational Performance		1.6044***		1.6623***		1.7915***
		(.1361)		(.1322)		(.1504)
Tenure	1.0632***	1.0646***	1.0703***	1.0717***	1.0729***	1.0748***
	(.0136)	(.0138)	(.013)	(.0132)	(.0136)	(.0139)
Executive's Age	.9931	.9926	.9973	.9965	.9882	.9872
	(.0109)	(.011)	(.0108)	(.0109)	(.0116)	(.0118)
Female	1.6211	1.6273	1.4994	1.5076	1.2521	1.2681
	(.5483)	(.5524)	(.5068)	(.51)	(.4096)	(.418)
Price-to-Earnings Ratio	.9997	.9997	.9998	.9998	.9999	.9999
	(.0002)	(.0002)	(.0002)	(.0002)	(.0003)	(.0003)
Stock Ownership (%)	.9932	.9913	.9982	.9963	.9953	.9928
	(.0176)	(.0186)	(.0163)	(.0173)	(.018)	(.0192)
Book-to-Market deciles						
1 (Growth)	108.0464***	94.3782***	99.2283***	86.9362***	118.0728***	105.2911***
	(38.4724)	(33.6433)	(33.4661)	(29.4393)	(40.8428)	(36.5938)
2	98.2267***	91.9154***	67.5853***	63.7375***	73.0677***	68.9427***

	(30.7946)	(28.6497)	(19.9758)	(18.876)	(22.7337)	(21.4203)
3	37.4731***	35.6265***	33.9417***	32.5322***	34.6643***	33.5993***
	(10.5861)	(9.971)	(9.6)	(9.1682)	(10.4935)	(10.1823)
4	32.3414***	31.5119***	28.9677***	28.0542***	28.1056***	27.3568***
	(8.8178)	(8.5287)	(7.7844)	(7.5268)	(8.1265)	(7.8994)
5	25.2429***	24.1694***	18.0168***	17.1713***	16.3255***	15.4889***
	(6.5495)	(6.2462)	(4.6046)	(4.3857)	(4.4734)	(4.262)
6	14.8532***	14.206***	13.5044***	12.8045***	12.0791***	11.5234***
	(3.552)	(3.3968)	(3.2369)	(3.0681)	(3.1175)	(2.9797)
7	11.2069***	10.8104***	7.9183***	7.5405***	7.3347***	6.9867***
	(2.5846)	(2.4776)	(1.8181)	(1.7257)	(1.8226)	(1.7321)
8	5.915***	5.7743***	4.59***	4.4061***	4.7704***	4.6009***
	(1.2392)	(1.2085)	(.9968)	(.9596)	(1.1483)	(1.113)
9	2.9017***	2.8467***	2.2704***	2.1943***	2.0036***	1.9289***
	(.5327)	(.5217)	(.4538)	(.4401)	(.4406)	(.4285)
10 (Value)						
Value of t+1 stock repurchases ($M)	1.0001	1.0001	1.0001	1.0001	1.0001	1.0001
	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)
Value of t+1 equity offerings ($M)	.9995**	.9995**	.9994***	.9994***	.9992***	.9992***
	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)
Size	1.2416***	1.2219***	1.2571***	1.2387***	1.1501**	1.1323**
	(.0649)	(.0639)	(.0649)	(.064)	(.0636)	(.063)
MAX	2.6817***	2.634***	2.1141***	2.0765***	1.9158***	1.8715***
	(.2575)	(.2529)	(.1872)	(.1831)	(.1723)	(.1678)
Price trend (t)	1.2124*	1.2131*	1.2217**	1.2202**	1.272***	1.2665***
	(.1217)	(.121)	(.1041)	(.1031)	(.1138)	(.111)
Price trend (t-1)	1.1531**	1.1473*	1.2409***	1.2337***	1.294***	1.2855***
	(.0837)	(.0828)	(.1027)	(.1003)	(.1154)	(.1126)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.2153	2.6452	.0727	.1613	.0814	.1872
	(2.0068)	(4.1408)	(.122)	(.2659)	(.2155)	(.4908)
Obs.	8631	8642	8631	8642	8631	8642
Pseudo R-squared	. .3341	. .3420	. .3128	.3209	.2990	.3081

Standard errors are in parenthesis
*** *p<0.01, ** p<0.05, * p<0.1*

B. Discussion

As expected, the results of this study seem to suggest a relationship between performing better than the average of industry peers in terms of operational performance and holding options in the money above the rational thresholds. This effect seems to provide some evidence that an irrational postponement of exercising heavily In-the-money options is determinant on recent better than average relative operational performance by increasing a CEOs confidence through the self-attribution bias. The diversion in scale between the AAP and ROP variables might seem a puzzle, but it is simply the difference between the average effect and the linear effect. The lower standard errors for the ROP points towards that variable being a better explanation of CEO option holding behavior. Simply put it does not just matter if a CEO was "Better than average" in terms of his firm's operational performance in a given year, but also by how much so.

A puzzle to be solved is why the book-to-market decile a firm belongs to is such an important determinant of whether its CEO holds options In-the-money above any of the rational thresholds. Table VI provides the values of means of the dependent variables utilized in this research and CEO compensation across the deciles. The average ITM is calculated as the weighted mean of all exercisable options packages a CEO held per yearly observation. Interestingly enough the average ITM of the top decile is 900% and in 69,5% of the yearly observations the typical CEO in that decile held at least one package 100% ITM. One possible explanation is that CEOs leading these growth firms in the upper deciles tend to get more media attention, which on the one hand might exacerbate their overconfidence and on the other hand might make exercising options a more important signal to the market. Malmendier & Tate (2008) for example construct an overconfidence measure based on press portrayal. Their sample, the Forbes 500, also consists of well-known firms. Graham, Harvey and Puri (2010) also note that overconfident CEOs tend to be leading growth firms.

Hayward et all (2004) provide a theoretical framework where media portrayal is actually the first link in the chain that leads to the CEO self-attributing certain positive events to purely his own actions and abilities and end up with a higher level of overconfidence. They point out that it is dependent on clear strategic choices which garner media attention, who in turn over attribute a CEO's abilities as a cause of success and push away the importance of purely probabilistic factors. They build their framework on the psychological research such as put forward by Taylor & Fiske (1975) who examine a number of earlier studies that point out that causes tend to be attributed by observers to the most salient source of information and that this is shaped by the literal point of view. For example a CEO might have a quite rational explanation of why a merger was so successful, but a journalist as an observer seeks a simple causal attribution and pins the success

purely on the CEO's actions and abilities which in turn makes the CEO do so as well. Thus the B/M decile a firm belongs to may approximate for possible external influences that exacerbate overconfidence. On the other hand the ROP is built as an internal factor that influences overconfidence, as it incorporates a CEOs ability to compare his performance to that of his peers in the same year as when he makes the decision to keep holding onto above rational threshold options. While positive cashflow information might cause good press portrayals it need not be naturally linked to the clear strategic choices Hayward et all (2004) point out as the trigger that causes over-attributing media portrayals. Lie (2006) found that options tend to be rewarded just before positive abnormal returns, which in this case might imply that managers working for growth firms might simply be better at timing the moment they get rewarded with an option package.

Thus there are some rational and irrational explanations why holding options in-the-money far above the rational thresholds by the CEO is so dependent on the B/M decile the firm is positioned in. A follow-up question one might have is why the B/M decile is a positive influence on the overconfidence proxies that utilize option holding behavior but a negative influence on the overconfidence proxy that looks at stock purchase behavior, "Netbuyer". Whilst exercising options might technically be a manner through which stock can be bought, for a long position it is only logical to keep holding unto options. The first important disclaimer is that the "Netbuyer" proxy Jenter (2005) constructed is different from the one Malmendier & Tate (2005) use. The first one looks at open market purchases where the managers had to actively purchase stock and increase their financial stake in the company to be defined as a "Netbuyer", the second one purely looks at positive deviations on the number of stocks a CEO holds. Thus the second one also takes into account a CEO who holds unto exercised In-The-Money options instead of selling them immediately. I partially replicated Jenter's research (2005) in table VII where we can see his conclusion of managers betting on their firms perceived undervaluation through the B/M ratio still holds. I however purely looked at the behavior of the CEOs in my own sample, which enables me to test whether Jenter's "Netbuyer" holds validity as a overconfidence proxy by inserting the AAP and the ROP variable in the regression. As expected the answer is a resounding "No", ROP is even negatively related to the "Netbuyer" variable. This provides some evidence against the "Netbuyer" variable in some of its forms as a valid proxy for CEO overconfidence, at the very least in this sample.

C. Segmented effects of relative operational performance

A major cause for concern when working with an especially large dataset such as the one utilized in this paper might be that only in a certain subsample the effect of the variable tested is

prevalent. Looking back at the theory, such an effect might even be expected. The AAP and ROP variables hypothesized influence on holding options In-The-Money above the rational thresholds requires a CEO to see positive information about cash-flows as important to determine his or her capabilities. This need not be true for so-called "Growth" firms whose CEOs might find measures of expansion and preliminary non-accounting indicators of positive investment results more important to determine his or her capabilities. Such as in Hirshleifer, Low and Hong Teoh (2012) were "success" is measured by an above average amount of patent applications and citations.

On the other hand CEOs in so-called "Small" firms might feel that positive news about their cash flows is neglected by the average trader. Similar to Jenter (2005), but for a different Fama-French factor, I suspect that firms who are smaller in size then the average might self-attribute positive cash-flow information even more. In order to test these two possible effects I calculate for each year to which of the six Fama-French (1992) portfolios a firm belongs. The first dimension, Size, is based on whether a firm is below or above average market capitalization in the stock market. The second dimension, Value, is calculated by dividing all the firms in the stock market up in thirds according to their Book-to-market ratio. I regress its effects in three different models. The base model simply includes indicators to which Size/Value portfolio it belongs. The full model includes both a main effect of ROP and interaction effects with Size/Value portfolios. The segmented model removes the main effect of ROP to determine the effect of it per segment. In Table IV the results are shown. Here we can conclude that the influence of size and value roughly moves in the suspected way. In the base model ROP retains its significance from the earlier regressions. In the full model the main ROP variable remains statistically significant and positive in the sign of its coefficient. For all three versions of the dependent variable only the interaction effect with the Big Growth portfolio is consistently significant. This interaction effect provides information that CEOs belonging to bigger in size "Growth" firms self-attribute positive information about cashflows far less than those working at smaller in size "Value" firms. Firms belonging to the middle "Neutral" slice seem to be quite susceptible to ROP as well. Differences between value and growth firms ought to be quite pronounced since my sample consists of firms included in the S&P 1500.

V Self Attribution of Negative information

A. Self-attribution on the negative side

In the past two models I presumed that self-attribution bias does not have a different slope for negative and positive information when it came to the ROP value. As pointed out in the literature review this approach is heterodox to the way the self-attribution bias is normally

explained in behavioral finance. I put this assumption to the test by including an interaction between the AAP and ROP variables to test whether negative and positive ROP have different slopes. Now that I focus more on a specific element of a psychological phenomenon it is time to deal with a certain effect that might impede the robustness of the previous regressions, namely unobserved heterogeneity. In the case of this paper one could argue that personal characteristics like education, childhood events and genetics are unaccounted for. To deal with this possible bias by ignoring the unmeasured influence of nature and nurture there thankfully exists models that take into account these fixed effects.

The conditional logit model is such a powerful tool that accounts for fixed effects but with a few quirks that must be explained before interpreting the regressions results. This type of model purely accounts for within-group variation, this means that time-invariant variables like gender or industry cannot be estimated. For the model to work the dependent variable must vary across time. This means that there is a significant drop in observations when compared to the random effects model from the previous chapter. It also means that the sample under analysis consists solely of CEOs with variation of the dependent variable for holding options in the money above the respective rational thresholds. The plus side however is that the model takes into account all these time-invariant "fixed" effects for each unique individual or group, the CEO-firm combination – in this case, whether they are measured or not. The model does have some problems as well with variables that vary little across time which could lead to high standard errors for those variables.

B. Results for the fixed effects binary choice regressions

The results for the conditional logit regression can be found on Table V. One should immediately note that many CEO-firm yearly observations were dropped due to all negative or all positive observations of the dependent variable. Some CEO's either never, or more likely, always held an option in-the-money above the rational thresholds in all their years of tenure that could be observed. The more stringent the overconfidence proxy as dependent variable the less observations need to be dropped. The fixed effects model widely checks the robustness of the previous models, but has a few interesting deviations.

ROP retains its significance and its estimators are roughly the same when compared to the earlier Random Effects regression, for example a CEO is about 1.6x more likely to keep holding unto options 40% or 67% ITM if he outperformed his industry peers in terms of cashflow relative to AT by 100% then if he did not. For 100% ITM this factor is raised to 1.8x. The estimated core influence of ROP is increased in the model where the interaction effect is included.

Table IV
Segmented Random Effects Logit Regression of the Overconfidence Proxies on Relative Operational Performance

The dependent variable, Holder, in the regressions is a dummy indicating whether the CEO held an option in-the-money above the rational threshold in question in that year. These thresholds of in-the-moneyness are respectfully 40%, 67% and 100%. Relative Operational Performance is defined as the relative deviation of earnings before interest, depreciation and amortization from its industry average normalized by value of total assets at the start of the year. The Base (1) models solely include dummy indicators for each of the six Fama-French portfolios based on the dimensions of market capitalization and the book-to-market ratio. The Full (2) model adds in the interaction effects with Relative Operational Performance, whilst the Segmented (3) model solely includes the interaction effects. The Small Value indicators acts as the base on which the influence of the other Fama-French portfolio indicators are calculated. MAX is a dummy variable equal to 1 if the highest price of the current fiscal year was greater than the year before. Price trend indicates the stock return, excluding dividends, over year t. The industry fixed effects are utilized using the Fama-French 48 indicators. Year fixed effects are also included. In the Segmented model the influence of control variables is estimated to be equal for all the different segments. The standard errors are robust to within CEO heteroskedasticity. Observations indicate the total of CEO-year observations used in the regression. Results are given in the odds-ratio.

	Overconfidence Proxies								
Variable	Holder 40			Holder 67			Holder 100		
	Base (1)	Full (2)	Segmented (3)	Base (1)	Full (2)	Segmented (3)	Base (1)	Full (2)	Segmented (3)
ROP	1.7644***	2.3106***		1.8135***	2.3527***		1.9625***	2.1956***	
	(.1481)	(.3543)		(.1417)	(.3986)		(.1642)	(.3788)	
ROP* Small Value			2.3106***			2.3527***			2.1956***
			(.3543)			(.3986)			(.3788)
ROP* Small Neutral		1.2311	2.8446***		1.1517	2.7096***		1.2388	2.7198***
		(.284)	(.5397)		(.2653)	(.494)		(.2657)	(.4816)
ROP* Small Growth		.7126	1.6466***		.6492**	1.5275***		.8406	1.8456***
		(.1515)	(.2556)		(.1407)	(.2169)		(.1842)	(.2814)
ROP* Big Value		.6533*	1.5094*		.6029**	1.4185*		.7583	1.665**
		(.1639)	(.3231)		(.1532)	(.2889)		(.2196)	(.3984)
ROP* Big Neutral		.4826***	1.1151		.6965	1.6386***		1.0482	2.3013***
		(.1066)	(.193)		(.1633)	(.2853)		(.2638)	(.4501)
ROP* Big Growth		.5799**	1.3399*		.5894**	1.3866**		.6026**	1.3231*
		(.1321)	(.2279)		(.1314)	(.204)		(.1357)	(.1957)
Small Value									

Small Neutral	4.6651***	4.6176***	4.6176***	4.8667***	4.7141***	4.7141***	4.8917***	4.8707***	4.8707***
	(.7231)	(.7598)	(.7598)	(.7507)	(.7488)	(.7488)	(.7904)	(.81)	(.81)
Small Growth	14.5235***	13.2459***	13.2459***	14.4607***	13.5192***	13.5192***	15.863***	15.3528***	15.3528***
	(3.4345)	(3.1824)	(3.1824)	(3.2654)	(3.0496)	(3.0496)	(3.7745)	(3.6757)	(3.6757)
Big Value	4.6607***	4.2428***	4.2428***	5.0351***	4.4337***	4.4337***	3.4026***	3.1901***	3.1901***
	(.9504)	(.9079)	(.9079)	(1.0095)	(.8983)	(.8983)	(.7075)	(.6807)	(.6807)
Big Neutral	10.8305***	10.8073***	10.8073***	12.3748***	12.6882***	12.6882***	9.1355***	9.7236***	9.7236***
	(2.0471)	(2.164)	(2.164)	(2.1964)	(2.3263)	(2.3263)	(1.7527)	(1.9106)	(1.9106)
Big Growth	19.9334***	20.3592***	20.3592***	23.0967***	23.6875***	23.6875***	19.7268***	22.6023***	22.6023***
	(4.3558)	(4.695)	(4.695)	(4.831)	(5.1654)	(5.1654)	(4.2489)	(5.0813)	(5.0813)
Tenure	1.0658***	1.0655***	1.0655***	1.0727***	1.0719***	1.0719***	1.0756***	1.0754***	1.0754***
	(.0133)	(.0132)	(.0132)	(.0127)	(.0126)	(.0126)	(.0132)	(.0131)	(.0131)
Executive's Age	.987	.9869	.9869	.9908	.991	.991	.9821	.982	.982
	(.0105)	(.0105)	(.0105)	(.0103)	(.0103)	(.0103)	(.0111)	(.0111)	(.0111)
Stock Ownership (%)	.9867	.9877	.9877	.993	.9946	.9946	.9907	.9914	.9914
	(.0171)	(.0165)	(.0165)	(.0163)	(.0157)	(.0157)	(.0178)	(.0175)	(.0175)
Value of next year's	1.0001**	1.0001**	1.0001**	1.0001	1.0001	1.0001	1.0001	1.0001	1.0001
Stock purchases (t+1)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)
Value of next year's	.9995**	.9995**	.9995**	.9995***	.9995***	.9995***	.9992***	.9992***	.9992***
Equity Offerings (t+1)	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)
MAX	2.8862***	2.8512***	2.8512***	2.2414***	2.2265***	2.2265***	2.0399***	2.0369***	2.0369***
	(.271)	(.268)	(.268)	(.1946)	(.1931)	(.1931)	(.1814)	(.1816)	(.1816)
Price trend (t)	1.2596**	1.2671**	1.2671**	1.2495***	1.2534***	1.2534***	1.3135***	1.3146***	1.3146***
	(.1322)	(.1305)	(.1305)	(.103)	(.102)	(.102)	(.1153)	(.1145)	(.1145)
Price trend (t-1)	1.1608**	1.1589**	1.1589**	1.2493***	1.2471***	1.2471***	1.3079***	1.3052***	1.3052***
	(.0876)	(.0866)	(.0866)	(.1037)	(.1025)	(.1025)	(.1209)	(.1201)	(.1201)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	33.0872**	33.5278**	33.5278**	2.3039	2.3335	2.3335	1.4703	1.4426	1.4426
	(53.0558)	(53.6824)	(53.6824)	(3.342)	(3.3756)	(3.3756)	(3.4411)	(3.3917)	(3.3917)
Obs	8662	8662	8662	8662	8662	8662	8662	8662	8662
Pseudo R-Squared	.3184	.3210	.3210	.3054	.3072	.3072	.2848	.2863	.2863

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Its interaction with the AAP variable to determine whether below average relative operational performance has less of an effect on the dependent variables actually points out, albeit weakly, that the slope is weaker in its coefficient for positive values of ROP. For the Holder 67 the interaction is weakly significant at the 10% level whereas this increase to significance at the 5% level for the Holder 100 dependent variable. Not lagging behind industrial peers in terms of operational performance seems to be an important determinant of a CEOs confidence and in turn his decision to keep holding unto options above the rational thresholds of 67% and 100% ITM.

The control variables provide some interesting results as well. The percentage of stock ownership seems not to be an important factor influencing the likelihood of the dependent variables. Interestingly enough, in the Fixed Effects model the estimated influence of the value of next year's stock repurchases is positive in its estimate and attains significance at 1% level when the dependent variable is Holder 100. The influence of the value of next year's equity offerings is similar in its significance for the Holder 100 dependent variable, but has an expected negative estimated influence. The evidence for the influence of long term stock price trend extrapolation – diminishes up to a certain degree, whilst the MAX dummy remains similar in scope and significance. The variable of Tenure, the years a CEO has been in office, could unfortunately not be included due to the statistical problem of separation. This means that the dependent variable separates the Year and Tenure variables either wholly or partially. Simply put, certain combinations of some years and values of Tenure can only be found in one of the two states of the dependent variable.[11] Since Age has a high level of correlation with Tenure, its estimates must be taken with a grain of salt as it might include some variation normally accounted for by tenure. The Book-to-market deciles continue to be powerful determinants of option holding behavior, but possible due to limited variation its standard errors have increased when compared to the random effects models.

C. Discussion

As hypothesized, future negative relative operational performance does not differ in its influence from positive relative operational performance. As a matter of fact in some cases of above average performance ROP's influence on the Holder overconfidence proxies has a less steep slope then for below average performance. The interaction effects between ROP and AAP are significant at the 10% level for Holder 67 and significant at the 5% level for Holder 100.

[11] To explain it more precisely, Albert & Anderson (1984) define it as:
"there is a vector a that correctly allocates all observations to their group." (p. 4)

Table V
Fixed Effects Logit Regression of the Overconfidence Proxies on Above Average Performance

The dependent variable, Holder, in the regressions is a dummy indicating whether the CEO held an option in-the-money above the rational threshold in question in that year. These thresholds of in-the-moneyness are respectfully 40%, 67% and 100%. Relative Operational performance is defined as the relative deviation of earnings before interest, depreciation and amortization from its industry average normalized by value of total assets at the start of the year. If this relative deviation is above 0, the dummy for Above Average Performance takes the value of 1. AAP is used to determine interaction with ROP for below average performance. The Price-to-Earnings Ratio is defined as the stock price at fiscal year-end divided by the earnings per share before extraordinary items of the same year. The B/M deciles are derived from the Book-to-Market ratio, defined as book equity divided by market equity. The base value by which B/M decile influence is calculated is the 10^{th} one. Size is the log of assets. MAX is a dummy variable equal to 1 if the highest price of the current fiscal year was greater than the year before. Price trend indicates the stock return, excluding dividends, over year t. The standard errors are robust for within CEO heteroskedasticity and serial correlation. Observations indicate the total of CEO-year observations used in the regression. The model itself controls for all time-invariant unobserved heterogeneity. Results are given in the odds-ratio.

Variable	Overconfidence Proxies					
	Holder 40		Holder 67		Holder 100	
	Controls for Fixed effects (1)	Interaction (2)	Controls for Fixed effects (1)	Interaction (2)	Controls for Fixed effects (1)	Interaction (2)
Relative Operational Performance	1.6002***	2.0222***	1.6196***	2.0957***	1.8021***	2.2641***
	(.1977)	(.4863)	(.2021)	(.5095)	(.2275)	(.4046)
(ROP)* (AAP)		.624		.5683*		.5851**
		(.1967)		(.18)		(.1372)
Above Average Performance		1.0316		1.1598		1.255
		(.1813)		(.1727)		(.1742)
Executive's Age	.2237***	.2223***	.3678	.3409*	1.3859	1.3096
	(.1291)	(.124)	(.2386)	(.2217)	(.7144)	(.5541)
Stock Ownership (%)	1.0721	1.0716	1.048	1.0465	1.0152	1.0149
	(.069)	(.0717)	(.036)	(.0362)	(.046)	(.0305)
Value of Next year's Stock Repurchases (t+1)	1.0001	1.0001	1.0001	1.0001	1.0002***	1.0002***
	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)
Value of Next year's Equity Offerings (t+1)	.9997	.9997	.9996*	.9996*	.9993***	.9993***
	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)

Book-to-market Deciles						
1 (Growth)	1395.5374***	1446.27***	1080.5241***	1124.362***	910.1908***	891.8954***
	(883.701)	(908.1528)	(629.7286)	(651.1505)	(505.7054)	(375.0233)
2	472.8516***	480.4599***	311.4918***	313.9626***	268.494***	261.8769***
	(249.0828)	(251.1117)	(155.7521)	(156.7322)	(131.127)	(94.8465)
3	166.1853***	167.2839***	144.6179***	145.3345***	121.4324***	116.7441***
	(77.3042)	(77.3361)	(64.8639)	(65.1373)	(55.272)	(39.1274)
4	117.1562***	115.0384***	97.519***	96.9044***	72.5735***	69.7196***
	(51.5983)	(50.1873)	(41.0037)	(40.7104)	(30.3961)	(21.7385)
5	63.3023***	62.4902***	45.6489***	45.5641***	32.7044***	31.7975***
	(25.6888)	(25.155)	(17.9285)	(17.9306)	(12.7967)	(9.3986)
6	35.5446***	35.57***	30.3682***	31.0442***	21.2463***	21.0245***
	(13.6981)	(13.5479)	(11.2243)	(11.4529)	(7.5557)	(5.9344)
7	18.476***	18.3907***	14.4625***	14.6826***	10.946***	10.9334***
	(6.6313)	(6.5792)	(5.0805)	(5.1818)	(3.6804)	(2.9146)
8	7.2863***	7.1995***	6.0082***	6.0469***	5.9518***	5.9152***
	(2.2269)	(2.1979)	(1.8917)	(1.9086)	(1.8545)	(1.4925)
9	3.173***	3.1593***	2.6181***	2.6446***	2.1411***	2.1308***
	(.803)	(.8057)	(.7199)	(.7355)	(.584)	(.4766)
10 (Value)						
Size	4.1222***	3.9848***	3.9969***	3.829***	3.8046***	3.6277***
	(1.3382)	(1.2779)	(1.1437)	(1.0867)	(1.0704)	(.6701)
MAX	1.8653***	1.8438***	1.5788***	1.5622***	1.4987***	1.4889***
	(.2057)	(.2017)	(.1575)	(.1562)	(.145)	(.1428)
Price trend (t)	1.1515	1.1469	1.0885	1.088	1.0988	1.1054
	(.1385)	(.1347)	(.1013)	(.0987)	(.1115)	(.0715)
Price trend (t-1)	1.2175	1.2078	1.2929**	1.2809**	1.3513**	1.337***
	(.1542)	(.1495)	(.1597)	(.1558)	(.2027)	(.1)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4312	4303	4800	4791	4791	4782
Pseudo R^2	.3659	.3665	.3282	.3296	.3215	.3233

Standard errors are in parenthesis
*** *p<0.01*, ** *p<0.05*, * *p<0.1*

However, in all cases the typical chief executive does not blame bad performance on external factors and keeps it in mind when deciding on holding unto these options. Very much like Doukas & Petmezas (2007) concluded in their research about the role that the self-attribution bias plays in merger activity, both positive and negative influence plays a role in future biased decision making. The research in this paper differs from their research in the sense that mergers and takeovers are more one of a kind projects, whereas above industry average performance amalgamates the yearly results of all internal and external projects as a determinant of biased decision making. This yearly consistence might provide the clue of why negative information is not disregarded as the self-attribution bias predicts. Brehmer (1980) puts forward a possible explanation where people tend not to learn from tasks when information to test ones hypotheses about personal abilities comes in a non-systematic way (p. 233). When information does come in a systematic way, like earnings performance, this effect ought to be weakened and negative performance need not be ignored when learning about one's personal qualities. The steeper slope on the negative side of ROP seems to even imply loss aversion as modelled by Tversky & Kahneman (1974). Apart from that the estimated overall effect remains robust when I account for unobserved heterogeneity.

The model also reinforces the importance of the B/M decile a firm belongs to in determining whether its CEO holds options In-the-money above the rational thresholds. As explained before, this sample purely consists of CEOs where there was variation in their option holding behavior. When looking at the sample sizes we can deduct that quite a lot of chief executives have no variation in this behavior. A big side note to that deduction is that unlike Malmendier & Tate's (2005) sample there are plenty of CEO's with only a few years of tenure included in my sample, which gives them less chance to show the required variation. The fact that the Holder proxies are partially dependent on operational performance when compared to salient peers seems to indicate that CEO's are much like investors in that their confidence can ebb and flow. The crucial deviating factor is that through the illusion of control and the disposition effect the CEO cares more about operational performance while behavioral studies of investor behavior show that they mostly care about market returns. This links nicely with the psychological research into self-attribution where an important factor in inducing it seems to be how committed someone is to a project (Weinstein, 1980). That commitment to a project is for an investor his portfolio, especially the stocks he personally picked and its market returns. In turn, for the CEO the project is the firm itself and his success is determinant by the cashflow emanating from the investments he picked.

VI Conclusion

The core purpose of this paper is to provide evidence that managerial overconfidence is partially dependent on time-variant components such as self-attribution inducing relative operational performance. This evidence is provided by linking a firms relative-to-industry operational performance, in terms of year-end cash flows normalized by size at the start of the year, to the likelihood that the manager will hold unto heavily In-The-Money options in that same year. The positive results for the regressions testing that link, made robust for unobserved heterogeneity and insider information, establish a fundament for this papers core purpose. The sensitivity of the likelihood of holding unto In-The-Money options to relative-to-industry operational performance is especially prevalent amongst small and value firms where cash-flows are a more important determinant of success. Another important find is that the found self-attribution effect does not move in the way most research in the world of behavioral finance describes it, whilst remaining consistent with psychological research, as negative performance is not overly attributed to external factors.

Through these results some lessons are found with important implications for future research. The main lesson is that because overconfidence amongst managers is commonly modelled as a character trait someone either has or has not, its shifting component is neglected. In any future research the determinants of this shifting component ought to depend on what factors a manager measures his firms success. Another important lesson is that the self-attribution bias of performance ought to be modelled according to its particular situation, for example when results come in a systematic manner and are accompanied by proper feedback negative results need not be dismissed by the agent under analysis. Thus after defining a self-attribution inducing factor of success, one must take into account how information about that factor is processed by the agent under analysis. All these factors ought to be taken into account when analyzing or controlling for the impact a shifting component of managerial overconfidence might have on important corporate decisions such as internal and external investments.

Appendix

Table VI
Table of means across the deciles of the Book-to-Market Ratio

B/M Decile	Average B/M ratio	Holder 40	Holder 67	Holder 100	Average ITM	Vested Options (x1000)	Salary (x1000)	Bonus (x1000)	Fair Value Options Awarded (x1000)	Fair Value of Stock grants (x1000)	Total Compensat-ion (x1000)
1	.1368	.8483	.6945	.7848	9.0692	1030.2479	816.0783	122.8663	2120.1861	2799.7044	7493.8971
2	.2436	.8564	.654	.7628	4.9393	917.9768	842.9652	171.2823	1739.7871	2522.8409	6984.6206
3	.3204	.8082	.572	.6988	1.6367	865.3367	830.0196	172.5288	1526.4007	2535.9279	6668.926
4	.3937	.7846	.5582	.678	1.4893	640.9277	850.0426	159.831	1319.2386	2369.4719	6246.5414
5	.4716	.7524	.5007	.6276	1.2568	645.8306	813.8536	169.0694	1240.1696	2224.6128	5923.6191
6	.5629	.6907	.4401	.573	.869	584.468	833.3503	237.0866	1127.2223	2209.819	5805.2987
7	.6721	.6524	.3927	.5097	.7391	607.9306	833.4993	157.8266	836.7091	1966.2016	5260.1594
8	.803	.5789	.3303	.4501	.5357	605.6825	838.1237	214.8136	815.5122	2161.3201	5393.2332
9	1.0012	.4958	.251	.3669	.214	650.3662	839.3412	279.9544	816.8565	2144.8647	5340.415
10	1.8958	.3405	.18	.2578	-.0695	615.9239	812.0672	207.73	694.8178	1949.4317	4759.555

Table VII

Random Effects Probit regressions of the "Netbuyer" dummy on Book-to-Market Deciles

The sample consists of all CEO-firm observations who were a part of the S&P 1500 from 2008 to 2018 for which the necessary data was available. The dependent variable, Netbuyer, has a value of 1 if the CEO has a net positive value of open market purchases of stock in his firm during that year. The open market purchases are defined as change in stock holdings, minus options exercised and stock granted then multiplied by the stock price at the year-end. The Book-to-Market ratio is calculated as defined by Fama & French (2002) and sorted into deciles. ROP, or Relative Operational Performance, is defined as the relative deviation of earnings before interest, depreciation and amortization from its industry average normalized by value of total assets at the start of the year. If this relative deviation is above 0, the dummy for Above Average Performance, AAP, takes the value of 1. Stock repurchase intensity is the value of next year's net stock repurchases by subtracting next year's stock offerings and dividing the value left by the market value of the firm in the current year. Standard errors are robust for heteroskedacity and within-CEO correlation.

Variable	Dummy variable for the CEO being a Netbuyer of stock in a Firm-Year		
	(1)	(2)	(3)
Book-to-Market deciles			
1 (Growth)	-0.504***	-0.506***	-0.453***
	(0.0923)	(0.0955)	(0.0948)
2	-0.488***	-0.491***	-0.443***
	(0.0827)	(0.0861)	(0.0855)
3	-0.396***	-0.399***	-0.359***
	(0.0803)	(0.0826)	(0.0824)
4	-0.361***	-0.362***	-0.328***
	(0.0793)	(0.0814)	(0.0810)
5	-0.428***	-0.428***	-0.400***
	(0.0804)	(0.0815)	(0.0815)
6	-0.186**	-0.194**	-0.163**
	(0.0776)	(0.0780)	(0.0782)
7	-0.219***	-0.221***	-0.203***
	(0.0754)	(0.0756)	(0.0755)
8	-0.0977	-0.104	-0.0842
	(0.0754)	(0.0755)	(0.0756)
9	-0.0319	-0.0298	-0.0229
	(0.0685)	(0.0687)	(0.0685)
10 (Value)			
Dollar value of equity stake	-8.66e-07**	-8.68e-07**	-8.59e-07**
	(3.73e-07)	(3.73e-07)	(3.75e-07)
Estimated value of exercisable options	-2.13e-07	-2.17e-07	-2.17e-07
	(6.79e-07)	(6.80e-07)	(6.92e-07)
Estimated value of unexercisable options	-1.79e-05***	-1.79e-05***	-1.78e-05***
	(4.34e-06)	(4.35e-06)	(4.33e-06)
Fair value of stock grants	-1.80e-05***	-1.83e-05***	-1.76e-05***
	(6.22e-06)	(6.27e-06)	(6.18e-06)
Fair value of option grants	-6.76e-06	-6.88e-06	-6.67e-06
	(1.15e-05)	(1.16e-05)	(1.15e-05)
Dollar change in the value of equity stake in current year	3.20e-06***	3.20e-06***	3.18e-06***
	(1.18e-06)	(1.18e-06)	(1.18e-06)
Dollar change in the value of equity stake in the previous year	-1.73e-07	-1.75e-07	-1.75e-07
	(2.90e-07)	(2.90e-07)	(2.89e-07)
Total return volatility (t-2)	-0.00201	-0.00205	-0.000972
	(0.00407)	(0.00409)	(0.00416)
Change in total return volatility	0.00751**	0.00749**	0.00775**

(t-2)			
	(0.00306)	(0.00306)	(0.00305)
Change in total return volatility (t-1)	0.00497	0.00497	0.00542
	(0.00375)	(0.00376)	(0.00377)
Size	0.0172	0.0183	0.0172
	(0.0134)	(0.0135)	(0.0133)
Above Average Performance		0.00825	
		(0.0406)	
Relative Operational Performance			-0.0563**
			(0.0253)
Year fixed effects	Yes	Yes	Yes
Constant	-0.204	-0.211	-0.234*
	(0.133)	(0.134)	(0.134)
Observations	8,164	8,147	8,164
CEO-firm combinations	2,023	2,021	2,023

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Table VIII
Regression of Investment on Cash Flow and Exercise Behavior

The dependent variable, Investment, is defined as capital expenditures normalized by last year's net valuation of Property, Plant and Equipment. Cash flow is defined as earnings before interest, taxes, depreciation and amortization normalized by last year's net valuation of Property, Plant and Equipment. Q is the market value of assets over the book value of assets. Stock Ownership is defined as the percentage of total shares a CEO held of the firm by which he is employed. Vested options are held exercisable options at the fiscal year's end. Size is the natural logarithm of total assets. Holder 67 takes on the value of 1 if the CEO has ever held unto exercisable options at least 67% in the money twice during his tenure. Only observations of CEOs who have been in office for at least 5 years were included. Interactions between cash flow and various control variables are included for control. Industries are defined as the 12 Fama-French industry groups. In columns (6) and (7) standard errors are robust to within-firm serial correlation and heteroskedacity.

	Baseline Regressions			Including Overconfidence Proxy and its Interaction Effect with Cash Flow			
	No Fixed Effects, No Controls (1)	Fixed Effects, No Controls (2)	Fixed Effects, Controls (3)	Fixed Effects, No Controls (4)	Fixed Effects, Controls (5)	Standard Errors clustered by Firm (6)	Industry-CF Interactions Clustered by Firm (7)
Cash flow	.052***	.067***	.147***	.046***	.128***	.128**	.114**
	(.002)	(.006)	(.013)	(.007)	(.014)	(.053)	(.048)
Q	.042***	.032***	.017***	.032***	.018***	.018*	.015*
	(.003)	(.004)	(.006)	(.004)	(.006)	(.01)	(.009)
Stock ownership (%)			.005***		.005***	.005**	.007**
			(.002)		(.002)	(.002)	(.003)
Vested options			0		0	0	0
			(0)		(0)	(0)	(0)
Size			.014		.016	.016	.006
			(.011)		(.011)	(.016)	(.017)
(Q)*(Cash flow)			.004***		.003***	.003	.002
			(.001)		(.001)	(.003)	(.004)
(Stock ownership) * (Cash flow)			-.001**		-.001	-.001	-.001
			(0)		(0)	(.001)	(.001)
(Vested Options) * (Cash flow)			0		0	0	0
			(0)		(0)	(0)	(0)

(Size) * (Cash flow)			-.013***		-.013***	-.013**	-.011*
			(.001)		(.001)	(.007)	(.006)
Holder 67				-.013	-.011	-.011	-.027
				(.022)	(.025)	(.016)	(.018)
(Holder 67) * (Cash flow)				.025***	.021***	.021*	.03**
				(.006)	(.007)	(.011)	(.014)
Year-fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm-fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes
(Year-fixed effects)* (Cash flow)	No	Yes	Yes	Yes	Yes	Yes	Yes
(Industry-fixed effects)*(Cash flow)	No	No	No	No	No	No	Yes
Constant	.112***	.152***	.108	.165***	.104	.104	.182
	(.008)	(.017)	(.087)	(.024)	(.09)	(.122)	(.129)
Observations	10112	10112	9024	10112	9024	9024	9024
Firms	1,241	1,241	1,234	1,241	1,234	1,234	1,234
R-squared	.149	.134	.149	.136	.15	.15	.175

Standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1

Table VIIII

Random Effects Probit Regression of the Overconfidence Proxies on Above Average Performance

The dependent variable, Holder, in the regressions is a dummy indicating whether the CEO held an option in-the-money above the rational threshold in question in that year. These thresholds of in-the-moneyness are respectfully 40%, 67% and 100%. Relative Operational Performance is defined as the relative deviation of earnings before interest, depreciation and amortization from its industry average normalized by value of total assets at the start of the year. If this relative deviation is above 0, the dummy for Above Average Performance takes the value of 1. The Price-to- Earnings Ratio is defined as the stock price at fiscal year-end divided by the earnings per share before extraordinary items of the same year. The B/M deciles are derived from the Book-to-Market ratio, defined as book equity divided by market equity. The base value by which B/M decile influence is calculated is the 10^{th} one. MAX is a dummy variable equal to 1 if the highest price of the current fiscal year was greater than the year before. Price trend indicates the relative change in stock price over year t. Industry fixed effects are utilized using the Fama-French 48 indicators. Year fixed effects are also included. The standard errors are robust to within CEO heteroskedasticity. Observations indicate the total of CEO-year observations used in the regression.

	Overconfidence Proxies					
Variable	Holder 40		Holder 67		Holder 100	
	(1)	(2)	(3)	(4)	(5)	(6)
Above Average Performance	0.2560***		0.3107***		0.3578***	
	(0.0680)		(0.0599)		(0.0619)	
Relative Operational Performance		0.2580***		0.2803***		0.3216***
		(0.0465)		(0.0442)		(0.0468)
Tenure	0.0335***	0.0341***	0.0381***	0.0388***	0.0394***	0.0402***
	(0.0071)	(0.0072)	(0.0068)	(0.0069)	(0.0071)	(0.0072)
Executive's Age	-0.0040	-0.0042	-0.0016	-0.0019	-0.0066	-0.0070
	(0.0062)	(0.0062)	(0.0061)	(0.0062)	(0.0066)	(0.0067)
Female	0.2535	0.2565	0.2279	0.2305	0.1285	0.1360
	(0.1886)	(0.1889)	(0.1908)	(0.1908)	(0.1845)	(0.1857)
Price-to-Earnings Ratio	-0.0001	-0.0002	-0.0001	-0.0001	-0.0000	-0.0000
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Stock Ownership (%)	-0.0030	-0.0039	-0.0006	-0.0016	-0.0023	-0.0035
	(0.0098)	(0.0105)	(0.0093)	(0.0099)	(0.0103)	(0.0109)
Book-to-Market deciles						
1 (Growth)	2.6292***	2.5527***	2.5908***	2.5147***	2.6824***	2.6121***
	(0.1944)	(0.1952)	(0.1857)	(0.1866)	(0.1906)	(0.1918)
2	2.5744***	2.5339***	2.3692***	2.3324***	2.4087***	2.3702***
	(0.1706)	(0.1704)	(0.1636)	(0.1645)	(0.1714)	(0.1717)

3	2.0450***	2.0159***	1.9901***	1.9664***	1.9858***	1.9669***
	(0.1551)	(0.1539)	(0.1560)	(0.1557)	(0.1661)	(0.1665)
4	1.9484***	1.9299***	1.8915***	1.8708***	1.8668***	1.8475***
	(0.1503)	(0.1496)	(0.1487)	(0.1487)	(0.1591)	(0.1592)
5	1.8216***	1.7916***	1.6380***	1.6055***	1.5738***	1.5376***
	(0.1423)	(0.1421)	(0.1417)	(0.1418)	(0.1512)	(0.1521)
6	1.5243***	1.4989***	1.4736***	1.4402***	1.4014***	1.3706***
	(0.1313)	(0.1316)	(0.1328)	(0.1329)	(0.1420)	(0.1426)
7	1.3688***	1.3460***	1.1698***	1.1403***	1.1197***	1.0888***
	(0.1268)	(0.1264)	(0.1269)	(0.1268)	(0.1373)	(0.1374)
8	1.0102***	0.9951***	0.8603***	0.8363***	0.8743***	0.8515***
	(0.1160)	(0.1161)	(0.1210)	(0.1215)	(0.1332)	(0.1341)
9	0.6071***	0.5939***	0.4603***	0.4383***	0.3977***	0.3751***
	(0.1025)	(0.1027)	(0.1118)	(0.1123)	(0.1219)	(0.1230)
10 (Value)						
Value of t+1 stock repurchases ($M)	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Value of t+1 equity offerings ($M)	-0.0003**	-0.0003**	-0.0003***	-0.0003***	-0.0005***	-0.0005***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Size	0.1224***	0.1136***	0.1291***	0.1202***	0.0773**	0.0680**
	(0.0290)	(0.0290)	(0.0291)	(0.0291)	(0.0311)	(0.0313)
MAX	0.5611***	0.5513***	0.4322***	0.4213***	0.3746***	0.3611***
	(0.0528)	(0.0529)	(0.0496)	(0.0496)	(0.0506)	(0.0506)
Price trend (t)	0.0960**	0.0975**	0.1061**	0.1068**	0.1288***	0.1282***
	(0.0476)	(0.0477)	(0.0432)	(0.0429)	(0.0451)	(0.0445)
Price trend (t-1)	0.0783**	0.0759**	0.1159***	0.1137***	0.1383***	0.1359***
	(0.0361)	(0.0362)	(0.0408)	(0.0407)	(0.0442)	(0.0441)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.0756	0.4730	-1.5052	-1.0697	-1.4235	-0.9689
	(0.9065)	(0.8602)	(0.9426)	(0.9254)	(1.4914)	(1.4758)
Obs.	8631	8642	8631	8642	8631	8642
Pseudo R-squared	.3354	.3427	.3155	.3229	.3001	.3085

Standard errors are in parenthesis
**** p<0.01, ** p<0.05, * p<0.1*

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