CEO Overconfidence or Stock Mispricing and Growth? Reexamining the Effect of CEO Option Exercise Behavior on Corporate Investment[1]

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Abstract

Malmendier and Tate (2005) use CEO late option exercise to proxy for unobservable CEO overconfidence and argue that managerial overconfidence can account for investment distortion. Consistent with CEO rationality, this paper provides an alternative explanation to their findings. By breaking the market-to-book ratio into firm mispricing, industry mispricing and growth opportunity, I find that industry mispricing and growth opportunity influence both CEO option exercise and corporate investment. When firms are overvalued or have better growth opportunities, CEOs are more likely to postpone their option exercise and at the same time invest more using internal cash. Moreover, CEO late option exercise fails to explain investment decisions after controlling for mispricing and growth opportunity. These findings suggest that CEO's personal portfolio decision may not be an appropriate proxy for managerial overconfidence.

JEL classification: G31; G34

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1. Introduction

One of the recent striking research areas in finance is the impact of CEO overconfidence on corporate polices. Malmendier and Tate (2005 and 2008) and Malmendier, Tate and Yan (2007) theoretically and empirically examine the influence of CEO overconfidence on investment distortions, financing policies and merger decisions, respectively. Perhaps the most important, Malmendier and Tate (2005) find that overconfident CEOs have a heightened sensitivity of corporate investment to cash flow, particularly among equity-dependent firms. Their studies not only enrich corporate finance and behavioral finance literature, but also have significant implications on managerial contracting practices and corporate governance. Despite its prominence and importance, little formal scrutiny has been done to validate the proxies they use for CEO overconfidence. The critical assumption of all these studies is that CEO option exercise behavior could proxy for unobservable CEO overconfidence. However, CEO option exercise behavior is also subject to other factors and does not necessarily proxy for managerial overconfidence. This paper examines whether their measures really proxy for CEO overconfidence, and provides an alternative explanation for their empirical findings.

The goal of this paper is to argue that CEO option exercise behavior is more likely related to stock mispricing and growth opportunities, and is not an appropriate proxy for underlying CEO overconfidence. Specifically, following Rhodes-Kropf, Robinson and Viswanathan (2005), I decompose the market-to-book ratio into firm mispricing, industry mispricing and growth opportunities. I find that industry mispricing and growth opportunity influence both CEO option exercise and corporate investment. When firms are overvalued or have better growth opportunities, CEOs are more likely to postpone their option exercise and at the same time invest more using internal cash. Moreover, CEO late option exercise could not explain investment decisions after controlling for mispricing and growth opportunity. Consequently, the empirical findings of Malmendier and Tate (2005) fail to support their theoretical prediction that managerial overconfidence causes high investment-cash flow sensitivity.

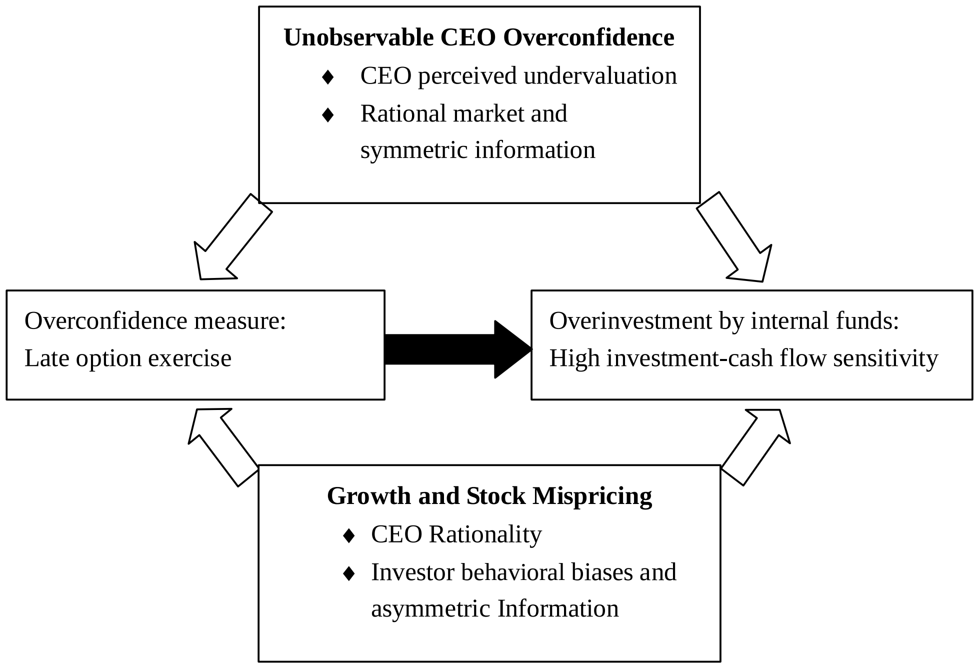

Figure 1

Figure 1 compares the framework of Malmendier and Tate (2005) and my approach. In Malmendier and Tate (2005), investors are rational and there is no asymmetric information or agency conflicts, while some irrational CEOs are overconfident. Overconfident CEOs systematically overestimate the returns of their investment projects. On one hand, they will overinvest relative to the optimal level if they have sufficient internal funds (cash). On the other hand, they are reluctant to issue equity because they perceive that the stock of their company is undervalued by market. Therefore, they reduce investment if they have less internal funds. All above make the corporate investment more sensitive to cash flow. Based on the work of Heaton (2002) and Hall and Murphy (2000, 2002), Malmendier and Tate (2005) argue that an overconfident CEO will keep relatively higher personal exposure to the idiosyncratic risk of his company because his personal wealth dependent on firm stock price and he overestimates the return. As a result, they identify a CEO as overconfident if he persistently exercises options later than suggested benchmark or holds options close to the expiration. By using CEO option exercise behaviors as the proxies for CEO overconfidence, Malmendier and Tate (2005) empirically find that firms with late CEO option exercise have higher investment-cash flow sensitivity, and thus infer that CEO overconfidence causes the investment distortion.

This paper takes a different approach and provides an alternative explanation for the empirical findings of Malmendier and Tate (2005). I assume that all CEOs are rational while the stocks can be mispriced, whether due to information asymmetry or investor biases. In the neoclassic model of investment and Q theory, the equilibrium investment is solely determined by growth opportunities. More investment is associated with better growth opportunities. Furthermore, Morck, Shleifer and Vishny (1990), Stein (1996) and Jensen (2005) theoretically argue that stock mispricing will affect the corporate investment decisions. Their hypotheses include manager's market timing-ability and manager's catering behavior. Because the traditional Tobin's Q is a noisy measure for both mispricing and growth opportunities, to overcome this problem I follow Rhodes-Kropf, Robinson and Viswanathan (2005) and decompose the market-to-book ratio into three components: stock mispricing, industry mispricing and real growth.

There exist three ways by which mispricing and growth opportunities can affect the CEO option exercise decisions. First, if a CEO has inside information about future stock prices and the firm is temporarily undervalued, then he may decide to postpone the option exercise. Many studies (Wie (2004), Jenter (2005) and Carpenter and Remmers (2001)) have tested whether CEOs have inside information and could gain abnormal returns. Second, if the firm (industry) is currently overvalued (overheated), CEOs may be less aggressive to exercise the option and may postpone the exercise. Pasternack (2002) finds empirical evidence that market reacts negatively to CEO option exercise. The rational CEOs value both their personal wealth and the additional perks from firms' overvaluation. Therefore, a rational CEO of an overvalued firm will consider both the direct profits and the potential costs from the option exercise. Conversely, a rational CEO of undervalued firm is not subject to that concern because his firm is already undervalued. The third link is based on firms' growth (investment) opportunity. If a CEO gets to know that his firm has a high growth opportunities, then he may want to postpone the option exercise. Different from the inside information story in which CEOs know the future stock price, the growth opportunities can only forecast the long-run fundamental value. A CEO may not necessarily profit from knowing the growth opportunities since the market price is also determined by other factors besides growth opportunities.

Because the mispricing and growth opportunities may have impacts on both corporate investment and CEO option exercise behavior, the effect of CEO option exercise behavior on investment-cash flow sensitivity could essentially reflects the impacts of mispricing and growth opportunities on corporate investment. If that is the case, then CEO option exercise behavior is not the appropriate measure for overconfidence and the empirical findings of Malmendier and Tate (2005) will fail to support their theory.

The main empirical results of this paper can be summarized as follows: First, industry mispricing and growth opportunities have positive impacts on corporate investment. From a theoretical perspective, this result is consistent with the neoclassic theory of investment and the agency cost of overvalued equity (Jensen (2005)). Second, when a firm has better growth opportunities, the CEO of that firm is more likely to hold an option until the last year prior to expiration. In addition, when a firm has a higher level of industry mispricing or better growth opportunities, the CEO of that firm is more likely to fail to exercise the option relative to the rational benchmark. These results also tend to support the conjecture that the CEOs of overvalued firms enjoy the perks from overvaluation and may take the potential cost of option exercise into account. Finally, the effect of CEO option exercise behavior on investment distortion does essentially reflect the impacts of industry mispricing and growth opportunities on corporate investment. Even if part of the variation in CEO option exercise decisions could be related to unobservable CEO overconfidence, it is not the CEO overconfidence, but the industry mispricing and growth opportunities that lead to the higher investment-cash flow sensitivity.

To the best of my knowledge, this paper makes three contributions to corporate finance literature: First, this is the first paper to provide an alternative explanation for the findings of Malmendier and Tate (2005) consistent with CEO rationality. It suggests that rigorous research based on CEO overconfidence requires more precise overconfidence measures for empirical tests. Second, this paper is the first to empirically show that managerial option exercise behavior is sensitive to stock mispricing and growth opportunity.[3] Consistent with Malmendier and Tate (2005), Jenter (2005) argues that manager's perceived mispricing is an important determinant of manager's decision making in both private trades and firm-level decisions. He finds that managers sell their equity holdings whenever investment opportunities are supposedly good. This pattern is hard to explain. Because Jenter (2005) does not have separate measures for mispricing and growth opportunities, his results could be caused by the imprecise measures for growth opportunities. Third, this paper further explains the puzzling empirical link between executive portfolio decisions and investment distortions, based on stock mispricing and investment opportunity rather than managers' perceived mispricing.

The rest of paper is as follows: Section 2 describes the data, the three components of market-to-book ratios and two overconfidence measures constructed in Malmendier and Tate (2005). Section 3 reports evidence on the link between CEO option exercise behavior and the three components of the market-to-book ratio. Section 4 replicates and then disputes the main results of Malmendier and Tate (2005). Section 5 concludes.

2. Data and Measures

2.1 Data Description

I use the same sample dataset analyzed by Malmendier and Tate (2005). The sample covers 477 large publicly traded U.S. firms from 180 to 1994. To be included in the sample, a firm must appear at least four times on one of the lists of the larges U.S. companies' complied by

[3]Recent literature on managerial portfolio decision includes Carpenter and Remmers (2001), Hall and Murphy (2000, 2002) and Jenter (2005). Hall and Murphy (2000, 2002) build the framework for the optimal option exercise price based on rational CEOs' diversification incentives.

Forbes magazine in the period between 1984 and 1994.

The CEO compensation package data set is originally used in Yermack (1995), which covers essentially 792 large U.S. publicly traded companies from 1984 to 1991. Hall and Liebman (1998) randomly selected half of Yermack's 792 companies and extended his sample up to 1994 and back to 1980. The data used in both Malmendier and Tate (2005) and this paper are based on Hall and Liebman (1998) and are provided by Professor Brian Hall. As emphasized in Malmendier and Tate (2005), this data set provides us with detailed information on the stock ownership and set of option packages including exercise price, remaining duration, and number of underlying shares for each CEO-year. One limit of this data set is that we can not deduce the exact exercise price for a particular option package.

To obtain a final sample, I then merge the CEO compensation package data set with the COMPUSTAT fiscal year-end accounting data and the stock prices from the center for research in securities prices (CRSP). To be consistent with Malmendier and Tate (2005), I measure investment as capital expenditure (item 128), cash flow as earnings before extraordinary items (item 18) plus depreciation (item 14), and capital as property, plants, and equipment (item 8). I normalize the investment and cash flow with beginning-of-the-year capital. As in Fama and French (2002), I measure Q as the ratio of market value of assets to book value of assets. Market value of assets is defined as total assets (item6) plus market equity minus book equity. Market equity is defined as common shares outstanding (item 25) times fiscal-year closing price (item 199). Book equity is calculated as stockholders' equity (item 216) [or the first available of common equity (item 60) plus preferred stock par value (item 130) or total assets (item 6) minus total liabilities (item 181)] minus preferred stock liquidating value (item 10) [or the first available of redemption value (item 56) or par value (item 130)] plus balance sheet deferred taxes and investment tax credit (item 35) when available minus post retirement assets (item 336) when available. Book value of assets is total assets (item 6). Malmendier and Tate (2005) find that the data contain a few severe outliers for capital-normalized cash flow. To exclude the effect of these outliers, I winsorize cash flow at the 1% level. I also employ several control variables. Corporate governance is the number of outside directors who currently serve as CEOs of other companies. Size is the natural logarithm of assets at the beginning of the year. Stock ownership is the fraction of company stock owned by the CEO and his immediate family at the beginning of the year. Vested options are the CEO's holdings of options that are exercisable within 6 months of the beginning of the year, as a fraction of common shares outstanding. Average annual return is the average yearly rate of return on the firm's stock over the past three years.

In order to construct the misvaluation and growth measures defined in Rhodes-Kropf, Robinson and Viswanathan (2005), I calculate the market-to-book ratio slightly different from the Q measure defined above. I match the fiscal year-end data from COMPUSTAT with CRSP market values occurring three months afterward. Since firms have different fiscal year end dates, this method compensate for COMPUSTAT's year-of-end scheme, and the year of the data correspond to the year in which the accounting information was filed.[4] I measure M/B as the ratio of the market value of assets to the book value of assets. Market value of assets is CRSP market equity plus book value of assets (item 6) minus deferred taxes (item 74) minus book equity (item 60).[5] In addition, I obtain net income (item 172) and return on assets (ROA) is calculated by dividing net income in year t by book assets (item 6) in year $t-1$. For leverage measures, I calculate market leverage (1-market equity / market value) and book leverage (1-book equity / total book assets). Table I (full sample) reports the summary statistics of the data. The majority of the summary statistics are very similar to those exhibited in Malmendier and Tate (2005), Table I. It illustrates that my alternative explanation for their findings is not due to the difference in the sample selection or the difference in the variable definitions.

[TABLE I - HERE]

[4] Please refer to Rhodes-Kropf, Robinson and Viswanathan (2005) for details.

[5] The definition of M/B is slightly different from the definition of Q, but the difference in scale is very tiny.

2.2 Decomposition of the Market-to-book Ratio

Following Rhodes-Kropf, Robinson and Viswanathan (2005), I partition the market-to-book ratio ($M/B_{i,t-1}$) into three components: mispricing at the firm level ($Dev^{Firm}_{i,t-1}$), mispricing at the aggregative level ($Dev^{Agg}_{i,t-1}$), and the growth component ($Growth_{i,t-1}$) for firm i at time $t-1$.

$$ln(M/B)_{it} = Dev^{Firm}_{i,t} + Dev^{Agg}_{i,t} + Growth_{i,t}$$

The first component, mispricing at the firm level or "firm-specific errors" ($Dev^{Firm}_{i,t-1}$) is the difference between the market value of firm i at time t and the fundamental value of the firm i at time t. Positive (negative) mispricing at the firm level indicates that the firm is overvalued (undervalued). The fundamental value of firm i at time t is obtained by applying annual industry regression multiples ($\alpha_{k,jt}\prime s$) to the firm-level accounting values. The values of ($\alpha_{k,jt}\prime s$) are obtained by estimating the model below for each year t and each industry j[6]

$$m_{it} = \alpha_{0,jt} + \alpha_{1,jt} b_{it} + \alpha_{2,jt}(ni)^{+}_{it} + \alpha_{3,jt} I_{(<0)} ni^{+}_{it} + \alpha_{4,jt} Lev_{it} + \varepsilon_{it}$$

where m_{it} is the natural log of the market value of assets, b_{it} is the natural log of the book value of assets, $(ni)^{+}_{it}$ is the natural log of the absolute value of net income, $I_{(<0)}$ is an indicator for negative net income observations, and Lev_{it} is the book leverage ratio.

The second component, mispricing at the aggregate level or "sector-wide errors" ($Dev^{Agg}_{i,t}$) is the difference between the *fundamental value* of firm i at time t based on time t accounting values and *industry multiples* ($\alpha_{k,jt}\prime s$), and the *long-run fundamental value* of firm i at time t based on time t accounting values and *long-run industry multiples* ($\bar{\alpha}_{k,j}\prime s$). The long-run industry multiples are the time-series average of ($\alpha_{k,jt}\prime s$).

The third component ($Growth_{i,t-1}$) is the difference between the valuation implied by long-run multiples and current book assets values. Each of those three components varies at the firm-year level and involve valuation multiples that vary across industries and over

[6] The Fama-French twelve industries are defined on the French's website.

times. Table AI presents the *long-run industry multiples* ($\bar{\alpha}_{k,j}\prime s$) as well as the Fama-Macbeth standard errors for twelve industries. The average R^2 values range between 92% and 97%, indicating that accounting information and leverage explain majority of the cross-sectional variation in market values within a specific industry-year. The summary statistics of these three components are also displayed in Table I.

[TABLE AI - HERE]

2.3 Malmendier and Tate (2005) CEO Overconfidence Measures

Malmendier and Tate (2005) use the timing of option exercises to identify CEO overconfidence. They argue that overconfidence may lead CEOs to overestimate the future returns of their investment projects. Therefore, overconfident CEOs believe that the stock prices of their company will continue to rise under their leadership more than they objectively should expect. As a result, overconfidence induces them to postpone option exercise in order to benefit personally from the expected future gains.

Holder 67 is the first overconfidence measure. It is a dummy variable equals one for all CEO-year after the CEO holds a five-year-old option that is more than 67% in-the-money, provided that he subsequently does it again at least once. To make the option package with different vesting period comparable, they examine the first year (year 5) in which all of the packages in the sample are at least partially exercisable. Then they compute the percentage in-the-money for each package. They use the Hall and Murphy (2002) theoretical framework to choose the rational benchmark (67% in-the-money during the fifth years), for risk-averse CEOs to exercise the options. It means that if an option is more than 67% in-the-money at some time in year 5, the CEOs should have exercised at least some portion of the package during or before the fifth year. They restrict the *Holder 67* sample to CEOs who at least twice during the sample period had options that were valued above the threshold during the fifth year. This restriction limits the number of observations. They then identify the first instance when the CEO failed to exercise the option during or before the fifth year. From this point, they classify the CEOs as overconfident if he subsequently exhibits the same behavior at least one more time during his tenure as CEO. As a result, if a CEO is identified as overconfident, and then *Holder 67* dummy equals one for all of his years in the sample. Table I also reports the summary statistics of the data for the *Holder 67* restriction sample.

Longholder is the second overconfidence measure. It is a dummy variable equal to one if the CEO ever held an option until the last year prior to expiration. Instead of on the end of the vesting period, *Longholder* focuses on the expiration date of option packages. A CEO is identified as overconfident for all of his years in the sample if he ever holds an option until the last year of its duration. Generally, the vesting period is 5 years and the duration is about 10 years. A CEO defined as overconfident chooses to hold, rather than exercise, the option for at least five years. In most cases, options that are held until the final duration year are in-the-money. It means that the CEO could have profitably exercised these options before their last year.

In a summary, *Holder 67* measure captures whether CEOs persistently fail to exercise option packages when they reaches 67% in-the-money benchmark. *Longholder* measure captures whether CEOs failed to exercise option package prior to the expiration date. In Malmendier and Tate (2005), both measures are used as proxies for the overconfidence of irrational CEOs, but it is not necessarily the only explanation. The CEO option exercise behavior could be subjected to other factors based on the CEO rationality, such as the change in investment opportunities, stock mispricing, the managerial signaling concern, and the variation in asymmetric information.

3. Test 1: Stock Mispricing, Growth and CEO Option Exercise

3.1 Testable Hypotheses

Jenter (2005) argues that manager's perceived mispricing seems to be an important determinant of managers' decision making in both private trades and firm-level decisions. He finds that manager's private trade is related to the market-to-book ratio and inside trading pattern shows that low valuation firms are regarded as undervalued by their own managers relative to high valuation firms. Rather than dependent on the managers' irrationality, this study attempts to empirically link the rational CEOs' option exercise decision with stock mispricing and growth opportunities by breaking market-to-book ratio into three components.

Traditional Tobin's Q or market-to-book ratio is often used to proxy for both stock mispricing and firm growth opportunities. However, to make a clean inference, it is critical to differentiate and identify the effects caused by mispricing and growth, respectively. It is reasonable to assume that CEOs are rational and the market may potentially make mistakes on firm valuation due to various reasons, such as information asymmetry, investors' sentiments, or limited arbitrage. In this study, I take mispricing as given rather than endogenous.

There exist several stories which could predict the effect of mispricing and growth opportunities on CEO option exercise decision. First, if a CEO has inside information about future stock price and the firm is temporarily undervalued, then he may decide not to decrease exposure to company risk. Many studies (Wie (2004), Jenter (2005) and Carpenter and Remmers (2001)) have tested whether CEOs have inside information and could gain abnormal returns. Most of them find no evidence. If the inside information hypothesis is true, then a lower level of mispricing measure ($Dev_{i,t}^{Firm}$ and $Dev_{i,t}^{Agg}$) will predict a higher probability that CEOs will fail to exercise the option relative to the benchmark (*Holder 67*) and a higher probability that CEOs will hold the option closed to the expiration (*Longholder*).

Second, if the firm (industry) is currently overvalued (overheated), CEOs may be very careful and less aggressive to exercise the option and may postpone exercising. The rational

CEOs value both their personal wealth and the extra perks from firms. Overvalued firm will bring its CEO more benefits through more perks. However, option exercise incurs cost for firms and this event could draw the attention of market. Though there is no theoretical work done on how the market should react to the CEO option exercise, it is not surprising to image a negative effect since it indicates that the CEO wants to reduce his exposure to the firm. If market is sensitive, then this event works as an alert that the CEO loses his confidence in the firm or the firm is actually overvalued. An example is Enron's bankruptcy, the CEO Kenneth Lay exercised a large amount options in August 2001, shortly followed by the scandals and bankruptcy of this overvalued giant firm. Moreover, Kenneth Lay's profitable option exercise was regarded as criminal evidence by the court. Therefore, a rational CEO of overvalued firm will consider both the profit and the potential cost from the option exercise. On the other hand, a rational CEO of undervalued firm is not subject to that constraint because his firm is already undervalued. As a result, a higher level of mispricing measure ($Dev_{i,t}^{Firm}$ and $Dev_{i,t}^{Agg}$) will predict a higher probability that CEOs will fail to exercise the option relative to the benchmark or hold the option closed to the expiration (*Longholder*).

The third link is based on firms' growth (investment) opportunity. If the CEO gets to know that the firm has high growth opportunities, then he may want to postpone exercise the options. Different from the inside information story in which CEOs know the future stock price, the growth opportunities can only forecast the long-run fundamental value. A CEO may not necessarily profit from knowing the growth opportunities since the market price is also affected by other factors besides growth. Nevertheless, it is reasonable that a higher level of growth measure will predict a higher probability that CEOs will fail to exercise the option relative to the benchmark (*Holder 67*) and a higher probability that CEOs will hold the option closed to the expiration (*Longholder*).

After exploring the three possible explanations that link stock mispricing and growth with the CEO option exercise decisions, I develop four testable hypotheses as follows:

Hypothesis 1a

The three components of market-to-book ratios have equal or higher explanatory power than Tobin's Q on explaining CEO option exercise decisions.

The three components of market-to-book ratios should outperform the noisy Q measure, or there is no benefit to make the decomposition, which reduces the degree of freedom in the regressions.

Hypothesis 1b

If CEOs have inside information, stock mispricing will negatively affect the probability that CEOs will postpone the option exercise.

Hypothesis 1c

If CEOs are concerned about the harm of option exercise to firm overvaluation, stock mispricing will positively affect the probability that CEOs will postpone the option exercise.

Hypothesis 1d

Firm growth (investment) opportunity will positively affect the probability that CEOs will postpone the option exercise.

3.2 Mispricing, Growth and Longholder Measure – Univariate Results

First, I examine the relationship between *Longholder* measure and the mispricing and growth measures. Table II reports the Spearman's rank correlation coefficients and the associated significance level for the major variables used. Stock ownership, vested options, Q and the three components of market-to-book ratios are data at the beginning of the fiscal year. The correlation between *Longholder* and Q is significantly positive (0.149). The correlation between *Longholder* and Dev^{Firm} is weak (0.057) but still significant. However, the correlation between *Longholder* and Dev^{Agg} is insignificantly negative and small (-0.006). Similar to Q, Growth has a significantly positive correlation with *Longholder*, though slightly weaker (0.121). Overall, these relations suggest that stock mispricing and growth may be related to CEO option exercise decision, and Q is more likely to capture the variation of growth opportunities rather than the variation of mispricing.

[TABLE II - HERE]

The correlations among stock ownership, vested options, and *Longholder* are also significant. Mechanically, a CEO with large amount of stock ownership might be willing to exercise the options due to risk aversion and diversification. Surprisingly, the correlation between *Longholder* and stock ownership is strong and positive (0.143). Nevertheless, the result can not be exclusive, since other factors are not controlled. There is a debate on the relation between the amount of vested options and the exercising behavior of CEOs. On one hand, CEOs with high percent of vested options should have a greater propensity to exercise due to risk aversion and diversification concerns. On the other hand, CEOs may concern about the market's negative reaction to a large amount of option exercise and may postpone the exercise. The positive correlation (0.335) between vested option and *Longholder* tends to support the second view.

Table III examines the relationship between *Longholder* and the three components of market-to-book ratios. For every year, and every stock ownership quintile,[7] I further divide the subset into three categories by the level of mispricing measures or growth: low-, medium-, and high level firms. I then calculate the mean of *Longholder* in each stock ownership quintile. Panel A shows the result by sorting on the mispricing at the firm level (Dev_{t-1}^{Firm}). On average, a firm that belongs to the high Dev_{t-1}^{Firm} group has higher mean of *Longholder* than does a firm belonging to the low Dev_{t-1}^{Firm} group. The difference is significant at the 5% level for both the ordinary t-test and the nonparametric Wilcoxon rank test. The same patterns show up for the first two CEO stock ownership quintiles, however, not for the rest three ownership quintiles. In the 4th and 5th quintiles, the situation even reverses: high group has low mean of *Longholder*. The results in Panel A indicate that there might be some connection between Dev_{t-1}^{Firm} and *Longholder*, but the relation will become weak and inconsistent after including control variables.

[7] I use the data at the beginning of year to sort firm into stock ownership quintile.

[TABLE III - HERE]

Panel B reports the results when sorting on the mispricing at the aggregative level (Dev_{t-1}^{Agg}) instead. On average, and within each stock ownership quintile, there is no consistent and significant relation between Dev_{t-1}^{Agg} and and *Longholder*. The overall difference of mean *Longholder* between high Dev_{t-1}^{Agg} group and low Dev_{t-1}^{Agg} group is only 0.004. In addition, the mean *Longholder* does not moronically change across Dev_{t-1}^{Agg} groups. These findings tend to support that mispricing at the aggregate level will not affect the probability that CEO hold an option until the last year prior to expiration.

Panel C exhibits the results when sorting on the growth opportunities. On average, a firm that belongs to the high growth group has higher mean of *Longholder* than does a firm belonging to the low growth group. The difference is relatively large (0.067) and significant at the 1% level for both the ordinary t-test and the nonparametric Wilcoxon rank test. The result is also consistent for all the CEO stock ownership quintiles and is significant except for the 3^{rd} quintile. The main conclusion from Panel C is that the CEOs of high growth firms are more likely to hold an option until the last year prior to expiration.

Overall, the univariate tests in Table III provide the preliminary results that *Longholder* measure constructed by (Malmendier and Tate (2005)) could be related to the firm level mispricing, to some extent, and more likely related to the firm growth opportunities.

3.3 Stock Mispricing, Growth and Longholder Measure – Regression Results

The above analysis is repeated in a regression framework to simultaneously control a number of variables. To capture the effect of firms' size, I include the natural logarithm of assets at the beginning of the year. To capture CEO's incentives for diversification, I include the stock ownership and vested options at the beginning of the year. To account for the effect of corporate governance, I include the number of outside directors who are currently CEOs in other companies.[8] Other controls include CEO tenures and the average annual return of past three years. Ideally, these variables should not proxy for CEO overconfidence provided that it does exist.

The regression also provides a horse race between Q and the three components of market-to-book ratios in explaining CEO option exercise behavior (*Longholder* measure). To test Hypothesis 1a-1d, I regress the dummy variable - *Longholder* measure on Q or the three components of market-to-book ratios plus the control variables. The regression specifications are:

$$(1)\quad P(Longholder_{it} = 1) = \text{Probit}\ [\gamma_0 + \gamma_1 \cdot Q + X'_{t-1} \cdot \gamma_2 + \eta_{it}]$$

$$(2)\quad P(Longholder_{it} = 1) = \text{Probit}\ [\gamma_0 + \gamma_{11} \cdot Dev^{Firm}_{t-1} + \gamma_{12} \cdot Dev^{Agg}_{t-1} + \gamma_{13} \cdot Growth_{t-1} + X'_{t-1} \cdot \gamma_2 + \eta_{it}]$$

Where *Longholder* is the dependent variable, Q and the three decompositions of (M/B) are at the beginning of the year and defined as before, X is the set of controls used in the regression. Note that X includes corporate governance, firm size, stock ownership, vested options, CEO tenure and the average annual return of past three years. The null hypothesis is that a) equation (2) has less explanatory power than equation (1), and b) γ_{11}, γ_{12} and γ_{13} the coefficients on the mispricing and growth measures, are equal to zero.

[TABLE IV - HERE]

Table IV reports the results where all regressions include control variables and the year-fixed effect. Since the preliminary results in Table III suggest that growth opportunities is more likely to affect the CEO option exercise behavior than the two mispricing measures, I first compare the explanatory power between Q and Growth to minimize the loss of the

[8] This proxy for corporate governance is suggested by Brickley, Coles and Terry (1994) and Byrd and Hickman (1992).

degree of freedom. Column (1) to Column (3) present the results. Column (1) shows that when using Q, the coefficient on Q is positive and statistically significant at the 1% level. Column (2) shows that when replacing Q by Growth, the coefficient on Growth is also positive and statistically significant at the 1% level. Moreover, the Pseudo R^2 increases from 0.078 to 0.090. Column (3) reports the results when using both Q and Growth. It is quite interesting that the effect of Q diminishes and the coefficient on Q becomes insignificant, while the coefficient on Growth is still strong and statistically significant at the 5% level. Going from column (1) to column (3), I find that adding Growth to Q increases the Pseudo R^2 from 0.078 to 0.091, while adding Q to Growth only increases the Pseudo R^2 from 0.090 to 0.091.

Column (4) adds Dev_{t-1}^{Firm} and Dev_{t-1}^{Agg} with Growth. However, the coefficients of these two mispricing measures are insignificant as conjectured. In addition, adding Dev_{t-1}^{Firm} and Dev_{t-1}^{Agg} does not increase Pseudo R^2 at all, which remains 0.090 as in Column (3). This finding confirms that *Longholder* is only affect by the growth (investment) opportunity. A higher level of growth opportunities will lead to a higher probability that CEO holds an option until the last year prior to expiration.

To guard against the potential serial correlation and heteroskedasticity, I recomputed the standard errors by clustering the observations within each firm. This process regards the time series of observations within the firm as a single observation, effectively eliminating any serial correlation. Column (5) lists the results, which indicates that the effect of Growth on *Longholder* is robust to clustering the standard errors within by firms. I also control for the firm-random effects, and the result is reported in Column (6). Again, the coefficient on Growth is statistically significant and economically larger (0.810 in Column (6) versus 0.244 in Column (2)). Therefore, the effect of Growth on *Longholder* is robust and not likely due to the data mining.

Table IV also reports the results of control variables. Size and past average annual return only have insignificant coefficients across different settings. Corporate governance has a significantly positive coefficient, but the significance disappears after controlling for the serial correlation or firm-random effect. Nevertheless, the positive sign suggests that CEOs with firms of better governance are more likely to hold the option longer. The reason could be that the better corporate governance may have stricter restriction on CEO option exercise. Hence, the CEOs of these firms are not so free to exercise options as the CEOs with firms of poor governance. Stock ownership has a significantly negative effect on *Longholder* across all settings, which supports CEOs' diversification incentives (Hall and Murphy (2000 & 2002)). Somewhat surprisingly, the coefficient on vested option is positive and statistically significant. One interpretation of this result is that CEOs with too many vested options are more likely to hold at least one option till the last year prior to expiration. Finally, CEO tenure has a positive and statistically significant effect on *Longholder* across all settings.

In a summary, the probit regressions provide results for testing the Hypothesis 1a-1d for *Longholder* measure. Hypothesis 1a is accepted since Growth outerperforms Q in explaining *Longholder*. Both Hypothesis 1b and Hypothesis 1c are rejected since neither Dev_{t-1}^{Firm} nor Dev_{t-1}^{Agg} has a statistically significant effect. Hypothesis 1d is accepted since the coefficient on Growth is economically and statistically significant.

3.4 Stock Mispricing, Growth and Holder 67 Measure – Regression Results

This subsection examines the relation between *Holder 67* measure and the three components of (M/B). Table II reports the correlation coefficients and the significance levels between *Holder 67* and other variables, within the *Holder 67* restriction sample. Consistent with Malmendier and Tate (2005), the correlation between *Holder 67* and *Longholder* is strong and highly significant (0.491). Similar to *Longholder*, the correlation between *Holder 67* and Q, and the correlation between *Holder 67* and Growth are significantly positive. Different from *Longholder*, the correlation between *Longholder* and Dev^{Firm} is insignificant while the correlation between *Longholder* and Dev^{Agg} becomes significant though not strong (0.078). The correlation results suggest that *Holder 67* measure constructed by (Malmendier and

Tate (2005)) could be related to both the aggregate level mispricing, and the firm growth opportunities.

Table V presents the results of the following regression specifications:

$$
\begin{aligned}
(3)\quad P(\mathit{Holder67}_{it} &= 1) = \text{Probit}\ [\gamma_0 + \gamma_1 \cdot Q + X'_{t-1} \cdot \gamma_2 + \eta_{it}] \\
(4)\quad P(\mathit{Holder67}_{it} &= 1) = \text{Probit}\ [\gamma_0 + \gamma_{11} \cdot Dev^{Firm}_{t-1} + \gamma_{12} \cdot Dev^{Agg}_{t-1} + \gamma_{13} \cdot Growth_{t-1} \\
&\qquad + X'_{t-1} \cdot \gamma_2 + \eta_{it}]
\end{aligned}
$$

Since the correlation results in Table II suggest that mispricing at the aggregate level and growth opportunities are more likely to affect the CEO option exercise behavior, I first compare the explanatory power between Q and the combination of Dev^{Agg}_{t-1} and Growth. Column (1) to Column (3) present the results. Column (1) shows that when using Q, the coefficient on Q is positive and statistically significant at the 1% level. Column (2) shows that the coefficients on both Dev^{Agg}_{t-1} and Growth are also positive and statistically significant at the 1% level. This result is consistent with the conjecture that CEO may concern the potential harm to the existing overvaluation when he exercises the options. Further, the Pseudo R^2 has a small increase from 0.131 in Colum (1) to 0.138 in Column (2). Column (3) shows that the effect of Q disappears because the coefficient on Q becomes insignificant and negative, while the coefficients on both Dev^{Agg}_{t-1} and Growth are still statistically significant at the 1% level and become economically stronger. The Pseudo R^2 in Column (3) remains 0.138, which indicate that Q does not increase the explanatory power if Dev^{Agg}_{t-1} and Growth are already included in the model. Column (1) to Column (3) suggests that Dev^{Agg}_{t-1} and Growth serves as a stronger proxy than traditional Q for misevaluation and growth opportunities, respectively.

[TABLE V - HERE]

Column (4) uses all the there components. The coefficient on the firm level mispricing measure (Dev^{Firm}_{t-1}) is insignificant as conjectured. The negative sign tends to support the insider information explanation though lack of power. In addition, adding Dev_{t-1}^{Firm} does not increase Pseudo R^2, which remains 0.138 in Column (2). The results in Column (5) indicate that the effects of Dev_{t-1}^{Agg} and Growth are robust to clustering the standard errors within by firms, though the significance level of Dev_{t-1}^{Agg} drops to 5%. Finally, Column (6) reports the results using firm-random effect probit regression, and it shows that the effects of Dev_{t-1}^{Agg} and Growth are still statistically significant and economically larger.

The control variables are mostly significant. Different from the results in Table IV, corporate governance lose its significance, while the effects of size and past average annual return turn statistically significant. The Pseudo R^2 in Table IV (0.138) is larger than the one in Table V (0.090), and it shows that the model is better fitted for *Holder 67* than *Longholder*.

In a summary, the probit regressions provide results for testing the Hypothesis 1a-1d for *Holder 67* measure. Hypothesis 1a is accepted since the combination of Dev_{t-1}^{Agg} and Growth outerperforms Q in explaining *Holder 67*. Hypothesis 1b is rejected since neither Dev_{t-1}^{Firm} nor Dev_{t-1}^{Agg} has a significantly negative effect. Hypothesis 1c is accepted since the coefficient on Dev_{t-1}^{Agg} is positive and statistically significant. Hypothesis 1d is accepted since the coefficient on Growth is economically and statistically significant.

4. Test 2: CEO Overconfidence or Stock Mispricing and Growth?

4.1 Testable Hypotheses

The results presented in the previous section show that the probability that CEOs will postpone the option exercise is related to the misvaluation and growth opportunities, to some extent. Assuming that CEO option exercise decision measures (*Longholder* and *Holder 67*) are proxies for unobservable CEO overconfidence, Malmendier and Tate (2005) argue that CEO overconfidence is related to the sensitivity of investment to cash flow. That is, the investment of overconfident CEOs is more sensitive to cash flow than the investment of CEOs who are not overconfident. The key of their statement is the assumption that the CEO option exercise behavior is a proxy for CEO overconfidence; however, it is not necessarily true. Numerous theoretical and empirical studies have shown that stock misevaluation and growth opportunities will affect firm investment as well as the investment-cash flow sensitivity. If *Longholder* and *Holder 67* measures actually proxy for the underlying misvaluation and growth opportunities, then *Longholder* and *Holder 67* will lose their power after controlling for the misvaluation and growth opportunities.

Though the results of Malmendier and Tate (2005) are robust after including Q and interaction of Q with cash flow, it is still problematic since Q is a noisy measure for misvaluation and growth opportunities. If the three components of (M/B) better capture the variations of misevaluation and growth opportunities, then the effects of *Longholder* and *Holder 67* on investment-cash flow sensitivity may turn weak and insignificant. Another possible scenario is that the three components of (M/B) I used do not proxy for the true misvaluation and growth opportunities perfectly, and part of the variation is captured by *Longholder* and *Holder 67*. If that is the case, then adding the three components of (M/B) may not totally remove the effects of the overconfidence measures although it will reduce their significance level to some extent. Under this scenario, an ideal test would divide the overconfidence measures into two parts. The first part is explained by the mispcring or growth if applicable from section III, as well as the controls independent of the true CEO overconfidence. The second part is the unexplained and unobservable variation which may be related to the true CEO overconfidence. If CEO overconfidence does affect the investment-cash flow sensitivity, then the second part of overconfidence measures should be responsible for the whole effects. Alternatively, if the effects of overconfidence measure on investment-cash flow sensitivity is totally determined by growth and (or) mispricing, then the first part is responsible for the whole effect.

After exploring the hypostases that link the effect of overconfidence measures on investment-cash flow sensitivity with stock mispricing and growth, I spread out two hypotheses as follows:

Hypothesis 2a

After controlling for misevaluation and growth opportunities, the effect of overconfidence measures (Longholder and Holder 67) on investment-cash flow sensitivity will diminish.

If the *Longholder* and *Holder 67* only proxy for mispricing or growth opportunities, then the effect of *Longholder* or *Holder 67* on investment-cash flow sensitivity essentially reflects the effect of mispricing or growth opportunities on investment-cash flow sensitivity. Therefore, the role of *Longholder* or *Holder 67* will turn insignificant after including proxies for mispricing or growth opportunities.

Hypothesis 2b

The effect of overconfidence measures (Longholder and Holder 67) on investment-cash flow sensitivity is dominated by their variation explained by mispricing and growth opportunities.

If *Longholder* and *Holder 67* proxy for mispricing, growth as well as irrelevant CEO overconfidence, then the effect of *Longholder* or *Holder 67* on investment-cash flow sensitivity is caused by the variation explained by mispricing and growth opportunities.

To test the prediction that the effect of overconfidence measures on investment-cash flow sensitivity is due to mispricing and growth opportunities, I use the same regression specification as in Malmendier and Tate (2005):

$$(5)\ I_{it} = b_1 + b_2 Q_{i,t-1} + b_3 C_{it} + Z'_{it} b_4 + b_5 \Delta_{it} + b_6 C_{it} \cdot Q_{i,t-1} + C_{it} \cdot Z'_{it} b_7 + b_8 C_{it} \cdot \Delta_{it} + u_{it}$$

$$(6)\ I_{it} = b_1 + [Dev^{Firm}_{t-1}, Dev^{Agg}_{t-1}, Growth_{t-1}] b_2 + b_3 C_{it} + Z'_{it} b_4 + b_5 \Delta_{it} + C_{it} \cdot [Dev^{Firm}_{t-1}, Dev^{Agg}_{t-1}, Growth_{t-1}] b_6 + C_{it} \cdot Z'_{it} b_7 + b_8 C_{it} \cdot \Delta_{it} + u_{it}$$

$$(7)\ I_{it} = b_1 + b_2 Q_{i,t-1} + b_3 C_{it} + Z'_{it} b_4 + [b_5^1 \hat{\Delta}_{it} + b_5^2 \cdot \mathrm{Resid}_{it}] + b_6 C_{it} \cdot Q_{i,t-1} + C_{it} \cdot Z'_{it} b_7 + [b_8^1 C_{it} \cdot \hat{\Delta}_{it} + b_8^2 C_{it} \cdot \mathrm{Resid}_{it}] \cdot \Delta_{it} + u_{it}$$

where I is the investment, C is the cash flow, Q is the market value of assets over book value of assets, Z is the set of control variables, and Δ is the overconfidence measure. In equation (7), $\hat{\Delta}$ is the estimated overconfidence measure and Resid is the associated residual based on equation (2) or (4). Malmendier and Tate (2005) estimate equation (5) and find a significant b_8 for both *Longholder* and *Holder 67*. Hypothesis 2a estimates equation (6) and predicts that b_6 is significant while b_8 is insignificant. Hypothesis 2b estimates equation (7) and predicts that b_8^1 is significant while b_8^2 is insignificant.

4.2 Baseline: Stock Mispricing, Growth opportunities and Corporate Investment

Previous research has addressed the impacts of growth opportunities and stock mispciring on corporate investment. In the neoclassic model of investment and Q theory, the equilibrium investment is solely determined by growth opportunities. Furthermore, Morck, Shleifer and Vishny (1990), Stein (1996) and Jensen (2005) argue that stock mispricing will affect the corporate investment decisions. Their hypotheses include manager's market timing-ability, manager' catering behavior. Therefore, I expect the three components of market-to-book ratios have individual effects on the investment.

[TABLE VI - HERE]

Tale VI reports the results when comparing the impacts of Q and the three components of (M/B) on investment and the investment-cash flow sensitivity. Column (1) and (2) shows the OLS regression results without additional controls used in Malmendier and Tate (2005). The coefficients on Q and the interaction of Q with cash flow are positively significant. The coefficients on Dev^{Firm} and Dev^{Agg} are insignificant but their interactions with cash flow are statistically significant. The coefficient on Growth is significant but its interaction with cash flow is insignificant. Column (3) and (4) exhibit the firm-fixed effects regression without additional controls. The effect of Q is still strong, and the effect of Dev^{Agg} on investment turns significant. Further, all three interactions with cash flow are statistically significant. The results do not change much after including additional controls. One exception is that the interaction of Growth with cash flow turns insignificant. Column (5) and (6) demonstrate the results. Finally, the adjusted R^2 have tiny difference under different regression settings.

Using Dev^{Firm}, Dev^{Agg} and Growth instead of Q does not increase the model's goodness-of-fit obviously.

Consistent with investment-cash flow sensitivity literature (Fazzari, Hubbard and Peterson (1988)), the effect of cash flow on investment is persistent no matter whether Q or the three components of (M/B) are included. Among the control variables, stock ownership, and vested option significantly increase the investment-cash flow sensitivity. In addition, size and corporate governance decrease the investment-cash flow sensitivity, but only the impact of size is statistically significant.

Yet as discussed above, though replacing Q by Dev^{Firm},Dev^{Agg} and Growth does not increase the explanatory power much, it exhibits that both mispricing at the aggregate level and growth opportunities affect the investment as well as the investment-cash flow sensitivity. The overvalued firms tend to invest more and have higher investment-cash flow sensitivity. This result is consistent with Jensen (2005). Managers of overvalued firms will increase investments in a way that justifies the overoptimistic view about the firms' growth, and the scale of overinvestment relies on the available internal funding, i.e., cash flows. In addition, it is not surprising that firms with better growth opportunities invest more and have higher investment-cash flow sensitivity.

4.3 Longholder Measure

First I replicate the results of Malmendier and Tate (2005) when using *Longholder* as a proxy for CEO overconfidence. Column (1) and (2) in Table VII present the results. The coefficient on the interaction of *Longholder* with cash flow is positive (0.120 in the firm-fixed effects specification with controls) and high significant (p-value=0.001). However, the result is not robust to clustering the standard errors by firm, which is consistent with the results of Malmendier and Tate (2005).

[TABLE VII - HERE]

Next, I use Dev^{Firm}, Dev^{Agg} and Growth both individually and all together to substitute Q in the regression. Column (3) to Column (6) shows the results. In Column (3), using Dev^{Firm} weakens the effect of *Longholder* on investment-cash flow sensitivity. The coefficient on the interaction of *Longholder* with cash flow drops from 0.120 to 0.50 and the significance level changes from the 1% level to the 10% level. In Column (4), using Dev^{Agg} does not reduce the effect of *Longholder* on investment-cash flow sensitivity (p-value=0.008). The coefficient remains positive (0.060) and still highly significant at the 1% level. In Column (5), using Growth successfully eliminates the effect of *Longholder* (p-value=0.124) since the coefficient on the interaction of *Longholder* with cash flow turns insignificant. In addition, the coefficient on the interaction of Growth with cash flow is statistically significant. In Column (6) in Table VII, using all the three components of (M/B) comes to the similar as in Column (5). The impact of *Longholder* on investment-cash flow sensitivity disappear while the impacts of Dev^{Firm} and Growth on investment-cash flow sensitivity remain strong and highly significant.

The results from Column (3) to Column (6) are consistent with the results obtained in the previous section that *Longholder* measure is significantly related to growth opportunities. When growth opportunities is controlled, the effect of *Longholder* diminishes. These results cast doubt on Malmendier and Tate (2005)'s argument that CEO overconfidence causes higher investment-cash flow sensitivity. Overall, Hypothesis 2a is accepted for *Longholder* measure. Whether a CEO ever held an option until the last year prior to expiration is not a proper proxy for CEO overconfidence; instead it is a proxy for firm's growth opportunities.

4.4 Holder 67 Measure

Similarly, I first replicate the results of Malmendier and Tate (2005) when using *Holder 67* as a proxy for CEO overconfidence. To be consistent with Malmendier and Tate (2005), Column (1), (3) and (5) in Table VIII present the results under three different regression specifications. The coefficient on the interaction of *Holder 67* with cash flow is positive

(0.059 in the firm-fixed effects specification with controls) and significant at the 5% level (p-value=0.011). The result turns stronger and is significant at the 1% level when including more controls (p-value=0.003). Furthermore, the result is robust to clustering the standard errors by firm, at the 5% level (p-value=0.047).

[TABLE VIII- HERE]

Column (2), (4) and (6) show the corresponding results when including Dev^{Firm}, Dev^{Agg} and Growth in three regression specifications. Comparing Column (1) with Column (2) (with fixed-effects and without controls), I find that the coefficient on the interaction of *Holder 67* with cash flow remain significant at the 5% level, though the p-value increases from 0.011 to 0.020. Comparing Column (3) with Column (4) (with fix-effects and controls), I find that the coefficient on the interaction of *Holder 67* with cash flow drops from 0.070 to 0.057 while the p-value increases from 0.003 to 0.016. It indicates that the effect of *Holder 67* turns weak though it is still significant at the 5% level. Comparing Column (5) with Column (6) comes to the same result (clustering the standard errors by firm). Moreover, the coefficients on the interaction of Dev^{Agg} and Growth with cash flow are negative and only statistically significant at the 5% level in Column (2). All these results tend to reject the Hypothesis 2a for *Holder 67*. The three components of (M/B) can not explain the effect of *Holder 67* on investment-cash flow sensitivity, although *Holder 67* is found significantly related to Dev^{Agg} and Growth in the previous section.

One possible reason could be due to the econometric issue: the improper use of firm-fixed effect. Among 237 firms in the *Holder 67* restriction sample, only about 60 firms have nonzero within-firm time series variation for *Holder 67* measure. The lack of within-firm variations destabilizes the effect of *Holder 67* when using firm-fixed effects in Column (1) to (6). Column (7) repeats the regression in Column (6) but uses the firm-random effect. Surprisingly, the coefficient on the interaction of *Holder 67* with cash flow shrinks and become insignificant (p-value=0.275). In addition, the coefficients on the interaction of Dev^{Agg} and

Growth with cash flow are significantly negative at the 5% level. Overall, the regression results of firm-random effect tend to support the Hypothesis 2a, however, this argument may be fragile and problematic because of the econometric issue.

Alternatively, it is possible that *Holder 67* captures some variation of underlying mispricing and growth opportunities, which is not totally captured by Dev^{Agg} and Growth. If that is the case, then combining both *Holder 67* and Dev^{Agg} together with Growth in the regression may not necessarily reduce the effect of *Holder 67.* To avoid such a problem, I then turn to test Hypothesis 2b for *Holder 67.* Based on the result in Column (2) Table V, I calculate the predicted value of *Holder 67*, by regressing *Holder 67* on Dev^{Agg} and Growth as well as other controls orthogonal to CEO overconfidence. The difference between the predicted *Holder 67* and the actual *Holder 67* is used as residual *Holder 67.* Though it is problematic to define the residual of Probit regression in that way, it works at least in this test since it is equivalent to include both predicted *Holder 67* and the actual *Holder 67* in the regression simultaneously.

[TABLE IX- HERE]

Table IX exhibits the regression results. In Column (1), I repeat the regression in Column (1) Table VIII and replace *Holder 67* and its interaction with cash flow by the predicted *Holder 67.* As predicted by Hypothesis 2b, the coefficient on the interaction of predicted *Holder 67* with cash flow is economically large (0.209 vs. 0.059 for *Holder 67* in Table VIII) and statistically significant (p-value=0.001). In Column (2), I replace *Holder 67* and its interaction with cash flow by the residual *Holder 67.* Consistent with the prediction of Hypothesis 2b, the coefficient on the interaction of predicted *Holder 67* with cash flow is extremely small (0.001) and insignificant (p-value=0.976). Moreover, the adjusted R^2 is slightly larger in Column (1) than in Column (2) (0.220 vs. 0.214). In Column (3) and Column (4), I repeat the comparison after including additional controls. The results remain the same. In Column (5), I include both predicted *Holder 67* and residual *Holder 67.* Yet as anticipated above, the effect of predicted *Holder 67* is highly significant at the 1% level while the effect of residual *Holder 67* is obviously insignificant (p-value=0.372). Comparing the adjusted R^2 gives some interesting results. Using predicted *Holder 67* yields better goodness-of-fit than using the actual *Holder 67*, since the adjusted R^2 is 0.252 in Column (3) Table IX while the counterpart is 0.244 in Column (3) Table VIII. Comparing the adjusted R^2 from Column (3) to (5) in Table IX, I find that residual *Holder 67* does not improve the explanation power given the existence of predicted *Holder 67*. Overall, the effect of *Holder 67* on investment-cash flow sensitivity is mainly caused by the predicted Holder 6, which is orthogonal to CEO overconfidence and actually related to mispricing at the aggregate level and firm growth opportunities, instead.

The results of Table IX provide strong evidence for Hypothesis 2b. Even if part of *Holder 67*'s variation could be related to the unobservable CEO overconfidence, it is not the CEO overconfidence, but the mispricing and growth opportunities that increase the investment-cash flow sensitivity.

5. Conclusion

One of the recent striking research areas is the impact of CEO overconfidence on corporate decision making. Despite its prominence, little formal scrutiny has been done to validate the proxies used for CEO overconfidence. The main purpose of this paper is to argue that CEO option exercise decision, which is more likely related to mispricing and growth opportunities, is not the appropriate proxy for unobservable CEO overconfidence. Consequently, the empirical findings of Malmendier and Tate (2005) could not necessarily support their theory that managerial overconfidence causes high investment-cash flow sensitivity. Furthermore, this result also questions the empirical findings of Malmendier and Tate (2008) as well as Malmendier, Tate and Yan (2007), since both of them consistently use CEO option exercise decision as the proxy for CEO overconfidence. It is beyond the scope of this paper to discuss whether CEOs are overconfident or whether true CEO overconfidence do have impacts on corporate decision making; instead, it emphasizes that rigorous researchers should look for more precise measures other than CEO option exercise decision, as the proxy for underlying managerial overconfidence.

This study also sheds light on the roles of stock mispricing and growth opportunities in determining managerial portfolio decisions. When a firm has better growth opportunities, the CEO is more likely to hold an option until the last year prior to expiration or fail to exercise the option relative to the rational benchmark. In addition, there exists a role of misvaluation based either on behavioral explanations or on asymmetric information between otherwise rational managers and markets. When a firm has higher misvaluation at the aggregate level, the CEO is more likely to fail to exercise the option relative to the rational benchmark. This result is hard to reconcile with the notion of insider trading decisions based on inside information. Alternately, it tends to support the conjecture that the CEOs of overvalued firms enjoy the perks from overvaluation and may take the cost of option exercise into account, because the market may regard it as a negative signal and thus ruin the overvaluation.

Finally, this study also reveals the positive impact of stock mispricing on corporate investment and investment-cash flow sensitivity. From a theoretical perspective, this result is consistent with the agency cost of overvalued equity (Jensen (2005)). In a summary, this paper focuses on stock mispricing and growth opportunities, and links their effects on CEO portfolio decision with their effects on corporate decision making. This design successfully explains the results in Malmendier and Tate (2005) by an alternative answer. Therefore, future research based on CEO overconfidence requires more precise overconfidence measures for empirical tests.

References

Baker, Malcolm, Jeremy C. Stein, and Jeffrey Wurgler, 2003, When does the market matter? Stock prices and the investment of equity-dependent firms, *Quarterly Journal of Economics* 118, 969-1006.

Baker, M., R. Ruback, and J. Wurgler, 2004, Behavioral Corporate Finance: A Survey, In Espen Eckbo, eds., Handbook in Corporate Finance: Empirical Corporate Finance.

Bertrand, Marianne and Antoinette Schoar, 2003, Managing with style: The effect of managers on firm policies, *Quarterly Journal of Economics*, 2003, 118, 1169-208.

Bolton, Patrick, Jose Scheinkman, and Wei Xiong, 2003, Executive compensation and short-termist behavior in speculative markets, Working paper, Princeton University.

Brickley, James A., Jeffrey L. Coles, and Rory L. Terry, 1994, Outside directors and the adoption of poison pills, *Journal of Financial Economics* 35, 371-390.

Byrd, John W., and Kent A. Hickman, 1992, Do outside directors monitor managers? Evidence from tender offer bids, *Journal of Financial Economics* 32, 195-221.

Carpenter, Jennifer N. and Barbara Remmers, 2001, Executive stock option exercises and inside information, *Journal of Business* 4, 513-534.

Eckbo, B. Espen, Ronald W. Masulis, and Oyvind Norli, 2000, Seasoned public offerings: Resolution of the 'new issues puzzle', *Journal of Financial Economics* 56, 251-291.

Fama, Eugene F., and Kenneth R. French, 2002, Testing trade-off and pecking order predictions about dividends and debt, *Review of Financial Studies* 15, 1-33.

Fazzari, Steve, R. Glenn Hubbard, and Bruce Peterson, 1988, Financing constraints and corporate investment, Brookings Papers on Economic Activity, 141-195.

Frank, Murray Z. and Vidhan K. Goyal, 2003, Testing the pecking order theory of capital structure, *Journal of Financial Economics* 67, 217-248.

Gervais, Simon, J. B. Heaton, and Terrance Odean, 2003, Overconfidence, investment policy, and executive stock options, Working paper.

Gilchrist, S., C. Himmelberg, and G. Huberman, 2004, Do stock price bubbles influence corporate investment? Working Paper (Federal Reserve Bank of New York #177).

Hadlock, Charles J., 1998, Ownership, liquidity, and investment, *Rand Journal of Economics* 29, 487-508.

Hall, Brian, and Jeffrey Liebman, 1998, Are CEOs really paid like bureaucrats? *Quarterly Journal of Economics* 113, 653-691.

Hall, Brian, and Kevin Murphy, 2000, Optimal exercise prices for executive stock options, *American Economic Review* 90, 209-214.

Hall, Brian, and Kevin Murphy, 2002, Stock options for undiversified executives, *Journal of Accounting and Economics* 33, 3-42.

Heaton, J. B., 2002, Managerial optimism and corporate finance, *Financial Management* 31, 33-45.

Hirshleifer, David, 2001, Investor psychology and asset pricing, *Journal of Finance* 64, 1533-1597.

Holmstrom, Bengt, 1999, Managerial incentive problems: a dynamic perspective, Review of Economic Studies 66, 169-182.

Hovakimian, Armen, Tim Opler, and Sheridan Titman, 2001, The debt-equity choice, *Journal of Financial and Quantitative Analysis* 36, 1-24.

Jensen, Michael, 1986, Agency costs of free cash flow, corporate finance and takeovers, *American Economic Review* 76, 323-329.

Jensen, Michael, 2005, Agency costs of overvalued equity, *Financial Management* 34, 5-19.

Jensen, Michael, and William Meckling, 1976, Theory of the firm: Managerial behavior, agency costs and ownership structure, *Journal of Financial Economics* 3, 305-360.

Jenter, Dirk, 2005, Market timing and managerial portfolio decisions, *Journal of Finance* 60, 1903-1949.

Jin, Li, 2002, CEO compensation, diversification, and incentives, *Journal of Financial Economics* 66, 29-63.

Kaplan, Steven, and Luigi Zingales, 1997, Do financing constraints explain why investment is correlated with cash flow? *Quarterly Journal of Economics* 112, 169-215.

Kaplan, Steven N., and Luigi Zingales, 2000, Investment-cash flow sensitivities are not a valid measure of financing constraints, *Quarterly Journal of Economics* 115, 707-712.

Lamont, Owen, Christopher Polk, and Jesus Saa-Requejo, 2001, Financial constraints and stock returns, *Review of Financial Studies* 14, 529-554.

Leland, Hanye, and David Pyle, 1977, Informational asymmetries, financial structure, and financial intermediation, *Journal of Finance* 32, 371-387.

Malmendier, Ulrike and Geoffrey Tate, 2005, CEO overconfidence and corporate investment, *Journal of Finance* 60, 2661-2700.

Malmendier, Ulrike, and Geoffrey Tate, 2008, Who makes acquisitions? CEO overconfidence and the market's reaction, *Journal of Financial Economics* 89, 20-43

Malmendier, Ulrike, Geoffrey Tate and Jun Yan, 2007, Corporate financial policies with overconfident Managers, NBER Working paper.

Meulbroek, Lisa K., 2001, The efficiency of equity-linked compensation: understanding the full cost of awarding executive stock options, *Financial Management* 30, 5-30.

Morck, Randall, Andrei Shleifer, and Robert Vishny, 1990, The stock market and investment: Is the market a sideshow?, Brookings Papers on Economic Activity 2, 157-215.

Myers, Stewart C., 1977, Determinants of corporate borrowing, *Journal of Financial Economics* 5, 147-175.

Myers, Stewart C. and Nicholas S. Majluf, 1984, Corporate financing and investment decisions when firms have information that investors do not have, *Journal of Financial Economics* 13, 187-221.

Pasternack, Daniel, 2002, Executive stock options: Exercise policy and market reaction, Working paper.

Rhodes-Kropf, and S. Viswanathan, 2004, Market valuation and merge waves, *Journal of Finance* 59, 2685-2718.

Rhodes-Kropf, M., D. Robinson, and S. Viswanathan, 2005, Valuation waves and merger activity: the empirical evidence, *Journal of Financial Economics* 77, 561-603.

Rozeff, Michael S., and Mir A. Zaman, 1988, Market efficiency and insider trading: New evidence, *Journal of Business* 61, 25-44.

Rozeff, Michael S., and Mir A. Zaman, 1998, Overreaction and insider trading: Evidence from growth and value portfolios, *Journal of Finance* 53, 701-716.

Stein, Jeremy, 1996, Rational capital budgeting in an irrational world, *Journal of Business* 69, 429-455.

Wie, Yu, 2004, Executive stock option exercises, insider information and earnings management, Working paper.

Yermack, David, 1995, Do corporations award CEO stock options effectively, *Journal of Financial Economics* 39, 237-269.

Table I
Summary Statistics

This table shows the summary statistics of the full sample and "Holder 67 restrictions sample". The full sample contains firm-year observations used in the Hall and Liebman (1998) dataset from 1980 to 1994. Firms with missing accounting information are excluded. The "Holder 67 restrictions sample" contains all CEO-years of CEOs who had options more than 67% in-the-money in the fifth year at least twice during their sample tenure. Q is the market value of assets over the book value of assets at the beginning of the year. Dev ^{Firm} is the mispricing at the firm level. Dev ^{Agg} is the mispciring at the aggregate level. As defined in Rhodes-Kropf, Robinson and Viswanathan (2005), Dev ^{Firm}, Dev ^{Agg} and Growth are decomposed from the market-to-book ratio. Corporate governance is the number of outside directors who currently serve as CEOs of other companies.

	Full Sample # of Firms = 332 # of CEOs = 669						Holder 67 Restrictions Sample # of Firms = 237 # of CEOs = 313					
Variable	Obs	Mean	Median	SD	Min	Max	Obs	Mean	Median	SD	Min	Max
Asset ($M)	3722	5398	2239	11591	9	184326	1525	5054	2121	11517	104	180237
Capital ($M)	3722	2398	953	5452	2	128063	1525	2301	998	4950	11	123754
Investment ($M)	3722	371	148	875	0	17810	1525	399	162	861	1	13770
Investment / Lagged Capital	3722	0.24	0.19	0.26	0.00	5.72	1525	0.23	0.19	0.18	0.01	2.80
Investment / Lagged Assets	3722	0.09	0.07	0.08	0.00	1.64	1525	0.10	0.08	0.07	0.00	0.70
Cash Flow ($M)	3722	437	185	935	-1577	15726	1525	482	198	1022	-1577	15601
Cash Flow / Lagged Capital	3722	0.36	0.25	0.41	-0.29	2.53	1525	0.36	0.27	0.35	-0.29	2.53
Cash Flow / Lagged Assets	3722	0.11	0.10	0.07	-0.06	0.36	1525	0.12	0.11	0.07	-0.06	0.36
Q (beginning of the fiscals year)	3722	1.45	1.14	0.95	0.51	12.26	1525	1.58	1.26	0.98	0.59	12.26
Dev ^{Firm} (beginning of the fiscal year)	3722	0.03	0.06	0.78	-10.49	1.39	1525	0.07	0.08	0.55	-10.45	1.25
Dev ^{Agg} (beginning of the fiscal year)	3722	0.01	0.00	0.14	-1.07	0.67	1525	0.02	0.02	0.14	-1.07	0.62
Growth (beginning of the fiscal year)	3722	0.16	0.10	0.36	-1.35	1.67	1525	0.22	0.17	0.36	-1.20	1.67
Net Income ($M)	3722	191	92	482	-4453	7279	1525	207	95	478	-3794	4856
ROA	3722	0.05	0.05	0.07	-0.94	0.52	1525	0.06	0.06	0.07	-0.94	0.49
Corporate Governance (outside CEOs)	3722	1.76	1.00	1.59	0.00	9.00	1525	1.78	1.00	1.63	0.00	8.00
Leverage (market)	3722	0.46	0.48	0.22	0.01	1.00	1514	0.40	0.42	0.21	0.01	0.93
Leverage (book)	3722	0.60	0.61	0.19	0.05	1.99	1525	0.57	0.57	0.17	0.08	1.38

Table II
Correlations

This table reports the Spearman's rank correlation coefficients and the significance level in the spare bracket. The "Holder 67 restrictions sample" contains all CEO-years of CEOs who had options more than 67% in –the-money in the fifth year at least two times during their sample tenure.

	Holder 67 Restrictions	Full Sample									
	Holder 67	Longholder	Size	Q	Dev ^{Firm}	Dev ^{Agg}	Growth	CF/K	Stock Ownership	Vested Options	Corporate Governance
Holder 67	1.000										
Longholder	0.491 [0.000]***	1.000									
Size	0.078 [0.002]***	-0.071 [0.000]***	1.000								
Q	0.117 [0.000]***	0.149 [0.000]***	-0.299 [0.000]***	1.000							
Dev ^{Firm}	0.017 [0.499]	0.057 [0.001]***	0.120 [0.000]***	0.397 [0.000]***	1.000						
Dev ^{Agg}	0.078 [0.002]***	-0.006 [0.739]	0.100 [0.000]***	0.313 [0.000]***	-0.042 [0.010]**	1.000					
Growth	0.052 [0.041]**	0.121 [0.000]***	-0.495 [0.000]***	0.728 [0.000]***	-0.136 [0.000]***	0.037 [0.023]**	1.000				
CF/K	0.081 [0.001]***	0.166 [0.000]***	-0.322 [0.000]***	0.621 [0.000]***	0.205 [0.000]***	0.036 [0.027]**	0.578 [0.000]***	1.000			
Stock Ownership	-0.016 [0.514]	0.143 [0.000]***	-0.492 [0.000]***	0.303 [0.000]***	0.104 [0.000]***	0.063 [0.000]***	0.276 [0.000]***	0.363 [0.000]***	1.000		
Vested Options	0.510 [0.000]***	0.335 [0.000]***	-0.068 [0.000]***	0.201 [0.000]***	0.137 [0.000]***	0.146 [0.000]***	0.024 [0.145]	0.201 [0.000]***	0.141 [0.000]***	1.000	
Corporate Governance	0.051 [0.040]**	-0.008 [0.611]	0.341 [0.000]***	-0.119 [0.000]***	-0.036 [0.027]**	0.065 [0.000]***	-0.152 [0.000]***	-0.129 [0.000]***	-0.342 [0.000]***	0.009 [0.588]	1.000

The symbols *, **, *** denote significance at the 10%, 5% and 1% levels, respectively.

Table III

Mispricing, Growth and Overconfidence Measure (Longholder)

The data consist of firm-year observations used in the Hall and Liebman (1998) dataset from 1980 to 1994. Firms with missing accounting information are excluded. Firm-year observations with missing Longholder measure are also excluded. As defined in Malmendier and Tate (2005), the overconfidence measure Longholder is a dummy variable equal to one if the CEO ever held an option until the last year prior to expiration. In panel A, for every year and every CEO ownership quintile, firms are divided annually into three equal groups based on their Dev^{Firm} (mispricing at the firm level). Groups are then aggregated across years and CEO ownership quintiles. The number of firms in each group is not exactly the same because of rounding error. Statistics in panel A are for differences in the means of Longholder dummy between the high-Dev^{Firm} and the low-Dev^{Firm} groups. Panel B and Panel C repeat Panel A by instead grouping on firms' Dev^{Agg} (mispricing at the aggregate level) and Growth, respectively.

Panel A Overconfidence Measure (Longholder) Across Firm Level Mispricing Groups

	Low Mispricing at the Firm Level		Med Mispricing at the Firm Level		High Mispricing at the Firm Level		*Test for difference in longholder between High and Low Groups*		
CEO Ownership Quintile	Mean Longholder	#	Mean Longholder	#	Mean Longholder	#	Diff (High-Low)	t-test (p-value)	Wilcoxon Rank Test (p-value)
Lowest	0.048	251	0.068	263	0.161	254	0.114	[0.0001] ***	[0.0001] ***
2	0.070	228	0.051	237	0.181	232	0.111	[0.0003] ***	[0.0004] ***
3	0.159	252	0.162	260	0.205	258	0.047	[0.1728]	[0.1733]
4	0.323	235	0.262	248	0.241	245	-0.083	[0.0443] **	[0.0451] **
Highest	0.175	240	0.206	252	0.167	234	-0.008	[0.8101]	[0.8103]
Total	0.154	1206	0.150	1260	0.191	1223	0.037	[0.0156] **	[0.0157] **

The symbols *, **, *** denote significance at the 10%, 5% and 1% levels, respectively. (continued)

Table III – *Continued*

Panel B Overconfidence Measure (Longholder) Across Aggregate Level Mispricing Groups

	Low Mispricing at the Aggregative Level		Med Mispricing at the Aggregative Level		High Mispricing at the Aggregative Level		*Test for difference in longholder between High and Low Groups*		
CEO Ownership Quintile	Mean Longholder	#	Mean Longholder	#	Mean Longholder	#	Diff (High-Low)	t-test (p-value)	Wilcoxon Rank Test (p-value)
Lowest	0.112	251	0.095	263	0.071	254	-0.041	[0.1125]	[0.1132]
2	0.079	227	0.118	237	0.103	233	0.024	[0.3785]	[0.3788]
3	0.171	251	0.202	263	0.152	256	-0.019	[0.5628]	[0.5629]
4	0.264	239	0.247	247	0.314	242	0.050	[0.2231]	[0.2235]
Highest	0.167	234	0.204	250	0.178	242	0.011	[0.7509]	[0.7510]
Total	0.159	1202	0.173	1260	0.163	1227	0.004	[0.7836]	[0.7836]

The symbols *, **, *** denote significance at the 10%, 5% and 1% levels, respectively.

(continued)

Table III – *Continued*

Panel C Overconfidence Measure (Longholder) Across Growth Component Groups

	Low Growth Component		Med Growth Component		High Growth Component			*Test for difference in longholder between High and Low Groups*	
CEO Ownership Quintile	Mean Longholder	#	Mean Longholder	#	Mean Longholder	#	Diff (High-Low)	t-test (p-value)	Wilcoxon Rank Test (p-value)
Lowest	0.080	250	0.034	263	0.165	255	0.085	[0.0037]***	[0.0039]***
2	0.079	228	0.059	237	0.164	232	0.085	[0.0053]***	[0.0057]***
3	0.148	244	0.188	266	0.188	260	0.041	[0.1280]	[0.1287]
4	0.218	243	0.321	243	0.285	242	0.067	[0.0605]*	[0.0612]*
Highest	0.321	239	0.285	250	0.500	227	0.060	[0.0156]**	[0.0161]**
Total	0.135	1204	0.157	1259	0.202	1226	0.067	[0.0001]***	[0.0001]***

The symbols *, **, *** denote significance at the 10%, 5% and 1% levels, respectively.

Table IV

Probit Regression of Longholder Measure on Mispricing and Growth

This table presents the probit regressions that predict whether Longholder measure equals to one based on the level of firm misvaluation and growth. As defined in Malmendier and Tate (2005), the overconfidence measure Longholder is a dummy variable equal to one if the CEO ever held an option until the last year prior to expiration. Q is the market value of assets over the book value of assets at the beginning of the year. Dev ^{Firm} is the mispricing at the firm level. Dev ^{Agg} is the mispciring at the aggregate level. As defined in Rhodes-Kropf, Robinson and Viswanathan (2005), Dev ^{Firm}, Dev ^{Agg} and Growth are decomposed from the market-to-book ratio. Corporate governance is the number of outside directors who currently serve as CEOs of other companies. Size is the natural logarithm of assets at the beginning of the year. Stock ownership is the fraction of company stock owned by the CEO and his immediate family at the beginning of the year. Vested options are the CEO's holdings of options that are exercisable within 6 months of the beginning of the year, as a fraction of common shares outstanding. Average annual return is the average yearly rate of return on the firm's stock over the past three years. Coefficients value, significance level and Pseudo R^2 are reported. In column 5, standard errors are robust to heteroskedasticity and within-firm serial correlation. In column 6, firm-random effects are controlled.

Explanatory Variable	(1) Longholder	(2) Longholder	(3) Longholder	(4) Longholder	(5) Longholder	(6) Longholder
Q	0.103 [0.001]***		0.060 [0.136]			
Dev ^{Firm}				0.007 [0.830]		
Dev ^{Agg}				0.275 [0.252]		
Growth		0.334 [0.000]***	0.244 [0.026]**	0.355 [0.000]***	0.442 [0.047]**	0.810 [0.002]***
Corporate Governance	0.058 [0.001]***	0.059 [0.001]***	0.060 [0.001]***	0.059 [0.001]***	0.056 [0.234]	0.046 [0.298]
Size	-0.017 [0.497]	0.002 [0.944]	0.003 [0.905]	0.008 [0.773]	-0.001 [0.988]	-0.072 [0.255]
Stock Ownership	-3.366 [0.000]***	-5.705 [0.000]***	-5.703 [0.000]***	-5.708 [0.000]***	-7.692 [0.000]***	-36.003 [0.000]***
Vested Options	4.003 [0.000]***	4.073 [0.000]***	4.077 [0.000]***	4.094 [0.000]***	4.392 [0.010]**	19.820 [0.000]***
Average Annual Return	0.090 [0.550]	0.140 [0.356]	0.088 [0.570]	0.111 [0.470]	0.161 [0.504]	0.947 [0.046]**
Years as CEO	0.029 [0.000]***	0.035 [0.000]***	0.035 [0.000]***	0.035 [0.000]***	0.038 [0.000]***	0.157 [0.000]***
Year-fixed Effects	yes	yes	yes	yes	yes	yes
Random Effect						firm
Standard Errors Clustered by Firm					yes	
Observations	3492	3492	3492	3492	3492	3492
Pseudo R^2	0.078	0.090	0.091	0.090	0.101	

Constant included. *p* value in square brackets.

The symbols *, **, *** denote significance at the 10%, 5% and 1% levels,

Table V

Probit Regression of Holder 67 Measure on Mispricing and Growth

This table presents the probit regressions that predict whether *Holder 67* measure equals to one based on the level of firm misvaluation and growth. As defined in Malmendier and Tate (2005), the overconfidence measure *Holder 67* is a dummy variable equal to one for all CEO-year after the CEO holds a five-year-old option that is more than 67% in-the-money, provide that he subsequently does it again at least once. Q is the market value of assets over the book value of assets at the beginning of the year. Dev ^{Firm} is the mispricing at the firm level. Dev ^{Agg} is the mispciring at the aggregate level. As defined in Rhodes-Kropf, Robinson and Viswanathan (2005), Dev ^{Firm}, Dev ^{Agg} and Growth are decomposed from the market-to-book ratio. Corporate governance is the number of outside directors who currently serve as CEOs of other companies. Size is the natural logarithm of assets at the beginning of the year. Stock ownership is the fraction of company stock owned by the CEO and his immediate family at the beginning of the year. Vested options are the CEO's holdings of options that are exercisable within 6 months of the beginning of the year, as a fraction of common shares outstanding. Average annual return is the average yearly rate of return on the firm's stock over the past three years. Coefficients value, significance level and Pseudo R^2 are reported. In column 5, standard errors are robust to heteroskedasticity and within-firm serial correlation. In column 6, firm-random effects are controlled.

Explanatory Variable	(1) Holder 67	(2) Holder 67	(3) Holder 67	(4) Holder 67	(5) Holder 67	(6) Holder 67
Q	0.223		-0.046			
	[0.002]***		[0.396]			
Dev ^{Firm}				-0.059		
				[0.347]		
Dev ^{Agg}		0.891	0.973	0.874	0.891	2.690
		[0.002]***	[0.001]***	[0.003]***	[0.044]**	[0.006]***
Growth		0.662	0.737	0.654	0.662	0.886
		[0.000]***	[0.000]***	[0.000]***	[0.003]***	[0.034]**
Corporate Governance	0.011	-0.003	-0.005	-0.005	-0.003	0.581
	[0.763]	[0.879]	[0.834]	[0.839]	[0.936]	[0.000]***
Size	0.229	0.226	0.228	0.227	0.226	0.471
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.004]***	[0.002]***
Stock Ownership	-10.612	-5.347	-5.386	-5.379	-5.347	-12.246
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.017]**	[0.000]***
Vested Options	24.952	12.342	12.383	12.378	12.342	18.681
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.002]***	[0.000]***
Average Annual Return	-1.543	-1.162	-1.127	-1.137	-1.162	-0.075
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.001]***	[0.907]
Years as CEO	0.027	0.011	0.011	0.012	0.011	0.112
	[0.002]***	[0.030]**	[0.028]**	[0.026]**	[0.324]	[0.000]***
Year-fixed Effects	yes	yes	yes	yes	yes	yes
Random Effect						firm
Standard Errors Clustered by Firm					yes	
Observations	1520	1520	1520	1520	1520	1517
Pseudo R^2	0.131	0.138	0.138	0.138	0.138	

Constant included. *p* value in square brackets.

The symbols *, **, *** denote significance at the 10%, 5% and 1% levels, respectively.

Table VI

Regression of Investment on Mispricing, Growth or Q

The dependent variable investment is defined as firm capital expenditures and normalized by capital at the beginning of the year. Cash flow is earnings before extraordinary items plus depreciation and is normalized by capital at the beginning of the year. Q is the market value of assets over the book value of assets at the beginning of the year. Dev ^{Firm} is the mispricing at the firm level. Dev ^{Agg} is the mispciring at the aggregate level. As defined in Rhodes-Kropf, Robinson and Viswanathan (2005), Dev ^{Firm}, Dev ^{Agg} and Growth are decomposed from the market-to-book ratio. Corporate governance is the number of outside directors who currently serve as CEOs of other companies. Size is the natural logarithm of assets at the beginning of the year. Stock ownership is the fraction of company stock owned by the CEO and his immediate family at the beginning of the year. Vested options are the CEO's holdings of options that are exercisable within 6 months of the beginning of the year, as a fraction of common shares outstanding. Coefficients value, significance level and adjusted R^2 are reported.

	No Fixed Effects, No Controls		Fixed-Effects, No Controls		Fixed-Effects, Controls	
Explanatory Variable	(1)	(2)	(3)	(4)	(5)	(6)
Cash Flow	0.216	0.238	0.188	0.271	0.537	0.708
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Q	0.051		0.050		0.067	
	[0.000]***		[0.000]***		[0.000]***	
(Q) ∗ (Cash Flow)	0.006		0.037		0.010	
	[0.334]		[0.000]***		[0.235]	
Dev ^{Firm}		0.001		-0.006		-0.013
		[0.828]		[0.568]		[0.205]
Dev ^{Agg}		0.015		0.146		0.134
		[0.665]		[0.000]***		[0.000]***
Growth		0.076		0.148		0.143
		[0.000]***		[0.000]***		[0.000]***
(Dev ^{Firm}) ∗ (Cash Flow)		0.091		0.081		0.106
		[0.000]***		[0.000]***		[0.000]***
(Dev ^{Agg}) ∗ (Cash Flow)		-0.170		0.198		0.150
		[0.003]***		[0.008]***		[0.037]**
(Growth) ∗ (Cash Flow)		0.006		0.097		-0.002
		[0.633]		[0.000]***		[0.932]

(continued)

Table VI – *Continued*

	No Fixed Effects, No Controls		Fixed-Effects, No Controls		Fixed-Effects, Controls	
	(1)	(2)	(3)	(4)	(5)	(6)
Stock Ownership					0.031	0.023
					[0.691]	[0.777]
Vested Options					0.086	0.117
					[0.238]	[0.116]
Size					-0.051	-0.049
					[0.000]***	[0.000]***
Corporate Governance					0.001	0.002
					[0.731]	[0.652]
(Stock Ownership) ∗ (Cash Flow)					0.743	0.595
					[0.000]***	[0.000]***
(Vested Options) ∗ (Cash Flow)					0.183	0.145
					[0.001]***	[0.009]***
(Size) ∗ (Cash Flow)					-0.043	-0.059
					[0.000]***	[0.000]***
(Corporate Governance) ∗ (Cash Flow)					-0.011	-0.014
					[0.225]	[0.112]
Year-fixed Effects	no	no	yes	yes	yes	yes
Firm-fixed Effects	no	no	yes	yes	yes	yes
(Year-fixed Effects) ∗ (Cash Flow)	no	no	yes	yes	yes	yes
Observations	3722	3722	3722	3722	3722	3722
Adjusted R^2	0.228	0.217	0.253	0.260	0.322	0.323

Constant included. *p* value in square brackets.

The symbols *, **, *** denote significance at the 10%, 5% and 1% levels, respectively.

Table VII

Regression of Investment on Mispricing, Growth and Longholder Measure

The dependent variable investment is defined as firm capital expenditures and normalized by capital at the beginning of the year. Cash flow is earnings before extraordinary items plus depreciation and is normalized by capital at the beginning of the year. Q is the market value of assets over the book value of assets at the beginning of the year. Dev ^{Firm} is the mispricing at the firm level. Dev ^{Agg} is the mispciring at the aggregate level. As defined in Rhodes-Kropf, Robinson and Viswanathan (2005), Dev ^{Firm}, Dev ^{Agg} and Growth are decomposed from the market-to-book ratio. Corporate governance is the number of outside directors who currently serve as CEOs of other companies. Size is the natural logarithm of assets at the beginning of the year. Stock ownership is the fraction of company stock owned by the CEO and his immediate family at the beginning of the year. Vested options are the CEO's holdings of options that are exercisable within 6 months of the beginning of the year, as a fraction of common shares outstanding. As defined in Malmendier and Tate (2005), the overconfidence measure Longholder is a dummy variable equal to one if the CEO ever held an option until the last year prior to expiration. Coefficients value, significance level and adjusted R^2 are reported. In column 2, standard errors are robust to heteroskedasticity and within-firm serial correlation.

	Fixed Effects, Controls	Standard Errors Clustered by Firm	Fixed-Effects, Controls			
Explanatory Variable	(1)	(2)	(3)	(4)	(5)	(6)
Cash Flow	0.664	0.664	0.633	0.633	0.021	0.33
	[0.000]***	[0.188]	[0.000]***	[0.000]***	[0.854]	[0.037]**
Q	0.066	0.066				
	[0.000]***	[0.047]**				
(Q) ∗ (Cash Flow)	0.006	0.006				
	[0.492]	[0.862]				
Dev ^{Firm}			-0.011			0.042
			[0.570]			[0.029]**
Dev ^{Agg}				0.057		0.181
				[0.134]		[0.000]***
Growth					0.007	0.097
					[0.622]	[0.000]***
(Dev ^{Firm}) ∗ (Cash Flow)			0.140			0.067
			[0.000]***			[0.007]***
(Dev ^{Agg}) ∗ (Cash Flow)				0.231		0.074
				[0.003]***		[0.368]
(Growth) ∗ (Cash Flow)					0.189	0.068
					[0.000]***	[0.002]***

(continued)

Table VII – *Continued*

	Fixed Effects, Controls	Standard Errors Clustered by Firm	Fixed-Effects, Controls			
	(1)	(2)	(3)	(4)	(5)	(6)
Stock Ownership	-0.027	-0.027	-0.006	0.010	-0.004	-0.016
	[0.736]	[0.871]	[0.947]	[0.909]	[0.965]	[0.845]
Vested Options	-0.070	-0.070	-0.080	-0.096	-0.109	0.111
	[0.353]	[0.568]	[0.316]	[0.229]	[0.170]	[0.138]
Size	-0.045	-0.045	-0.050	-0.056	-0.074	-0.065
	[0.000]***	[0.087]*	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Corporate Governance	0.001	0.001	0.001	-0.001	-0.002	0.003
	[0.915]	[0.928]	[0.972]	[0.891]	[0.564]	[0.461]
(Stock Ownership) ∗ (Cash Flow)	0.787	0.787	0.471	0.421	0.573	0.758
	[0.000]***	[0.375]	[0.002]***	[0.006]***	[0.000]***	[0.000]***
(Vested Options) ∗ (Cash Flow)	-0.293	-0.293	-0.292	-0.309	-0.334	0.142
	[0.000]***	[0.057]*	[0.000]***	[0.000]***	[0.000]***	[0.014]**
(Size) ∗ (Cash Flow)	-0.062	-0.062	-0.064	-0.064	-0.004	-0.043
	[0.000]***	[0.296]	[0.000]***	[0.000]***	[0.696]	[0.003]***
(Corporate Governance) ∗ (Cash Flow)	0.001	0.001	-0.006	-0.004	0.008	-0.013
	[0.957]	[0.978]	[0.538]	[0.647]	[0.374]	[0.193]
Longholder	-0.04	-0.04	-0.019	-0.019	-0.029	-0.003
	[0.073]*	[0.345]	[0.413]	[0.415]	[0.209]	[0.909]
(Longholder) ∗ (Cash Flow)	0.120	0.120	0.060	0.050	0.052	-0.043
	[0.001]***	[0.280]	[0.093]*	[0.008]***	[0.124]	[0.223]
Year-fixed Effects	yes	yes	yes	yes	yes	yes
(Year-fixed Effects) ∗ (Cash Flow)	yes	yes	yes	yes	yes	yes
Firm-fixed Effects	yes	yes	yes	yes	yes	yes
Observations	3689	3689	3689	3689	3689	3689
Adjusted R^2	0.339	0.339	0.299	0.290	0.307	0.341

Constant included. *p* value in square brackets.

The symbols *, **, *** denote significance at the 10%, 5% and 1% levels, respectively.

Table VIII

Regression of Investment on Mispricing, Growth and Holder 67 Measure

The dependent variable investment is defined as firm capital expenditures and normalized by capital at the beginning of the year. Cash flow is earnings before extraordinary items plus depreciation and is normalized by capital at the beginning of the year. Q is the market value of assets over the book value of assets at the beginning of the year. Dev ^{Firm} is the mispricing at the firm level. Dev ^{Agg} is the mispciring at the aggregate level. As defined in Rhodes-Kropf, Robinson and Viswanathan (2005), Dev ^{Firm}, Dev ^{Agg} and Growth are decomposed from the market-to-book ratio. Corporate governance is the number of outside directors who currently serve as CEOs of other companies. Size is the natural logarithm of assets at the beginning of the year. Stock ownership is the fraction of company stock owned by the CEO and his immediate family at the beginning of the year. Vested options are the CEO's holdings of options that are exercisable within 6 months of the beginning of the year, as a fraction of common shares outstanding. As defined in Malmendier and Tate (2005), the overconfidence measure *Holder 67* is a dummy variable equal to one for all CEO-year after the CEO holds a five-year-old option that is more than 67% in-the-money, provide that he subsequently does it again at least once. Coefficients value, significance level and adjusted R^2 are reported. In column 5 and 6, standard errors are robust to heteroskedasticity and within-firm serial correlation. In column 7, firm-random effects rather than firm-fixed effects are controlled.

	Fixed Effects, No Controls		Fixed-Effects, Controls		Standard Errors Clustered by Firm		Random-Effects, Controls
Explanatory Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cash Flow	0.355	0.576	0.259	0.240	0.259	0.240	0.602
	[0.000]***	[0.000]***	[0.014]**	[0.242]	[0.450]	[0.416]	[0.001]***
Q	0.096		0.085		0.085		
	[0.000]***		[0.000]***		[0.000]***		
(Q) ∗ (Cash Flow)	-0.063		-0.055		-0.055		
	[0.000]***		[0.000]***		[0.001]***		
Dev ^{Firm}		0.017		0.038		0.038	0.065
		[0.447]		[0.081]*		[0.123]	[0.001]***
Dev ^{Agg}		0.295		0.191		0.191	0.229
		[0.000]***		[0.000]***		[0.018]**	[0.000]***
Growth		0.141		0.106		0.106	0.079
		[0.000]***		[0.000]***		[0.008]***	[0.000]***
(Dev ^{Firm}) ∗ (Cash Flow)		0.041		-0.021		-0.021	-0.034
		[0.171]		[0.517]		[0.652]	[0.252]
(Dev ^{Agg}) ∗ (Cash Flow)		-0.250		0.015		0.015	-0.247
		[0.018]**		[0.902]		[0.933]	[0.029]**
(Growth) ∗ (Cash Flow)		-0.071		-0.031		-0.031	-0.060
		[0.016]**		[0.444]		[0.727]	[0.026]**

(continued)

Table VIII– *Continued*

	Fixed Effects, No Controls		Fixed-Effects, Controls		Standard Errors Clustered by Firm		Random-Effects, Controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Stock Ownership			0.176	0.007	0.176	0.007	0.020
			[0.102]	[0.945]	[0.406]	[0.957]	[0.831]
Vested Options			0.030	0.122	0.030	0.122	0.278
			[0.793]	[0.297]	[0.896]	[0.411]	[0.002]***
Size			-0.079	-0.075	-0.079	-0.075	-0.015
			[0.000]***	[0.000]***	[0.006]***	[0.014]**	[0.064]*
Corporate Governance			0.006	0.007	0.006	0.007	0.005
			[0.231]	[0.176]	[0.440]	[0.368]	[0.238]
(Stock Ownership) ∗ (Cash Flow)			-0.460	0.392	-0.460	0.392	0.583
			[0.065]*	[0.172]	[0.432]	[0.348]	[0.011]**
(Vested Options) ∗ (Cash Flow)			-0.097	-0.228	-0.097	-0.228	-0.268
			[0.548]	[0.178]	[0.811]	[0.368]	[0.003]***
(Size) ∗ (Cash Flow)			0.015	0.016	0.015	0.016	0.010
			[0.214]	[0.411]	[0.763]	[0.562]	[0.512]
(Corporate Governance) ∗ (Cash Flow)			-0.030	-0.031	-0.030	-0.031	-0.025
			[0.005]***	[0.005]***	[0.174]	[0.151]	[0.012]**
Holder 67	-0.034	-0.038	-0.034	-0.032	-0.034	-0.032	-0.020
	[0.031]**	[0.019]**	[0.030]**	[0.041]**	[0.082]*	[0.093]*	[0.131]
(Holder 67) ∗ (Cash Flow)	0.059	0.054	0.070	0.057	0.070	0.057	0.024
	[0.011]**	[0.020]**	[0.003]***	[0.016]**	[0.047]**	[0.072]*	[0.275]
Year-fixed Effects	yes	yes	yes	yes	yes	yes	yes
(Year-fixed Effects) ∗ (Cash Flow)	yes	yes	yes	yes	yes	yes	yes
Firm-fixed Effects	yes	yes	yes	yes	yes	yes	no
Firm-random Effects	no	no	no	no	no	no	yes
Observations	1525	1525	1525	1525	1525	1525	1525
Adjusted R^2	0.220	0.229	0.244	0.256	0.244	0.256	

Constant included. *p* value in square brackets.
The symbols *, **, *** denote significance at the 10%, 5% and 1% levels, respectively.

Table IX

Regression of Investment on Predicted Holder 67 Measure

The dependent variable investment is defined as firm capital expenditures and normalized by capital at the beginning of the year. Cash flow is earnings before extraordinary items plus depreciation and is normalized by capital at the beginning of the year. Q is the market value of assets over the book value of assets at the beginning of the year. Corporate governance is the number of outside directors who currently serve as CEOs of other companies. Size is the natural logarithm of assets at the beginning of the year. Stock ownership is the fraction of company stock owned by the CEO and his immediate family at the beginning of the year. Vested options are the CEO's holdings of options that are exercisable within 6 months of the beginning of the year, as a fraction of common shares outstanding. The predicted *Holder 67* measure is calculated from the probit regression displayed in Table V, Column 2. The residual *Holder 67* measure is the difference between *Holder 67* measure and its predicted value. Coefficients value, significance level and adjusted R^2 are reported.

	Fixed Effects, No Controls		Fixed Effects, Controls		
Explanatory Variable	(1)	(2)	(3)	(4)	(5)
Cash Flow	0.236	0.362	0.016	0.244	-0.004
	[0.000]***	[0.000]***	[0.894]	[0.020]**	[0.975]
Q	0.096	0.096	0.083	0.083	0.082
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
(Q) ∗ (Cash Flow)	-0.062	-0.064	-0.048	-0.053	-0.048
	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Est_Holder 67	-0.028		-0.035		-0.048
	[0.490]		[0.499]		[0.358]
(Est_Holder 67) ∗ (Cash Flow)	0.209		0.309		0.318
	[0.001]***		[0.000]***		[0.000]***
Resid_Holder 67		-0.027		-0.028	-0.031
		[0.127]		[0.118]	[0.092]*
(Resid_Holder 67) ∗ (Cash Flow)		0.001		0.002	0.028
		[0.976]		[0.935]	[0.372]
Stock Ownership			0.193	0.207	0.192
			[0.088]*	[0.052]*	[0.089]*
Vested Options			0.092	-0.012	0.081
			[0.531]	[0.923]	[0.586]
Size			-0.083	-0.083	-0.084
			[0.000]***	[0.000]***	[0.000]***
Corporate Governance			0.005	0.005	0.005
			[0.280]	[0.288]	[0.283]
(Stock Ownership) ∗ (Cash Flow)			-0.032	-0.278	-0.062
			[0.901]	[0.272]	[0.810]
(Vested Options) ∗ (Cash Flow)			-0.500	-0.174	-0.479
			[0.009]***	[0.302]	[0.012]**
(Size) ∗ (Cash Flow)			0.020	0.016	0.022
			[0.093]*	[0.186]	[0.064]*
(Corporate Governance) ∗ (Cash Flow)			-0.025	-0.024	-0.024
			[0.021]**	[0.024]**	[0.024]**
Year-fixed Effects	yes	yes	yes	yes	yes
Firm-fixed Effects	yes	yes	yes	yes	yes
(Year-fixed ffects) ∗ (Cash Flow)	yes	yes	yes	yes	yes
Observations	1525	1525	1525	1525	1525
Adjusted R^2	0.220	0.214	0.252	0.240	0.254

Constant included. *p* value in square brackets.
The symbols *, **, *** denote significance at the 10%, 5% and 1% levels, respectively.

Table AI

Conditional Regression Multiples

This table reports the output from valuation regression for Fama and French 12 industries classification. The model is estimated cross-sectionally at the industry-year level. The subscripts *j* and *t* denote industry and year, respectively. $E_t(\hat{\alpha}_k)$ is the time-series average multiple from the regression associated with the *k*th variable. Fama-Macbeth standard errors are presented below average point estimates. The time-series average R^2 is also reported for each industry. Regressions are run annually for each industry from 1979 to 1994. The regressions use: *m* - the natural log of the market value of assets, *b* - the natural log of the book value of assets, $(ni)^+$ - the natural log of the absolute value of net income, and an indicator interacted with log net income to separately estimate net income for firms with negative net income, and *Lev*- book leverage.

Model $$m_{it} = \alpha_{0jt} + \alpha_{1jt} b_{it} + \alpha_{2jt} ni^{+}{}_{it} + \alpha_{3jt} I_{(<0)} (ni^{+})_{it} + \alpha_{4jt} Lev_{it} + \varepsilon_{it}$$

	Fama and French Industry Classification											
Parameter	1	2	3	4	5	6	7	8	9	10	11	12
$E_t(\hat{\alpha}_0)$	1.02	1.01	1.09	1.30	1.65	1.68	1.46	0.54	1.19	2.02	1.39	1.56
	0.31	*0.38*	*0.30*	*0.39*	*0.31*	*0.24*	*0.48*	*0.14*	*0.30*	*0.30*	*0.21*	*0.23*
$E_t(\hat{\alpha}_1)$	0.91	0.89	0.87	0.85	0.77	0.76	0.90	1.00	0.90	0.74	0.76	0.79
	0.04	*0.07*	*0.05*	*0.07*	*0.09*	*0.06*	*0.08*	*0.05*	*0.06*	*0.10*	*0.06*	*0.06*
$E_t(\hat{\alpha}_2)$	0.09	0.10	0.09	0.09	0.17	0.18	0.03	-0.02	0.07	0.17	0.20	0.12
	0.04	*0.07*	*0.05*	*0.06*	*0.08*	*0.06*	*0.08*	*0.04*	*0.06*	*0.10*	*0.05*	*0.05*
$E_t(\hat{\alpha}_3)$	0.02	0.02	0.02	-0.01	0.02	-0.01	0.19	-0.05	0.02	-0.07	-0.12	-0.01
	0.03	*0.04*	*0.02*	*0.04*	*0.07*	*0.08*	*0.52*	*0.31*	*0.04*	*0.08*	*0.11*	*0.03*
$E_t(\hat{\alpha}_4)$	-1.19	-0.98	-0.97	-0.94	-1.28	-1.42	-1.25	-0.79	-1.23	-1.61	-0.39	-0.97
	0.26	*0.28*	*0.21*	*0.47*	*0.35*	*0.38*	*0.35*	*0.31*	*0.17*	*0.37*	*0.19*	*0.20*
R^2	0.96	0.97	0.96	0.96	0.96	0.92	0.97	0.99	0.95	0.93	0.93	0.92

The Fama-French industries are defined on Kenneth R. French’s website:
http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html