Investor Overconfidence, Firm Value, and Corporate Decisions

Biljana Nikolic and Xuemin (Sterling) Yan*

Abstract

Behavioral theory predicts that investor overconfidence causes overpricing because overconfident investors overestimate the precision of their information and underestimate risk. We test this prediction by using a measure of investor overconfidence derived from the characteristics and holdings of U.S. equity mutual fund managers. We find that firms with more overconfident investors are relatively overvalued based on M/B and two misvaluation measures. The impact of investor overconfidence on firm value is stronger among stocks with greater arbitrage risk. Furthermore, firms with more overconfident investors issue more equity and make more investments. Overall, our findings suggest that investor overconfidence has a significant impact on firm value and corporate decisions.

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* Biljana Nikolic is at School of Business Administration, University of San Diego, San Diego, CA 92110, Phone: 619-260-4294, Email: bnikolic@sandiego.edu. Xuemin (Sterling) Yan is at Robert J. Trulaske, Sr. College of Business, University of Missouri, Columbia, MO 65211, Phone: 573-884-9708, Email: yanx@missouri.edu. We thank Grace Hao, John Howe, Delroy Hunter, Christos Pantzalis, and seminar participants at Monash University, University of Missouri, and University South Florida for helpful comments.

I. Introduction

In this paper we examine the impact of investor overconfidence on firm value and corporate financing and investment decisions. Investor overconfidence has been the subject of much research in the recent finance literature, yet there has been little analysis of its impact on firm value.[1] The lack of research in this area is surprising because firm value is one of the most fundamental concepts in finance and has important implications for market efficiency, capital allocation, and real investment. Moreover, simple behavioral arguments suggest that investor overconfidence directly impact firm value. Intuitively, overconfident investors overestimate the quality of their information and underestimate risk, which causes their demand for risky assets to be irrationally high. In the absence of offsetting arbitrage positions, this irrational demand will lead to overpricing.

We formalize this intuition in a simple model, which is an extension of Grossman and Stigliz (1980) and O'Hara (2003). In our model, the risk-averse informed investors are overconfident in the sense that they perceive their private signal to be more precise than it actually is. By overestimating the precision of their private information, overconfident investors underestimate the variance of the payoff for the risky security. Combined with risk aversion, this underestimation of risk leads to a lower required risk premium and a higher demand for the risky security, thereby pushing its price higher than can be justified by the fundamentals. Therefore, our model predicts that firms with overconfident investors will be overvalued.

It is important to note that the positive impact of investor overconfidence on firm value arises not because investors are systematically optimistic about the prospect of the firm. Overconfident investors receive unbiased information, so they are not systematically optimistic

[1] See, e.g., Odean (1998), Daniel, Hirshleifer, and Subrahmanyam (1998, 2001), Barber and Odean (2000, 2001, 2002), Gervais and Odean (2001), Statman, Thorley, and Vorkink (2006), and Grinblatt and Keloharju (2009).

or pessimistic. Systematic optimism, if it exists, impacts prices through the first moment, i.e., by altering the expected payoff. Overconfidence, on the other hand, impacts prices through the second moment, i.e., by underestimating risk or variance.

To test the prediction of our model, we construct a measure of investor overconfidence using the characteristics and holdings of U.S. equity mutual fund managers. Specifically, we form an overconfidence index by combining six overconfidence proxies suggested in prior literature: manager's gender, management structure, portfolio turnover, portfolio concentration, prior performance, and idiosyncratic risk. We then compute a firm-level overconfidence index (henceforth OCI) as the weighted average overconfidence index of all fund managers who hold the stock.

We focus on overconfidence among mutual fund managers for four reasons. First, the psychology literature suggests that experts (e.g., mutual fund managers) tend to be more overconfident (Heath and Tversky, 1991; Griffin and Tversky, 1992). Second, theoretical work typically models overconfidence as an overestimation of the precision of the private information, and professional investors such as mutual fund managers are more likely to possess private information. Third, mutual funds hold a large and growing fraction of the U.S. stock market, making them more likely to be marginal price setters.[2] Finally, detailed characteristics and holdings data are readily available for mutual funds and their managers.

We begin by testing whether investor overconfidence is associated with overvaluation. In our first set of analyses we use the market-to-book (M/B) ratio as a measure of firm value. Each year we sort our sample firms into quintiles based on their overconfidence scores (i.e., OCI). We then compute the average M/B for each quintile portfolio as well as the difference in

[2] According to the ICI Fact Book (2011) mutual funds held 23% of the U.S. stock market at the end of 2010.

M/B between the two extreme OCI quintiles. Our results show a strong positive relation between investor overconfidence and the M/B ratio. The difference in M/B between high-OCI firms and low-OCI firms is 0.65 (*t*-stat=4.93). This result is economically significant as it implies a difference of $650 million in market value between high- and low-OCI firms that have one billion dollars of total assets. Our results persist after controlling for several previously established determinants of firm value in cross-sectional regressions. Overall, we find strong evidence that firms with more overconfident investors have higher firm value.

Next, we employ two misvaluation measures to provide more direct evidence on the hypothesis that investor overconfidence causes overvaluation. Both misevaluation measures reflect deviations of a firm's market value from its fundamental value. The first measure, proposed by Rhodes-Kropf, Robinson, and Viswanathan (RKRV, 2005), estimates a firm's fundamental value as a function of its book value, net income, and leverage ratio relative to its industry peers. The second measure, proposed by Dong, Hirshleifer, Richardson, and Teoh (DHRT, 2006), derives the fundamental value from the residual income model of Ohlson (1995). A number of studies including RKRV (2005), DHRT (2006), Hertzel and Li (2010), and Dong et al. (2012) have used these two misvaluation measures and present strong evidence that they proxy for mispricing.

Consistent with our results for the M/B ratio, we find strong evidence that firms with more overconfident investors are more overvalued based on the RKRV misvaluation measure and the DHRT misvaluation measure. Both measures increase monotonically across OCI portfolios. Moreover, the difference between high-OCI firms and low-OCI firms is economically and statistically significant at 0.38 (*t*-stat=7.68) for the RKRV measure and 0.12 (*t*-stat=3.05) for the DHRT measure. Overall, our results based on the two misvaluation measures are consistent with the prediction that investor overconfidence causes overvaluation.

The above findings raise a natural question of why the mispricing associated with investor overconfidence is not arbitraged away by professional arbitrageurs. Behavioral theory and the limits-to-arbitrage argument (Shleifer and Vishny, 1997 and Pontiff, 2006) suggest that mispricing can persist if arbitrage is costly and risky. Following numerous previous studies, we measure arbitrage risk by using the idiosyncratic volatility of stock returns (IVOL). If the positive relation between investor overconfidence and firm value reflects mispricing, we expect this relation to be more pronounced among firms with greater IVOL. Our evidence is consistent with this prediction, i.e., the effects of OCI on M/B, RKRV, and DHRT are the strongest among high-IVOL stocks.

A potential alternative explanation for our results is that overconfident investors do not impact firm value directly, but rather they prefer firms with certain characteristics that are correlated with firm value. For example, overconfident investors may be attracted to firms with greater information uncertainty (DHS, 1998). To the extent that firms with more uncertain prospects tend to have higher market valuations (Pastor and Veronesi, 2003), it might explain the positive relation between investor overconfidence and firm value. We address this concern in two ways. First, we control for total mutual fund ownership in our cross-sectional regressions. If the positive relation between investor overconfidence and firm value is driven solely by investor preference for certain firm characteristics, we would expect the coefficient on OCI to become insignificant after controlling for mutual fund ownership. We show that this is not the case. Second, we control for numerous proxies for information uncertainty including firm age, cash flow volatility, idiosyncratic volatility, dispersion of analyst forecasts, and residual analyst coverage. Our results are robust to these additional controls. Taken together, these additional tests show that our findings are unlikely to be driven by reverse causality.

Recent studies suggest that corporate managers exploit stock-market mispricing in making financing and investment decisions (see Baker and Wurgler, 2002; Baker et al., 2003; Gilchrist, Himmelberg, and Huberman, 2005; Dong et al., 2006; Polk and Sapienza, 2009; Dong et al., 2012). To the extent that investor overconfidence impacts firm value, we expect it to also affect corporate financing and real investment. Consistent with this expectation, we find that high-OCI firms issue significantly more equity than low-OCI firms do. Moreover, we find that high-OCI firms invest considerably more than low-OCI firms do. Our results hold in univariate portfolios as well as in multiple regressions. Our findings on corporate investment are particularly important. As Baker and Wurgler (2012, p.22) state: "It is one thing to say that investor irrationality has an impact on capital market prices, or even financing policy, which leads to transfer of wealth among investors. It is another to say that mispricing leads to underinvestment, overinvestment or the general misallocation of capital and deadweight losses for the economy as a whole." Our results suggest that investor confidence not only impacts asset prices, but also alters real investment.

Our paper adds significantly to the literature on investor overconfidence. Prior studies have focused on the impact of investor overconfidence on trading volume, investment performance, and market anomalies (Barber and Odean, 2000, 2001, 2002; Daniel, Hirshleifer, and Subrahmanyam, 1998, 2001; Statman, Thorley, and Vorkink 2006; Grinblatt and Keloharju, 2009). Our paper is the first to examine the impact of investor overconfidence on firm value. Consistent with the hypothesis that investor overconfidence causes overvaluation, we find a positive relation between overconfidence and firm value as well as two overvaluation measures.

We also show that firms with more overconfident investors issue more equity and make more investments, consistent with corporate managers exploiting market misvaluation in making financing and investment decisions.

Behavioral finance rests on two building blocks (see, e.g., Shleifer and Vishny, 1997 and Baker and Wurgler, 2012). The first is that some investors are not fully rational and their demand for risky assets is affected by beliefs that are not justified by fundamentals. Moreover, if such demand is correlated across investors, it may push prices away from fundamental values. The second building block of behavioral finance is that rational investors are limited in their ability to arbitrage away mispricing. We provide evidence on both building blocks in this paper. We identify an important source of irrational demand due to investor overconfidence and show that such demand influences prices. We also demonstrate that the relation between investor overconfidence and firm value is stronger among stocks with greater idiosyncratic risk – consistent with the limits-to-arbitrage argument.

One of the great challenges to any empirical study of investor overconfidence is to come up with a good proxy for overconfidence. We contribute to the literature by constructing a novel measure of investor overconfidence using the characteristics and holdings of U.S. equity mutual fund managers. Ideally, we would like to measure the level of overconfidence across all investors including individual investors. However, overconfidence is a characteristic of people, not of market (Odean 1998), and investor-level characteristics are generally not available for other classes of investors on a broad scale. In a way, our paper is analogous to several recent studies using mutual fund data to investigate market-wide phenomena. Chen, Hong, and Stein (2002) investigate the relation between breadth of ownership and subsequent stock returns, and they measure breadth of ownership by using the number of mutual funds holding a stock. Frazzini

(2006) analyzes the relation between disposition effect and post earnings announcement drift. He constructs a measure of capital gain by using the historical purchase prices of equity mutual funds.

Our paper also contributes to the growing literature that examines the impact of market mispricing on corporate decisions. Earlier studies use aggregate data and find that the "irrational" component of the stock valuation does not affect real investment (e.g., Morck, Shleifer, and Vishny, 1990). More recent studies including Baker and Wurgler (2002), Ang and Cheng (2005) Gilchrist et al. (2005), Dong et al. (2006), Polk and Sapienza (2009), and Dong et al. (2012) show that market mispricing influences not only corporate investment decisions but also capital structure and merger and acquisition decisions. Our findings are more consistent with recent studies and suggest that investor overconfidence has a significant impact on equity financing and real investment.

Finally, our paper is related to a large and established literature that examines the relation between information and firm value. In a seminal paper, Merton (1987) considers a market with incomplete information, and shows that in equilibrium the firm value increases with investors' awareness and the size of investor base. More recently Easley and O'Hara (2004) consider a market with complete but asymmetric information, and show that, holding the total amount of information constant, the firm value decreases in the proportion of private information. While the existing literature emphasizes the amount and composition of information, we study how the way in which investors process information impacts firm value.

The remainder of the paper is organized as follows. In Section II we present a simple model. In Section III we describe our data, sample, and measures. In Section IV we report and discuss empirical results. Section V concludes.

II. Model

In this section we present a simple model to analyze the effect of investor overconfidence on security prices. The model is an extension of O'Hara (2003). The setup of our model is as follows. There are two periods. In the first period traders choose their portfolios and in the second period assets in the portfolio pay off. There are two assets: a risk-free bond yielding a gross return of R and a risky asset, whose terminal value is $\tilde{v} \sim N(m, 1/\rho)$. The per capita supply of bond is fixed $\bar{b}$, while the per capita supply of the risky asset is random $\tilde{x} \sim N(\bar{x}, 1/\eta)$. There are two signals about the future payoff of the risky asset, $s_i \sim N(v, 1/\gamma)$ where i=1 or 2. All traders observe the public signal s_2. Only a fraction μ of the traders (i.e., the informed traders) observe the private signal s_1. Those who do not observe the private signal are uninformed. All random variables in our model are independently normally distributed and their distributions are common knowledge.

We follow prior studies (e.g., Odean (1998) and DHS (1998, 2001)) and assume that the informed traders are overconfident. More specifically, we assume that informed traders mistakenly believe the precision of their private signal to be $\gamma + k$, where $k > 0$.

All traders have CARA preferences with a coefficient of risk aversion $\delta > 0$ and initial wealth of $\bar{\psi}^j$. The traders choose their demands for bond b and for risky asset x to maximize their expected utility subject to the budget constraint: $\bar{\psi}^j = b^j + px^j$. The trader j's terminal wealth is $\widetilde{\omega}^j = b^j R + \tilde{v} x^j$. Solving for the trader's optimal demand for the risky asset yields:

$$x^I = \frac{\widetilde{v}^I - pR}{\delta(\rho^I)^{-1}} \quad \text{and} \quad x^U = \frac{\widetilde{v}^U - pR}{\delta(\rho^U)^{-1}} \tag{1}$$

Where superscript I stands for informed traders and U stands for uninformed traders. Each trader's demand for the risky asset will depend on his beliefs about the asset's risk and return.

Because informed and uninformed traders possess different information about the risky asset and they process information differently, they will form different beliefs. Consider first the beliefs of informed traders. Using Bayes' rule it is easy to show that their beliefs are normal, with mean and precision given by:

$$\tilde{v}^I = \frac{m\rho + s_1(\gamma + k) + s_2\gamma}{\rho + \gamma + k + \gamma} \quad \text{and} \quad \rho^I = \rho + \gamma + k + \gamma. \tag{2}$$

Although uninformed traders do not observe s_1, they know its distribution and they rationally infer how it will affect the demand of the informed traders and the equilibrium price. Hence they conjecture a price function $p = am + bs_1 + cs_2 - dx + e\bar{x}$, where a, b, c, d, and e are parameters determined in the equilibrium. To find the beliefs of uninformed investors it is convenient to define an observable random variable:

$$\Theta = \frac{p - am - cs_2 + \bar{x}(d - e)}{b} = s_1 - \frac{d}{b}(x - \bar{x}). \tag{3}$$

Calculations show that $\Theta \sim N(v, \rho_\Theta)$, where

$$\rho_\Theta = \left[\gamma^{-1} + \left(\frac{d}{b}\right)^2 \eta^{-1}\right]^{-1}. \tag{4}$$

Therefore the beliefs of uninformed investors about the risky asset are normally distributed with mean and precision given by:

$$v^U = \frac{m\rho + \Theta\rho_\Theta + s_2\gamma}{\rho + \rho_\Theta + \gamma} \quad \text{and} \quad \rho^U = \rho + \rho_\Theta + \gamma. \tag{5}$$

In equilibrium per-capita supply must equal per-capita demand, or:

$$\mu\left(\frac{m\rho + s_1(\gamma+k) + s_2\gamma - pR(\rho+\gamma+k)}{\delta}\right) + (1-\mu)\left(\frac{m\rho + \Theta\rho_\Theta + s_2\gamma - pR(\rho+\rho_\Theta)}{\delta}\right) = \tilde{x} \quad (6)$$

We find equilibrium price by solving the above equation and verifying that the price is of the form conjectured by uninformed traders. Proposition 1 characterizes this equilibrium.

PROPOSITION 1: *There exists a partially revealing equilibrium in which*

$$p = am + bs_1 + cs_2 - dx + e\bar{x}, \quad (7)$$

where

$$a = \frac{\rho}{R[\rho+\gamma+\mu(\gamma+k)+(1-\mu)\rho_\Theta]}, \qquad b = \frac{[\mu(\gamma+k)+(1-\mu)\rho_\Theta]}{R[\rho+\gamma+\mu(\gamma+k)+(1-\mu)\rho_\Theta]},$$

$$c = \frac{\gamma}{R[\rho+\gamma+\mu(\gamma+k)+(1-\mu)\rho_\Theta]}, \qquad d = \frac{\left[\delta + \frac{(1-\mu)\rho_\Theta\delta}{\mu(\gamma+k)}\right]}{R[\rho+\gamma+\mu(\gamma+k)+(1-\mu)\rho_\Theta]},$$

$$\text{and } e = \frac{\frac{(1-\mu)\rho_\Theta\delta}{\mu(\gamma+k)}}{R[\rho+\gamma+\mu(\gamma+k)+(1-\mu)\rho_\Theta]},$$

where $\rho_\Theta = \left[\gamma^{-1} + \left(\frac{\delta}{\mu(\gamma+k)}\right)^2 \eta^{-1}\right]^{-1}$.

Proof: See Appendix A.

The proposition shows that there exists a partially revealing equilibrium, in which the equilibrium price reflects a multitude of factors relating to information, risk, asset fundamentals, and degree of investor overconfidence.

PROPOSITION 2: *The expected price-to-fundamental ratio E(p/m) is increasing in investor overconfidence:*

$$\frac{dE\left(\frac{p}{m}\right)}{dk} > 0. \quad (8)$$

Proof: See Appendix A.

Proposition 2 states that everything else equal, the more overconfident the informed traders are, the more overvalued the risky asset will be relative to fundamentals.

COROLLARY: *The risky asset is on average overpriced when k>0.*

$$E(p_{(k>0)}) > E(p_{(k=0)}) \quad (9)$$

Proof: See Appendix A.

The above corollary states that relative to the benchmark case in which all investors are rational, the risky asset is on average overpriced when informed investors are overconfident. We note that the informed traders receive unbiased information, so this overpricing does not originate from biased beliefs about the first moment. Rather, the overpricing results from biased beliefs about the second moment. That is, underestimation of risk inflates the informed traders' demand for the risky asset and drives up its price.

Our model is closely related to DHS (1998, 2001), who also examine the implications of investor overconfidence for financial markets. Although DHS (2001) derive price and return equations when investors are overconfident, they do not emphasize the impact of investor overconfidence on market prices and expected returns per se. Rather, the focus of DHS (2001) is to examine whether investor overconfidence can explain cross-sectional return anomalies such as the book-to-market effect. DHS (1998) show that overconfident investors under-react to public information and overreact to private information. Thus, investor overconfidence may push prices away from fundamental values; however, the direction of this divergence depends on the nature of the information (i.e., good or bad). In contrast, we are the first to examine the unconditional impact of investor overconfidence on prices.

III. Data, Sample, and Measures

A. Data and Sample

We combine data from several sources. We obtain stock returns, SIC code, trading volume, share price, and shares outstanding from CRSP. We restrict our sample to only common stocks (CRSP share code of 10 or 11) and remove financial firms (SIC code between 6000 and 6999). We obtain book value of equity, total assets, R&D expense, operating income after depreciation, dividends, and long-term debt from COMPUSTAT annual file. We exclude those firms with negative book value of equity. We obtain consensus analyst earnings per share (EPS) forecasts and long-term earnings growth rate (LTG) from I/B/E/S.

We obtain monthly fund returns, monthly total net assets, portfolio turnover, and investment objectives from CRSP Survivorship Bias Free Mutual Fund Database (CRSP MFDB).[3] We obtain fund holdings are from Thomson Financial (TFN). Fund manager names and beginning and ending dates are from Morningstar Direct database. We restrict our mutual fund sample to U.S. equity funds, for which holdings data are the most complete and reliable. To select equity funds, we follow the investment objective selection criteria from Kacperczyk et al. (2008). In addition, we use fund name and character strings from Gil-Bazo and Ruiz-Verdu (2009) to identify and exclude index funds. We exclude stocks not held by any of our sample

[3] We aggregate all share classes of the same fund because all share classes of a fund are backed by the same portfolio of assets and have the same portfolio manager.

fund. Our sample period is 1988 to 2010, which reflects the data availability when we started working on this project.

B. Investor overconfidence

A key challenge for any study of investor overconfidence is to come up with a good measure of overconfidence. Prior literature has suggested a number of proxies for overconfidence, which fall into two broad categories. The first category includes personal characteristics that the psychology literature has found to be related to overconfidence, such as gender (Barber and Odean, 2001). The second category relies on the behaviors of overconfident investors derived from theoretical models. For instance, Odean (1998) and others show that overconfident investors trade more actively, hold larger positions in risky assets, hold more concentrated portfolios, and take greater risk than do rational investors. These findings suggest that portfolio turnover, portfolio concentration, and portfolio idiosyncratic risk are all positively related to overconfidence. Further, DHS (1998) and Gervais and Odean (2001) show that self-attribution bias leads to (increased) overconfidence as investors attribute good outcomes to their own ability and poor outcomes to external factors, suggesting that prior performance can be a proxy for overconfidence.[4] In addition, because self-attribution bias is more pronounced among solo managers than among managers who work in teams, management structure should also be related to overconfidence. To reduce noise and maximize power, we combine the above measures into a composite overconfidence index. Specifically, our index contains the following six components: manager's gender, management structure, portfolio turnover, portfolio concentration, prior portfolio performance, and portfolio idiosyncratic risk.

[4] Prior literature suggests that past success makes both analysts (Hilary and Menzley, 2006) and CEOs (Billett and Qian, 2008; Libby and Rennekamp, 2012) overconfident about future performance.

Gender is an indicator variable which equals one for funds with a solo, male manager and zero otherwise. We determine a manager's gender by matching the manager's first name to several name lists and databases.[5] If a manager's first name can be male or female, we use various sources including the fund company's website and fund prospectus to determine the manager's gender. Management structure is an indicator variable which equals one if a fund is managed by solo manager and zero otherwise. We measure portfolio concentration by using the Herfindahl (1950) concentration index which is the sum of the squared portfolio weights across all stocks in the portfolio. Prior performance is measured as prior 36-month four-factor alpha of the fund. We define portfolio idiosyncratic risk as a standard deviation of four-factor model residuals measured over past 36 months.

Each quarter, we rank fund managers in each investment objective into percentiles based on each of the four characteristics that are not indicator variables. For example, when ranking managers on turnover, the bottom one percent of the managers with the lowest turnover is assigned a score of 0.01. Similarly, the top one percent of the managers with the highest turnover is assigned a score of 1. Indicator variables including gender and management structure, remain zero/one. We then sum the scores on the six components to obtain the overconfidence index for the fund manager. The index can take on values between 0 and 6 with higher index values corresponding to a higher degree of overconfidence. This index approach has several distinct advantages: it is parsimonious, it reduces the noise associated with individual proxies, and it allows us to capture multiple dimensions of overconfidence. To transform manager level overconfidence index to a firm level overconfidence index (henceforth OCI) we compute weighted average overconfidence index of fund managers who hold the stock.

[5] The sources include popular names list published by United States Social Security Administration for years 1980 to 2009, www.babynameguide.com, and babynamesworld.parentsconnect.com.

C. Firm Value and Misvaluation Measures

C.1. Market-to-Book

We measure firm value using the market-to-book ratio (M/B).[6] Following Gompers et al. (2003), we compute M/B as the market value of equity (price times shares outstanding from CRSP) plus assets minus the book value of equity (CEQ+TXDB from COMPUSTAT) over total assets (TA).

C.2. RKRV Measure

In order to provide more direct evidence that investor overconfidence causes overvaluation, we also construct two measures of misvaluation. We follow Rhodes-Kropf, Robinson, and Viswanathan (RKRV 2005) and construct a misvaluation measure by decomposing market-to-book ratios as follows.

$$m - b \equiv (m - v) + (v - b) \qquad (10)$$

Where m is the log market value, b is the log book value, and v is the log fundamental value. RKRV (2005) use three different models to estimate v. The models differ only with respect to the accounting variables included in the regression. To conserve space, we focus on RKRV's third model (the most comprehensive model), which includes book value, net income, and leverage.

$$m_{it} = \alpha_{jt} + \beta_{1jt} b_{it} + \beta_{2jt} ln(NI)^{+}_{it} + \beta_{3jt} I_{(<0)} ln(NI)^{+}_{it} + \beta_{4jt} LEV_{it} + \varepsilon_{it} \qquad (11)$$

[6] Market-to-book ratio or Tobin's Q are the most commonly used measures of firm value. See, e.g., Morck, Shleifer, and Vishny (1988), Yermack (1996), Baker and Wurgler (2002), Gompers, Ishii, and Metrick (2003), Dong et al. (2006), and DeAngelo, DeAngelo, and Stulz (2010).

We estimate the above regression model each year for each industry. The RKRV misvaluation measure is the residual in the above regression, termed as "firm-specific error" by RKRV (2005). Essentially, the RKRV measures firm-specific deviations from valuations implied by industry accounting multiples. A number of studies including RKRV (2005), Doukas, Kim, and Pantzalis (2008), and Hertzel and Li (2010) have used this measure and present strong evidence that it proxies for mispricing. Hertzel and Li (2010), for example, show that SEO firms with high level of growth options tend to invest in real assets, whereas those with greater RKRV overvaluation measure tend to pay down debt or stockpile cash.

C.3. DHRT Measure

We follow Dong, Hirshleifer, Richardson, and Teoh (DHRT 2006) and construct our second misvaluation measure based on the residual income model. Specifically, we use the model of Ohlson (1995) to obtain a forward-looking measure of fundamental value (V). We then scale V by the market price (P) and multiply by negative one to arrive at our misvaluation measure. We multiply V/P by negative one so that larger (less negative) numbers correspond to higher valuation. For brevity, we refer the reader to Appendix B for details regarding the construction of V/P. Previous studies have used V/P to predict future abnormal returns (Lee, Myers, and Swaminathan, 1999), investigate takeover decisions (DHRT, 2006), and examine firms' financing decisions (Dong, et al., 2012). These studies provide strong evidence that V/P proxies for mispricing.

We recognize that fundamental values are not observable, so mispricing is difficult to measure. Although neither of the two misvaluation measures is perfect, they are both widely used in the literature and have a significant advantage over traditional valuation measures such as the market-to-book ratio (M/B). For example, V/P uses a forward-looking measure of fundamental value that filters out the confounding effects of future growth opportunities, while the RKRV measure uses broader set of variables to estimate fundamental value. Furthermore, we use two alternative mispricing measures, one based on relative valuation and the other based on absolute valuation, to ensure that our results are not driven by the choice of any specific valuation model.

IV. Empirical Results

A. Descriptive Statistics

In Table I we present descriptive statistics for our sample firms. Panel A reports the time series average of the cross sectional means, medians, 25th percentiles, 75th percentiles, and standard deviations for each firm characteristic from 1988 to 2010. These characteristics include the overconfidence index, market-to-book ratio, the RKRV and DHRT misvaluation measures, market capitalization, total assets, firm age, return on assets, R&D, idiosyncratic volatility, cash flow volatility, analyst coverage, and dispersion of analyst earnings forecasts.[7]

The average MKTCAP is $2.20 billion and the average AGE is 16.14 years, so our sample is tilted towards larger and older firms. This is not surprising given our extensive COMPUSTAT and I/B/E/S data requirements. The average M/B ratio is 1.93, which is consistent with recent studies. For example, Villalonga and Amit (2006) report an average M/B ratio of 2.03 for all firms in their sample and 1.95 for non-family firms. The average RKRV is close to zero because, by construction, RKRV captures the extent of overvaluation relative to industry peers. The average DHRT is negative because we multiply *V/P* by negative one. Our sample firms have an average ROA of 5.05%, which is somewhat lower than the long term average ROA in the U.S

[7] For brevity, we refer the reader to Appendix C for details of variable definitions and construction.

(Gebhardt, Lee, and Swaminathan, 2001), but consistent with declining profitability in recent periods (Irvine and Pontiff, 2009). Finally, the average OCI for our sample firms is 2.51.

In Panel B we report the time-series average of cross-sectional correlations between the above variables. The M/B is positively correlated with the RKRV misvaluation measure. This is not surprising because RKRV is derived from a decomposition of M/B. The two misvaluation measures have a modest positive correlation with each other, suggesting that they potentially capture different dimensions of overvaluation. The OCI is positively correlated with M/B, RKRV, and DHRT. These correlations are statistically significant and constitute initial evidence that investor overconfidence is associated with overvaluation. Several other correlations are also noteworthy. ASSETS, MKTCAP, and AGE are significantly positively correlated with each other. Cash flow volatility is positively correlated with idiosyncratic return volatility and R&D, but negatively correlated with ROA.

B. Investor Overconfidence and Firm Value

Our model predicts that firms with more overconfident investors will have higher market values than firms with less overconfident investors. We first test this prediction using a portfolio approach. In June of each year we sort all sample firms into quintiles based on their most recent OCI. We then compute equal-weighted M/B for each quintile. We also compute the difference in M/B between the two extreme OCI quintiles.

The results are reported in Panel A of Table II. The M/B ratio increases monotonically across OCI portfolios from 1.58 for low-OCI quintile to 2.23 for high-OCI quintile. The difference in M/B between high- and low-OCI portfolios is highly economically and statistically significant at 0.65 (t=4.93). This difference implies that a high-OCI firm with total assets of $1 billion would have a market value that is approximately $650 million higher than the market value of a low-OCI firm with the same amount of total assets. Overall, our univariate analysis indicates a strong positive relation between investor overconfidence and firm value, supporting the prediction of our model.

Prior literature has identified several firm characteristics that are related to firm value such as firm age, R&D, ROA, and S&P 500 index membership (Yermack, 1996; Gompers et al., 2003; Villalonga and Amit, 2006). To investigate whether our univariate results are driven by systematic differences in these firm characteristics between high- and low-OCI firms, we estimate the following cross-sectional regression each year:

$$M/B_{i,t} = \beta_0 + \beta_1 OCI^{RANK}{}_{i,t-1} + \gamma Controls_{i,t-1} + e_{i.t} \quad (12)$$

OCI^{RANK} for each firm is the quintile rank of its most recent OCI.[8] The vector of control variables includes ASSETS, AGE, ROA, R&D, S&P500, and Delaware. To reduce the impact of outliers, we winsorize AGE, ROA, and R&D at the 1st and 99th percentile. Following Fama and MacBeth (1973) we report the average coefficients across years and compute *t*-statistics based on the time-series variation in yearly coefficients along with an adjustment for heteroskedasticity and autocorrelation (Newey and West, 1987).

Panel B of Table II reports the results. In Model 1, which includes OCI as the independent variable, we find that the coefficient on OCI is positive and statistically significant at 0.17 (*t*-stat=4.52). This result implies that firms in the highest OCI quintile have M/B ratios that are 0.68 higher than those of firms in the lowest OCI quintile, consistent with the result from the portfolio analysis. In Models 2 and 3, we include OCI as well as control variables. The

[8] We find qualitatively similar results when we use raw OCI instead of OCI^{RANK}.

coefficients on all control variables are statistically significant and consistent with prior literature. Specifically, we find that M/B is negatively related to total assets and firm age, and is positively related to Delaware, S&P 500 index membership, R&D, and ROA. More importantly, the coefficient on OCI remains economically and statistically significant, ranging from 0.17 (*t*-stat=4.96) to 0.19 (*t*-stat=5.04). These results imply that even after controlling for other known determinants of firm value, firms in the highest OCI quintile have M/B ratios that are between 0.68 and 0.76 higher than those of firms in the lowest OCI quintile. In economic terms, for a firm with total assets of $1 billion, this difference in M/B ratio translates into a difference in market value of between $680 million and $760 million.

Overall, the portfolio and regression results show strong evidence that M/B is positively associated with OCI. Firms with the most overconfident investors have market values that are over 40% higher than market values of firms with the least overconfident investors.[9] We interpret this finding as consistent with the hypothesis that investor overconfidence causes overvaluation.

C. Investor Overconfidence and Misvaluation

To provide more direct evidence that investor overconfidence causes overvaluation, in this section we examine the relation between investor overconfidence and two measures of misvaluation, i.e. the RKRV misvaluation measure and the DHRT misvaluation measure. If investor overconfidence indeed causes overvaluation, we expect both RKRV and DHRT to be positively related to the level of overconfidence.

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[9] The average M/B ratio for low OCI quintile is 1.58. The difference in M/B ratio between high- and low-OCI quintiles suggested by the regression coefficients is between 0.64 and 0.72. The percentage difference in market values then is between (0.68/1.58 =) 43% and (0.76/1.58 =) 48%.

Table III reports the average RKRV and DHRT for portfolios sorted on OCI. Focusing first on the RKRV measure, we find that the average RKRV increases from -0.19 for low-OCI firms to 0.19 for high-OCI firms. The difference in the average RKRV measure between high- and low-OCI firms is 0.38 (*t*-stat=7.68), which is both economically and statistically significant. We find similar results using the DHRT measure. The average DHRT increases monotonically from -0.77 for low-OCI firms to -0.65 for high-OCI firms. The difference in the average DHRT measure between high- and low-OCI firms is 0.12 (*t*-stat=3.05). Overall, we find significant evidence that investor overconfidence is positively related to our misvaluation measures. To the extent that RKRV and DHRT capture mispricing, our results provide strong support for the prediction that firms with more overconfident investors are relatively more overvalued.

D. Limits to Arbitrage

We interpret our findings as suggesting that investor overconfidence causes overpricing. Such an interpretation raises a natural question as to why mispricing is not arbitraged away. Prior literature suggests that mispricing may persist if arbitrage risk and costs prevent rational arbitrageurs from fully offsetting the price impact of irrational investors. In particular, Shleifer and Vishny (1997) and Pontiff (2006) argue that idiosyncratic risk impedes arbitrage. Thus, to the extent that the positive relation between investor overconfidence and firm value reflects mispricing, we should find this relation to be more pronounced among firms with greater idiosyncratic risk.

We follow prior studies (e.g., Wurgler and Zhuravskaya (2002)) and estimate a firm's idiosyncratic volatility by regressing daily stock returns on market returns and lagged market returns over each month.

$$r_{i,t} = \alpha_i + \beta_{1,i} r_{m,t} + \beta_{2,i} r_{m,t-1} + e_{i,t} \tag{13}$$

We include lagged market returns to account for the effects of possible non-synchronous trading (Dimson (1979)). We require a minimum of 10 daily observations for each month. We define idiosyncratic volatility (IVOL) as the standard deviation of regression residual and then average IVOL over the past twelve months.

In Table IV we examine the strength of the investor overconfidence–firm value relation across idiosyncratic volatility portfolios. We sort all firms independently into quintile portfolios based on IVOL and OCI. We then calculate average firm value or misvaluation measures for each portfolio. Finally, for each IVOL quintile, we compute the difference between high-OCI firms and low-OCI firms.

Consistent with the limits-to-arbitrage story, we find that the impact of investor overconfidence on overvaluation is stronger among high-IVOL firms than among low-IVOL firms. Looking at the M/B ratio, we find that the difference between high- and low-OCI firms increases from 0.15 for low-IVOL stocks to 0.68 for high-IVOL stocks. More importantly, the difference between these two differences is highly significant 0.53 (t-stat=4.87). Similarly, looking at the RKRV misvaluation measure, we find that the difference between high- and low-OCI firms is increasing in idiosyncratic volatility (from 0.14 to 0.45), with a difference between high- and low-IVOL portfolios of 0.31 (t-stat=6.03). The results are qualitatively similar when using at the DHRT measure; high-OCI firms are significantly more overvalued than low-OCI firms only for the high-idiosyncratic volatility quintile and not for the low-idiosyncratic volatility quintile. Overall, the evidence on the effect of limits to arbitrage supports the mispricing story and suggests that firms with more overconfident investors are more overvalued.

E. Information Uncertainty

A potential alternative explanation for our findings is that overconfident investors do not impact firm value directly, but rather they prefer firms with certain characteristics that are correlated with firm value. For example, overconfident investors may be attracted to firms with greater information uncertainty (DHS, 1998). To the extent that firms with more uncertain prospects tend to have higher market valuations (Pastor and Veronesi, 2003), a preference for information uncertainty by overconfident investors might explain our results.

We address this concern in two ways. First, we expand our regression specification to include a comprehensive set of control variables that proxy for information uncertainty, i.e., cash flow volatility, idiosyncratic volatility, dispersion of analyst earnings forecasts, and residual analyst coverage. This set of control variables is in addition to total assets and firm age, two variables widely considered proxies for information uncertainty that we already control for in earlier regressions. Second, we include mutual fund ownership to control for the overall preferences of mutual fund managers. If the positive relation between investor overconfidence and firm value is driven solely by investor preference for certain firm characteristics, we should expect the coefficient on OCI to become insignificant after controlling for mutual fund ownership.

Table V reports the results. The dependent variables are the market-to-book ratio, the RKRV misvaluation measure, and the DHRT misvaluation measure. In the first three columns, we control for several additional proxies for information uncertainty. Overall, after controlling for these additional proxies for information uncertainty, we continue to find strong evidence that investor overconfidence is positively related to overvaluation. The coefficient on OCI^{RANK} is positive and statistically significant in each regression. In the last three columns, we also include total mutual fund ownership in the regression. While we find that mutual fund ownership is positively related to the two misvaluation measures, controlling for mutual fund ownership does not alter our basic finding that investor overconfidence is positively related to overpricing. The coefficient on OCI^{RANK} remains positive and statistically significant in each regression. Overall, the evidence in Table V suggests that our main findings are unlikely to be driven by reverse causality.

F. Does Investor Overconfidence Impact Stock Issuance and Corporate Investment?

In our final set of analyses we examine whether the impact of overconfidence on firm value has implications for corporate decisions. In particular, recent literature suggests that corporate managers exploit stock-market mispricing in their financing and investment decisions (e.g., Baker and Wurgler, 2002; Baker et al., 2003; Gilchrist et al., 2005; Polk and Sapienza, 2009). Specifically, firms tend to issue more equity and invest more when their stocks are overvalued and tend to repurchase equity and reduce investment when their stocks are undervalued. To the extent that investor overconfidence causes mispricing, we expect it to also affect corporate financing and real investment.

F.1. Equity Financing

We first focus on equity financing. We expect that firms with more overconfident investors have higher levels of stock issuance than firms with less overconfident investors. We consider two measures of equity financing, the net stock issues (Fama and French, 2008) and external equity issues (Baker et al., 2003). Net stock issues (*NS*) is the natural log of the ratio of the split-adjusted shares outstanding at the fiscal year end in *t* divided by the split adjusted shares outstanding at the fiscal year end in *t-1*, computed using COMPUSTAT data. External equity issues (*EI*) is change in book equity minus change in retained earnings scaled by total assets.

Each year we sort firms into quintiles based on their most recent OCI. We then compute equal-weighted average measures of equity financing for each OCI quintile. Results in Panel A of Table VI indicate that the average *NS* is 3.01% of shares outstanding for low-OCI firms and is 3.98% of shares outstanding for high-OCI firms. The difference in *NS* between high- and low-OCI firms is economically and statistically significant 0.97% (t=3.06). Similarly, the average *EI* increases from 5.68% for low-OCI firms to 7.77% for high-OCI firms, producing a statistically and economically significant difference of 2.09% (t=2.32).

Prior studies have identified several determinants of external equity financing such as M/B and prior returns. To investigate whether our results are robust to these control variables, we follow DeAngelo et al. (2010) and Dong et al. (2012) and estimate the following regressions each year:

$$Equity\ Financing_{i,t} = \beta_0 + \beta_1 OCI^{RANK}{}_{i,t-1} + \beta_2 M/B_{i,t-1} + \beta_3 CF_{i,t-1} + \beta_4 AGE_{i,t-1} + \beta_5 LEV_{i,t-1} + \beta_6 ROA_{i,t-1} + \beta_7 RET_{i,t-12,t-1} + e_{i.t} \quad (14)$$

where *Equity Financing* is either *NS* or *EI*. OCI^{RANK} is the quintile rank of a firm's most recent OCI. M/B is market-to-book ratio. CF is cash flow. AGE is firm age. LEV is leverage. ROA is return on assets. $RET_{t-12,t-1}$ is past twelve month return. To reduce the impact of outliers, we winsorize all control variables except OCI and RET at the 1^{st} and 99^{th} percentile. Following Fama and MacBeth (1973) we average the coefficients across years and compute t-statistics using the time-series standard deviation of estimated annual coefficients.

Panel B of Table VI presents the results. If the impact of OCI on equity financing is entirely due to its impact on M/B, then we would expect the coefficient on OCI to become insignificant once we control for M/B. However, if OCI provides incremental information about the extent of overvaluation that is not captured in M/B, then we would expect the coefficient on OCI to remain significantly positive. In order to fully explore whether the impact of OCI on equity financing is independent of or subsumed by the impact of M/B, we estimate three separate regressions; the first regression includes OCI, the second includes M/B, and the third includes both OCI and M/B. Because we use two equity financing variables we estimate a total of six regressions.

We find that equity financing is negatively related to cash flow, firm age, and ROA, and positively related to M/B, leverage, and past stock returns. These results are consistent with those reported in prior studies. After controlling for M/B ratio and other determinants of stock issuance, investor overconfidence still exerts a positive impact on *NS*. The coefficient on OCI remains positive and statistically significant. This finding suggests that investor overconfidence has a positive impact on *NS* that is incremental to other control variables, particularly M/B and past stock returns. However, the impact of overconfidence on *EI* appears to go through M/B ratio. The coefficient on OCI^{RANK} is positive and statistically significant when controlling for everything except M/B, but becomes insignificant after controlling for M/B ratio. Overall, these results are consistent with the idea that investor overconfidence causes mispricing, and that corporate managers exploit market mispricing when making financing decisions.

F.2. Corporate Investment

We next turn to the impact of investor overconfidence on corporate investment. To the extent that investor overconfidence causes overpricing and that market mispricing affects real investment (Gilchrist et al., 2005 and Polk and Sapienza, 2009), we expect that firms with more overconfident investors experience higher levels of corporate investment than firms with less overconfident investors. We consider two measures of corporate investment. The capital investment (*CI*) is defined following Baker et al. (2003) as a ratio of the capital expenditure to total assets. Asset growth rate (*AG*) is defined following Cooper, Gulen, and Schill (2008) as the year-on-year percentage change in total assets.

Our portfolio results are presented in Panel A of Table VII. The average *CI* increases from 6.32% for low-OCI firms to 7.55% for high-OCI firms. The results suggest that high-OCI firms' capital expenditure as a percentage of total assets is on average 1.23% (*t*-stat=5.96) higher than that of low-OCI firms. The results for the asset growth rate are similar. The average *AG* increases monotonically from 9.24% for low-OCI firms to 15.29% for high-OCI firms. The difference in *AG* between high- and low-OCI firms is highly economically and statistically significant at 6.05% (*t*-stat=6.29). These univariate results are consistent with the idea that corporate managers exploit overconfidence-induced mispricing in their investment decisions.

Following Baker et al. (2003) we use regressions to control for standard determinants of investments. Specifically, each year we estimate the following regression:

$$Corporate\ Investment_{i,t} = \gamma_0 + \gamma_1 OCI^{RANK}{}_{i,t-1} + \gamma_2 Q_{i,t-1} + \gamma_3 CF_{i,t-1} + e_{i.t} \quad (15)$$

where corporate investment is either *CI* or *AG*. OCI^{RANK} for each firm is the quintile rank of their most recent OCI. We include *Q* (measured by M/B) to control for investment opportunities. According to *Q*-theory, variations in investment should be completely driven by variations in *Q*. However, a large empirical literature has documented that investment is sensitive to firms' cash flows, particularly among financially constrained firms (e.g., Hubbard, 1998 and Baker et al., 2003). In this paper we do not take a stance on the interpretation of the investment-cash flow sensitivity; we use cash flows as a control variable to ensure that our results are not due to cash flows. To reduce the impact of outliers, we winsorize all control variables except OCI at the 1st and 99th percentile. Following Fama and MacBeth (1973) we average the coefficients across years and compute *t*-statistics using the time-series variation in estimated annual coefficients.

The results in Panel B of Table VII show that controlling for *Q* and cash flows does not alter the qualitative impact of OCI on corporate investment. The coefficients on OCI are statistically and economically significant in all regression specifications. Even after controlling for market-to-book ratio (*Q*), we find that high-OCI firms invest between 0.80% and 5.28% of their total assets more than low-OCI firms do. This result suggests that overconfidence has a significant incremental impact on corporate investment, beyond that of market-to-book ratio. We argue that this result obtains because overconfidence better captures the mispricing of the stock than the market-to-book ratio does. However, since some of the impact of overconfidence on investment is through M/B ratio, the economic significance of the OCI coefficients is somewhat reduced when compared to the portfolio analysis.

Baker et al. (2003) argue that *Q* contains three components: (1) information about future investment opportunities; (2) non-fundamental component of the stock prices, i.e., mispricing; and (3) measurement error. We are not particularly concerned about the possibility that *Q* might be correlated with mispricing because it would work against us finding any independent effect of investor overconfidence. That is, if *Q* is correlated with mispricing, then the coefficient on OCI will under-estimate the effect of investor overconfidence on investment. In spite of this potential bias, we find a positive and significant coefficient on OCI in all regressions.

The issue of measurement error in *Q* is potentially more problematic. Indeed, to the extent that *Q* does not perfectly capture future investment opportunities, any evidence of mispricing-investment relation can be alternatively interpreted as rational. For example, one might argue that OCI contain information about future investment opportunities that is not captured in *Q*. Although we cannot rule out this possibility, it is not obvious why a measure based on manager and portfolio characteristics such as gender would be correlated with investment opportunities. Moreover, if *Q* is plagued by severe measurement error, then the coefficient of *Q* in the investment regression will be biased toward zero. However, we find strong evidence of a positive relation between *Q* and investment. Overall, our results suggest that investor overconfidence has a significant and positive impact on equity financing and real investment decisions.

V. Conclusions

In this paper we derive and test several novel implications of investor overconfidence for financial markets. Specifically, we examine the impact of investor overconfidence on firm value, financing behavior, and real investment. Overconfident investors overestimate the precision of their information and underestimate risks, which results in a lower required risk premium and a higher equilibrium price for the risky security. Thus, theory predicts that investor overconfidence causes overvaluation. To the extent that corporate managers exploit stock-market mispricing in their financing and investment decisions, we expect firms with more overconfident investors to issue more equity and make more investments.

We test these predictions using a measure of investor overconfidence derived from characteristics and holdings of U.S. equity mutual fund managers. Consistent with our predictions we find a strong positive relation between investor overconfidence and market-to-book ratios, and between investor overconfidence and two overvaluation measures. We show that the impact of investor overconfidence on firm value is stronger among high idiosyncratic volatility stocks. This result provides further support for the mispricing story.

Finally, we find that firms with more overconfident investors issue more equity and invest more than firms with less overconfident investors do, even after controlling for standard determinants of stock issuance and corporate investment. Overall, our results suggest that investor overconfidence has a significant impact on firm value, equity financing, and investment decisions.

References:

Ang, James S., and Yingmei Cheng, 2006, Direct evidence on the market-driven acquisition theory, *Journal of Financial Research* 29, 199-216.

Baker, Malcolm, Jeremy 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, Malcolm, and Jeffrey Wurgler, 2002, Market Timing and Capital Structure, *Journal of Finance* 57, 1-32.

Baker, Malcolm, and Jeffrey Wurgler, 2012, Behavioral corporate finance – An updated survey, forthcoming *Handbook of the Economics of Finance*, Volume 2.

Barber, Brad, and Terrence Odean, 2000, Trading is hazardous to your wealth: The common stock investment performance of individual investors, *Journal of Finance* 55, 773-806.

Barber, Brad, and Terrence Odean, 2001, Boys will be boys: Gender overconfidence and common stock investment, *Quarterly Journal of Economics* 116, 261-292.

Barber, Brad, and Terrence Odean, 2002, Online investors: Do the slow die first? *Review of Financial Studies* 15, 455-487.

Billett, Matthew, and Yiming Qian, 2008, Are Overconfident CEOs Born or Made? Evidence of Self-Attribution Bias from Frequent Acquirers, *Management Science* 54, 1037-1051.

Chen, J., H. Hong, and J. Stein, 2002, Breadth of Ownership and Stock Returns, *Journal of Financial Economics* 66, 171-205.

Cooper, M., H. Gulen, and M. Schill, 2008, Asset growth and the cross-section of stock returns, *Journal of Finance* 63, 1609-1651.

Daniel, Kent, David Hirshleifer, and Avanidhar Subrahmanyam, 1998, Investor psychology and security market under- and overreactions, *Journal of Finance* 53, 1839-1885.

Daniel, Kent, David Hirshleifer, and Avanidhar Subrahmanyam, 2001, Overconfidence, Arbitrage, and Equilibrium Asset Prices, *Journal of Finance* 56, 921-965.

DeAngelo, Harry, Linda DeAngelo, and Rene Stulz, 2010, Seasoned Equity Offerings, Market Timing, And the Corporate Lifecycle, *Journal of Financial Economics* 95, 275-295.

Dong, Ming, David Hirshleifer, Scott Richardson, and Siew Hong Teoh, 2006, Does Investor Misvaluation Drive the takeover Market?, *Journal of Finance* 61, 725-762.

Dong, M., D. Hirshleifer, and S.H. Teoh, 2012, Overvalued equity and financing decisions, *Review of Financial Studies* 25, 3645-3683.

Doukas, J. C. Kim, and C. Pantzalis, 2008, The two faces of analyst coverage, *Financial Management* 34, 99-125.

Easley, David, and Maureen O'Hara, 2004, Information and the Cost of Capital, *Journal of Finance* 59, 1553-1583.

Fama, Eugene F., and Kenneth R. French, 2008, Dissecting anomalies, *Journal of Finance* 63, 1653-1678.

Fama, Eugene F., and James MacBeth, 1973, Risk, return and equilibrium: Empirical tests, *Journal of Political Economy* 81, 607–636.

Frazzini, A., 2006, The disposition effect and underreaction to news, *Journal of Finance* 59, 2017-2046.

Gervais, Simon, and Terrance Odean, 2001, Learning to be overconfident, *Review of Financial Studies* 14, 1–27.

Gil-Bazo, Javier, and Pablo Ruiz-Verdu, 2009, Yet another puzzle? The relation between price and performance in the mutual fund industry, *Journal of Finance* 64, 2153–2183.

Gilchrist, Simon, Charles Himmelberg, and Gur Huberman, 2005, Do stock price bubbles influence corporate investment?, *Journal of Monetary Economics* 52, 805-827.

Gompers, Paul, Joy Ishii, and Andrew Metrick, 2003, Corporate Governance and Equity Prices, *Quarterly Journal of Economics* 118, 107–156.

Griffin, D., and A. Tversky, 1992, The weighing of evidence and the determinants of overconfidence, *Cognitive Psychology* 24, 411–435.

Grinblatt, Mark, and Matti Keloharju, 2009, Sensation seeking, overconfidence, and trading activity, *Journal of Finance* 64, 549-578.

Grossman, Sandford, and Joseph Stigliz, 1980, On the Impossibility of Informationally Efficient Markets, *American Economic Review* 70, 393-408.

Heath, Chip, and Amos Tversky, 1991, Preference and belief: Ambiguity and competence in choice under uncertainty, *Journal of Risk and Uncertainty* 4, 5-28.

Herfindahl, Orris C., 1950, Concentration in the steel industry, Doctoral dissertation, Columbia University.

Hertzel, M., and Z. Li, 2010, Behavioral and rational explanations of stock price performance around SEOs: Evidence from a decomposition of market-to-book ratios, *Journal of Financial and Quantitative Analysis* 45, 935-958.

Hilary, Gilles, and Lior Menzly, 2006, Does Past Success Lead Analysts to Become Overconfident?, *Management Science* 52, 489-500.

Hubbard, G., 1998, Capital-Market Imperfections and Investment, *Journal Economic Literature* 36, 193–225.

Investment Company Institute, 2011, Investment Company Fact Book. Investment Company Institute, Washington, D.C.

Irvine, Paul J., and Jeffrey Pontiff, 2009, Idiosyncratic Return Volatility, Cash Flows, and Product Market Competition, *Review of Financial Studies* 22, 1149-1177.

Kacperczyk, Marcin, Clemens Sialm, and Lu Zhang, 2008, Unobserved Actions of Mutual Funds, *Review of Financial Studies* 21, 2379-2416.

Lee, C., J. Myers, and B. Swaminathan, 1999, What is the intrinsic value of the Dow? *Journal of Finance* 54, 1693-1741.

Libby, Robert, and Kristina Rennekamp, 2012, Self-Serving Attribution Bias, Overconfidence, and the Issuance of Management Forecasts, *Journal of Accounting Research* 50, 197-231.

Merton, Robert, 1987, A simple model of capital market equilibrium with incomplete information, *Journal of Finance* 42, 483-510.

Morck, Randall, Andrei Shleifer, and Robert Vishny, 1988, Management ownership and market valuation: An empirical analysis, *Journal of Financial Economics* 20, 293-315.

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.

Morningstar Mutual Fund Sourcebook, 1993-1995. (Morningstar, Inc., Chicago, IL.)

Mutual Fund Sourcebook, 1984-1992. (Mutual Fund Sourcebook, Inc., Chicago, IL.)

Newey, Whitney K. and Kenneth D. West, 1987, A Simple positive definite, heteroskedasticity and autocorrelation consistent covariance matrix, *Econometrica* 55, 703-705.

Odean, Terrance, 1998, Volume, volatility, price and profit when all traders are above average, *Journal of Finance* 53, 1887-1934

O'Hara, Maureen, 2003, Liquidity and Price Discovery, *Journal of Finance* 58, 1335-1354.

Ohlson, J., 1995, Earnings, book values, and dividends in equity valuation, *Contemporary Accounting Research* 11, 661-687.

Pastor, Lubos, and Pietro Veronesi, 2003, Stock Valuation and Learning about Profitability, Journal of Finance 58, 1749–1790.

Polk, Christopher and Paula Sapienza, 2009, The Stock Market and Corporate Investment: A Test of Catering Theory, *Review of Financial Studies* 22, 187-217.

Pontiff, Jeffrey, 2006, Costly arbitrage and the myth of idiosyncratic risk, Journal of Accounting and Economics 42, 35-52.

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

Shleifer Andrei, and Robert Vishny, 1997, The limits of Arbitrage, *Journal of Finance* 52, 35-56.

Statman, Meir, Steven Thorley, and Keith Vorkink, 2006, Investor overconfidence and trading volume, *Review of Financial Studies* 19, 1531–1565.

Villalonga, Belen, and Raphael Amit, 2006, How do Family Ownership, Control, and Management Affect Firm Value?, *Journal of Financial Economics* 80, 385-417.

Yermack, David, 1996, Higher Market Valuation of Companies with a Small Board of Directors, *Journal of Financial Economics* 40, 185-211.

Table I
Descriptive statistics

The sample includes only common stocks (those with a sharecode of 10 or 11 in CRSP) of U.S. firms with CRSP and COMPUSTAT coverage and positive mutual fund ownership during 1988-2010. Financial firms (those with SIC code between 6000 and 6999) are excluded from the sample. OCI is the weighted average overconfidence index of all mutual funds holding the stock, as defined in Section III.B. M/B is the market-to-book ratio. RKRV is the misvaluation measure as defined in Rhodes-Kropf et al. (2005). DHRT is the misvaluation ratio as defined in Dong et al. (2006). For expositional reason, we multiply the original DHRT by negative one. MKTCAP is market capitalization. ASSETS is total assets. AGE is a number of years since the first return appears in CRSP. ROA is return on assets. R&D is research and development expense scaled by total assets. IVOL is monthly idiosyncratic volatility of daily stock returns over prior 12 months. CFVOL is volatility of cash flows over prior 5 years. RESNA is residual analyst coverage. DISP is standard deviation of the one-year ahead analysts' earnings forecasts. Detailed variable definitions are in Appendix C. Panel A presents time-series averages of cross-sectional statistics for all firms in the sample. Panel B presents average cross-correlations among firm characteristics for all stocks in the sample. Superscripts * and ** indicate statistical significance at the 5% and 1% respectively.

Panel A – Descriptive statistics

Variable	Mean	25th Percentile	Median	75th Percentile	Stdev
OCI	2.51	1.90	2.51	3.07	0.81
M/B	1.93	1.06	1.40	2.15	1.51
RKRV	0.06	-0.39	0.04	0.50	0.77
DHRT	-0.69	-1.00	-0.59	-0.29	0.51
MKTCAP ($ billion)	2.20	0.09	0.27	1.00	10.28
ASSETS ($ billion)	2.30	0.09	0.28	1.05	12.12
AGE (years)	16.14	5.00	11.18	22.14	15.91
ROA (%)	5.05	1.31	7.99	13.60	17.24
R&D (%)	10.37	0.75	4.38	12.93	16.44
IVOL (%)	3.09	1.92	2.78	3.86	1.66
CFVOL	0.10	0.04	0.07	0.12	0.18
RESNA	0.07	-0.46	0.18	0.68	0.80
DISP	0.08	0.02	0.04	0.09	0.12

Panel B – Cross-Correlations

	OCI	M/B	RKRV	DHRT	MKTCAP	ASSETS	AGE	ROA	R&D	IVOL	CFVOL	RESNA	DISP
OCI	1.00												
M/B	0.14**	1.00											
RKRV	0.06**	0.21**	1.00										
DHRT	0.17**	0.52**	0.24**	1.00									
MKTCAP	0.00	0.08**	0.09**	0.01	1.00								
ASSETS	0.00	-0.05**	0.02**	-0.05**	0.66**	1.00							
AGE	-0.04*	-0.20**	-0.06**	-0.13**	0.31**	0.30**	1.00						
ROA	0.05*	-0.04	0.05**	-0.16**	0.10**	0.04**	0.07**	1.00					
R&D	0.09**	0.43**	0.18**	0.23**	-0.05**	-0.06**	-0.25**	-0.51**	1.00				
IVOL	-0.07	0.10**	-0.10**	0.13**	-0.19**	-0.16**	-0.35**	-0.43**	0.30**	1.00			
CFVOL	0.00	0.21**	0.07**	0.10**	-0.08**	-0.10**	-0.18**	-0.28**	0.31**	0.29**	1.00		
RESNA	0.05**	0.04**	0.01	0.09**	-0.06**	-0.07**	-0.08**	0.06**	0.02	0.01	-0.04**	1.00	
DISP	-0.01	-0.16**	-0.17**	-0.17**	0.01**	0.11**	0.12**	-0.20**	0.04**	0.06**	0.03**	-0.04**	1.00

Table II
Investor Overconfidence and Firm Value

The sample includes only common stocks (those with a sharecode of 10 or 11 in CRSP) of U.S. firms with CRSP and COMPUSTAT coverage and positive mutual fund ownership during 1988-2010. Financial firms (those with SIC code between 6000 and 6999) are excluded from the sample. Panel A presents results of the portfolio analysis. Overconfidence (OCI) is measured as the weighted average overconfidence index of all mutual funds holding the stock, as defined in Section III.B. Each year, we sort firms into overconfidence quintiles based on their most recent available OCI and compute equal-weighted average M/B for each quintile. We report time series average of mean M/B for each overconfidence quintile, as well as the difference in M/B between firms in high- and low-overconfidence quintiles. Panel B presents regression results. Each year we estimate regressions of M/B on investor overconfidence and a set of control variables. OCI^{RANK} is the quintile rank of OCI variable. Control variables include the following: ASSETS is total assets. AGE is a number of years since the first return appears in CRSP. S&P500 is an indicator variable which equals 1 if a firm is member of S&P500 index in a given year, and 0 otherwise. Delaware is an indicator variable which equals 1 if a firm was incorporated in Delaware, and 0 otherwise. ROA is return on assets. R&D is research and development expense scaled by total assets. Detailed variable definitions are in Appendix C. Reported coefficients are time series averages from the cross-sectional regressions. Numbers in parenthesis are *t*-statistics based on the time-series standard deviation adjusted for heteroskedasticity and autocorrelation using Newey-West (1987) approach.

Panel A – Portfolio Analysis

	OCI Portfolio					
	OCI1 *(low)*	OCI2	OCI3	OCI4	OCI5 *(high)*	OCI5-OCI1
M/B	1.58	1.74	1.95	2.10	2.23	0.65
	(27.00)	(19.71)	(17.52)	(14.47)	(17.01)	(4.93)

Panel B – Cross-sectional Regression

	Model 1	Model 2	Model 3
Intercept	1.43	3.00	2.39
	(17.89)	(14.24)	(15.81)
OCI^{RANK}	0.17	0.19	0.17
	(4.52)	(5.04)	(4.96)
log(ASSETS)		-0.31	-0.23
		(-14.46)	(-12.48)
AGE		-0.01	-0.01
		(-5.62)	(-4.13)
Delaware		0.18	0.08
		(4.23)	(2.73)
S&P500		1.28	1.15
		(9.85)	(8.67)
R&D			4.51
			(21.28)
ROA			1.19
			(8.03)
Adjusted R^2	0.02	0.14	0.27

Table III

Investor Overconfidence and Misvaluation – Portfolio Analysis

The sample includes only common stocks (those with a sharecode of 10 or 11 in CRSP) of U.S. firms with CRSP and COMPUSTAT coverage and positive mutual fund ownership during 1988-2010. Financial firms (those with SIC code between 6000 and 6999) are excluded from the sample. Overconfidence (OCI) is measured as the weighted average overconfidence index of all mutual funds holding the stock, as defined in Section III.B. Each year, we sort firms into overconfidence quintiles based on their most recent available OCI and compute equal-weighted average firm misevaluation measure for each quintile. This table presents time series mean of average firm misevaluation measures across overconfidence quintiles, as well as the difference in firm misvaluations between firms in high- and low-overconfidence quintiles. Firm misvaluation is measured by RRKV misevaluation measure and DHRT misvaluation measure. RKRV is the misvaluation measure as defined in Rhodes-Kropf et al. (2005). DHRT is the misvaluation ratio as defined in Dong et al. (2006). For expositional reason, we multiply the original DHRT by negative one. Detailed definitions of RKRV and DHRT are in Section III.C and Appendix B. Numbers in parenthesis are *t*-statistics based on the time-series standard deviation of average firm values, adjusted for heteroskedasticity and autocorrelation using Newey-West (1987) approach.

	OCI Portfolio					
	OCI1 *(low)*	OCI2	OCI3	OCI4	OCI5 *(high)*	OCI5-OCI1
RKRV misvaluation measure						
	-0.19	-0.02	0.14	0.19	0.19	0.38
	(-4.48)	(-0.90)	(6.93)	(8.80)	(8.47)	(7.68)
DHRT misvaluation measure						
	-0.77	-0.73	-0.68	-0.66	-0.65	0.12
	(-13.57)	(-13.30)	(-12.13)	(-14.61)	(-19.38)	(3.05)

Table IV
Investor Overconfidence and Misvaluation – The Effect of Limits to Arbitrage

The sample includes only common stocks (those with a sharecode of 10 or 11 in CRSP) of U.S. firms with CRSP and COMPUSTAT coverage and positive mutual fund ownership during 1988-2010. Financial firms (those with SIC code between 6000 and 6999) are excluded from the sample. Overconfidence (OCI) is measured as the weighted average overconfidence index of all mutual funds holding the stock, as defined in Section III.B. Each year, we sort firms into independent quintiles based on their most recent available OCI and their idiosyncratic volatility. We compute equal-weighted average firm valuation measure for each of the 25 portfolios. This table presents time series mean of average difference in firm valuations between firms in high- and low-overconfidence quintiles across idiosyncratic volatility (IVOL) quintiles. Firm valuation measures are M/B, RRKV, and DHRT. M/B is market-to-book ratio. RKRV is the misvaluation measure as defined in Rhodes-Kropf et al. (2005). DHRT is the misvaluation ratio as defined in Dong et al. (2006). For expositional reason, we multiply the DHRT by negative one. Detailed definitions of RKRV and DHRT are in Section III.C and Appendix B. IVOL is a standard deviation of residuals from monthly regression of excess daily stock return on excess daily market return, averaged over prior 12 months. Numbers in parenthesis are *t-statistics* based on the time-series standard deviation of average firm values, adjusted for heteroskedasticity and autocorrelation using Newey-West (1987) approach.

	M/B	*RKRV*	*DHRT*
IVOL quintile	OC5-OC1	OC5-OC1	OC5-OC1
1 (low)	0.15	0.14	0.04
	(2.85)	(2.81)	(0.84)
2	0.38	0.31	0.13
	(5.35)	(5.02)	(2.69)
3	0.61	0.41	0.15
	(6.57)	(6.47)	(2.76)
4	0.76	0.42	0.13
	(6.62)	(8.27)	(2.40)
5 (high)	0.68	0.45	0.15
	(4.59)	(9.58)	(2.96)
IVOL5-IVOL1	0.53	0.31	0.11
	(4.87)	(6.03)	(2.06)

Table V
Firm Value, Investor Overconfidence, and Information Uncertainty

The sample includes only common stocks (those with a sharecode of 10 or 11 in CRSP) of U.S. firms with CRSP and COMPUSTAT coverage and positive mutual fund ownership during 1988-2010. Financial firms (those with SIC code between 6000 and 6999) are excluded from the sample. Overconfidence (OCI) is measured as the weighted average overconfidence index of all mutual funds holding the stock, as defined in Section III.B. Each year we estimate the regressions of firm valuation on OCI and a set of control variables. Firm valuation is measured by M/B, RKRV, and DHRT. M/B is market-to-book ratio. RKRV is the misvaluation measure as defined in Rhodes-Kropf et al. (2005). DHRT is the misvaluation ratio as defined in Dong et al. (2006). For expositional reason, we multiply the DHRT by negative one. Detailed definitions of RKRV and DHRT are in Section III.C and Appendix B. OCI^{RANK} is the quintile rank of OCI variable. The set of control variables includes the following: IVOL is monthly idiosyncratic volatility of daily stock returns over prior 12 months. CFVOL is volatility of cash flows over prior 5 years. RESNA is residual analyst coverage. . DISP is standard deviation of the one-year ahead analysts' earnings forecasts. ASSETS is total assets. AGE is a number of years since the first return appears in CRSP. ROA is return on assets. R&D is research and development expense scaled by total assets. S&P500 is an indicator variable which equals 1 if a firm is member of S&P500 index in a given year, and 0 otherwise. Delaware is an indicator variable which equals 1 if a firm was incorporated in Delaware, and 0 otherwise. MFO is a proportion of firm's shares outstanding held by mutual funds. Detailed definitions of control variables are in Appendix C. Reported coefficients are time series averages from the cross-sectional regressions. Numbers in parenthesis are *t*-statistics based on the time-series standard deviation of coefficients, adjusted for heteroskedasticity and autocorrelation using Newey-West (1987) approach.

	Dependent variable					
	M/B	*RKRV*	*DHRT*	*M/B*	*RKRV*	*DHRT*
Intercept	2.06	0.10	-0.80	2.04	0.06	-0.82
	(5.72)	(1.12)	(-5.94)	(5.76)	(0.77)	(-5.98)
OCI^{RANK}	0.10	0.07	0.02	0.09	0.07	0.02
	(4.55)	(6.31)	(3.58)	(5.03)	(6.86)	(3.39)
IVOL	-0.82	-2.38	2.74	-0.25	-1.74	3.22
	(-0.13)	(-1.50)	(1.04)	(-0.04)	(-1.12)	(1.19)
CFVOL	1.40	0.48	-0.02	1.39	0.49	-0.00
	(7.46)	(5.48)	(-0.42)	(7.31)	(6.03)	(-0.05)
Dispersion	-0.66	-1.00	-0.91	-0.66	-1.01	-0.91
	(-2.44)	(-6.05)	(-5.15)	(-2.51)	(-6.16)	(-5.08)
Residual coverage	-0.06	-0.04	0.04	-0.06	-0.04	0.04
	(-3.73)	(-4.17)	(4.27)	(-3.63)	(-4.40)	(4.53)
AGE	-0.01	-0.00	-0.00	-0.00	-0.00	-0.00
	(-4.27)	(-1.01)	(-6.64)	(-4.31)	(-0.30)	(-6.06)
log(ASSETS)	-0.20	-0.04	0.01	-0.20	-0.04	0.01
	(-6.87)	(-5.92)	(1.66)	(-7.55)	(-6.70)	(1.22)
Delaware	0.04	0.03	0.02	0.04	0.03	0.01
	(1.26)	(2.90)	(3.32)	(1.35)	(3.16)	(2.76)
S&P500	0.81	0.27	0.06	0.81	0.27	0.07
	(6.28)	(10.50)	(2.20)	(5.95)	(10.20)	(2.71)
ROA	4.17	0.49	-0.54	4.22	0.46	-0.55
	(15.42)	(7.67)	(-4.93)	(16.43)	(6.79)	(-4.87)
R&D	5.24	1.23	0.80	5.24	1.22	0.78
	(16.43)	(13.27)	(7.51)	(16.80)	(12.65)	(7.42)
MFO				0.04	0.62	0.53
				(0.06)	(4.02)	(4.57)
$Adj\text{-}R^2$	0.34	0.12	0.21	0.34	0.12	0.22

Table VI
The Effect of Investor Overconfidence on External Equity Financing

The sample includes only common stocks (those with a sharecode of 10 or 11 in CRSP) of U.S. firms with CRSP and COMPUSTAT coverage and positive mutual fund ownership during 1988-2010. Financial firms (those with SIC code between 6000 and 6999) are excluded from the sample. Overconfidence (OCI) is the weighted average overconfidence index of all mutual funds holding the stock, as defined in Section III.B. Panel A reports results of a portfolio analysis. Each June we sort firms into overconfidence quintiles based on their latest OCI and calculate equal weighted average measure of equity financing. Equity financing is measured as either net stock issues (NS) or external equity issues (EI). NS is defined following Fama and French (2008) as a natural log of the split adjusted number of shares in year *t* divided by the split adjusted number of shares in year *t-1*. EI is defined following Baker et al. (2003) as a change in book equity minus change in retained earnings scaled by total assets. The estimated time-series averages are expressed in percentages. Numbers in parenthesis are *t*-statistics. Panel B reports results of cross-sectional regressions. Each year we estimate regressions of equity financing variables on investor overconfidence and set of control variables. OCI^{RANK} is the quintile rank of the OCI variable. M/B is market-to-book ratio as defined in Baker et al. (2003). Cash flow (CF) is income plus depreciation scaled by total assets. AGE is a number of years since the first return appears in CRSP. ROA is return on assets. LEV is total long term debt scaled by market value of equity. $RET_{t-12,t-1}$ is prior 12-month stock return. Reported coefficients are time series averages from the cross-sectional regressions. Coefficients on OCI^{RANK} and M/B are multiplied by 100. Numbers in parentheses are *t*-statistics based on the Fama and MacBeth (1973) approach.

Panel A: Portfolio Analysis

	OCI Portfolios					
	OCI1 *(low)*	OCI2	OCI3	OCI4	OCI5 *(high)*	OCI5-OCI1
NS (%)						
	3.01	2.76	2.37	2.74	3.98	0.97
	(5.97)	(9.44)	(6.73)	(7.15)	(8.69)	(3.06)
EI (%)						
	5.68	4.83	4.18	5.00	7.77	2.09
	(5.00)	(6.05)	(5.27)	(6.27)	(5.79)	(2.32)

Panel B – Multiple Regressions

	NS			*EI*		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	0.06	0.06	0.05	0.14	0.08	0.08
	(10.64)	(9.07)	(8.76)	(6.65)	(5.33)	(5.61)
OCI^{RANK}	0.18		0.14	0.37		0.06
	(4.09)		(2.87)	(5.22)		(0.69)
M/B		0.63	0.62		2.91	2.90
		(4.56)	(4.52)		(7.83)	(7.72)
CF	-0.05	-0.06	-0.06	-0.13	-0.15	-0.15
	(-5.36)	(-7.00)	(-7.02)	(-3.93)	(-4.74)	(-4.77)
AGE	-0.01	-0.01	-0.01	-0.02	-0.01	-0.01
	(-9.22)	(-8.98)	(-9.10)	(-6.47)	(-5.56)	(-5.76)
ROA	-0.10	-0.11	-0.11	-0.29	-0.30	-0.30
	(-11.38)	(-11.97)	(-11.89)	(-5.83)	(-6.23)	(-6.22)
LEV	0.01	0.01	0.01	-0.02	-0.01	-0.01
	(3.88)	(5.81)	(5.86)	(-3.73)	(-2.17)	(-2.18)
$RET_{t-12,t-1}$	0.01	0.02	0.02	0.04	0.04	0.04
	(6.46)	(6.54)	(6.47)	(7.33)	(8.33)	(8.31)
Adj-R^2	0.08	0.08	0.09	0.14	0.18	0.18

Table VII
The Effect of Investor Overconfidence on Corporate Investment

The sample includes only common stocks (those with a sharecode of 10 or 11 in CRSP) of U.S. firms with CRSP and COMPUSTAT coverage and positive mutual fund ownership during 1988-2010. Financial firms (those with SIC code between 6000 and 6999) are excluded from the sample. Overconfidence (OCI) is measured as the weighted average overconfidence index of all mutual funds holding the stock, as defined in Section III.B. Panel A reports results of a portfolio analysis. Each June, we sort firms into overconfidence quintiles based on their latest OCI and calculate equal weighted average corporate investment. Corporate investment is measured as either capital investment or asset growth. Capital investment is capital expenditures divided by total assets, as in Baker et al. (2003). Asset growth is defined following Cooper et al. (2008) as percentage change in total assets. The estimated time-series averages are expressed in percentages. Numbers in parenthesis are *t*-statistics. Panel B reports results of cross-sectional regressions. Each year we estimate regressions of investment variables on OCI and set of control variables. OCI^{RANK} is the quintile rank of the OCI variable. Q is market-to-book ratio (M/B), as defined in Baker et al. (2003). Cash flow (CF) is income plus depreciation scaled by total assets. Reported coefficients are time series averages from the cross-sectional regressions. Coefficients on OCI^{RANK} and Q are multiplied by 100. Numbers in parentheses are *t*-statistics based on the Fama and MacBeth (1973) approach.

Panel A - Portfolio Analysis

	OCI Portfolios					
	OCI1 *(low)*	OCI2	OCI3	OCI4	OCI5 *(high)*	OCI5-OCI1
CI (%)						
	6.32	6.65	7.29	7.54	7.55	1.23
	(13.39)	(14.81)	(13.35)	(12.4)	(13.98)	(5.96)
AG (%)						
	9.24	10.71	12.11	13.80	15.29	6.05
	(6.76)	(5.93)	(7.81)	(8.07)	(8.27)	(6.29)

Panel B – Multiple Regressions

	CI			*AG*		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	0.05	0.05	0.05	0.05	0.02	-0.00
	(20.29)	(23.19)	(20.78)	(3.54)	(1.98)	(-0.06)
OCI^{RANK}	0.23		0.20	1.32		0.81
	(6.49)		(6.13)	(7.28)		(4.80)
Q		0.24	0.20		4.08	3.97
		(4.62)	(4.31)		(7.88)	(7.65)
CF	0.15	0.15	0.15	0.36	0.30	0.30
	(7.64)	(7.82)	(7.81)	(5.66)	(5.13)	(5.10)
Adj-R^2	0.08	0.08	0.08	0.04	0.07	0.07

Appendix A: Proofs of Propositions

Proof of Proposition 1: It is sufficient to show that there is an equilibrium price in the form given in equation (7). Solving for p from (6) and substituting Θ from (3) yields:

$$p = \frac{m\rho + s_1[\mu(\gamma + k) + (1-\mu)\rho_\Theta] + s_2\gamma - x\left[\delta + (1-\mu)\rho_\Theta \frac{d}{b}\right] + (1-\mu)\rho_\Theta \frac{d}{b}\tilde{x}}{R[\rho + \mu(\gamma + k) + (1-\mu)\rho_\Theta]} \qquad (A1)$$

Both Θ and ρ_Θ involve coefficients from the conjectured price equation in the form of $\left(\frac{d}{b}\right)$. The ratio of the coefficients on $-x$ and s_1 in equation (A1) must be d/b:

$$\frac{d}{b} = \frac{\delta + (1-\mu)\rho_\Theta \frac{d}{b}}{\mu(\gamma + k) + (1-\mu)\rho_\Theta}$$

$$\frac{d}{b} = \frac{\delta}{\mu(\gamma + k)} \qquad (A2)$$

Substituting $\left(\frac{d}{b}\right)$ into (4), we obtain that $\rho_\Theta = \left[\gamma^{-1} + \left(\frac{\delta}{\mu(\gamma+k)}\right)^2 \eta^{-1}\right]^{-1}$. The coefficients in the price equation are given in the statement of the Proposition 1 (equation (7)).

Proof of Proposition 2: Using the results from Proposition 1 it is easy to show that:

$$E\left(\frac{p}{m}\right) = E\left(\frac{am + bs_1 + cs_2 - dx + e\bar{x}}{m}\right) = a + b + c + \frac{\bar{x}}{m}(e - d),$$

$$E\left(\frac{p}{m}\right) = \frac{1}{R}\left(1 - \frac{\bar{x}\delta}{m(\rho + \gamma + \mu(\gamma + k) + (1-\mu)\rho_\Theta)}\right), \qquad (A3)$$

Differentiating the $E\left(\frac{p}{m}\right)$ with respect to k yields:

$$\frac{dE\left(\frac{p}{m}\right)}{dk} = \frac{Rm\bar{x}\delta(\mu + (1-\mu)\, d\rho_\Theta/dk)}{\left(Rm(\rho + \gamma + \mu(\gamma + k) + (1-\mu)\rho_\Theta)\right)^2} > 0 \quad (A4)$$

because

$$\frac{d\rho_\Theta}{dk} = \frac{2\gamma^2\mu^2(\gamma + k)\eta\delta^2}{(\mu^2(\gamma + k)^2\eta + \gamma\delta^2)^2} > 0. \quad (A5)$$

Proof of Corollary: It is sufficient to show that $E\left[p_{(k>0)} - p_{(k=0)}\right] > 0$:

$$E\left[p_{(k>0)} - p_{(k=0)}\right]$$

$$= E\left[\frac{s_1\mu k[\rho + \gamma + \mu\gamma + (1-\mu)\rho_\theta] - \mu k(m\rho + s_1(\mu\gamma + (1-\mu)\rho_\theta) + s_2\gamma - \tilde{x}\delta)}{R\left[\rho + \mu(\gamma + k) + (1-\mu)\rho_\Theta\right] \times \left[\rho + \mu\gamma + (1-\mu)\rho_\Theta\right]}\right]$$

$$= \frac{\mu k\tilde{x}\delta}{R\left[\rho + \mu(\gamma + k) + (1-\mu)\rho_\Theta\right] \times \left[\rho + \mu\gamma + (1-\mu)\rho_\Theta\right]} > 0. \quad (A6)$$

Appendix B: Construction of the DHRT Misvaluation Measure

Following Dong, Hirshleifer, Richardson, and Teoh (2006), we construct a misvaluation measure as the ratio of a firm's fundamental value to its market price (*V/P*). We estimate the fundamental value ($V_{i,t}$) of a firm using a version of the residual income model (Ohlson, 1995):

$$V_{i,t} = B_{i,t} + \sum_{k=1}^{k=\infty} \frac{E_t\left[\{ROE_{i,t+k} - r_{i,t}\}B_{i,t+k-1}\right]}{\left(1 + r_{i,e}\right)^k}, \qquad (B1)$$

where E_t is the expectation operator conditional on the information available at time *t*. $B_{i,t}$ is the book value of equity of firm *i* at time *t*. $ROE_{i,t+k}$ is the return on equity for firm *i* in year *t+k*. Finally, $r_{i,e}$ is the annualized cost of equity for firm *i*.

The implementation of this model requires forecasts of future cash-flows up to a terminal period (*T*) and appropriate terminal value. The terminal value is estimated by treating the residual income at year *T-1* as perpetuity. Lee, Myers and Swaminathan (1999) show that the quality of V_t estimates is not sensitive to the choice of forecast horizon beyond three years. In addition, the residual income model tends to be less sensitive to errors in terminal value estimates than the dividend-discount model is, because pre-terminal values already include book value. Thus, we follow the estimation procedure of Dong, Hirshleifer, and Teoh (2012) and adopt a three-period forecast horizon. Firm value then is the solution to the following equation:

$$V_t = B_t + \frac{FROE_{t+1} - r_{i,e}}{\left(1 + r_{i,e}\right)} B_t + \frac{FROE_{t+2} - r_{i,e}}{\left(1 + r_{i,e}\right)^2} B_{t+1} + \frac{FROE_{t+3} - r_{i,e}}{\left(1 + r_{i,e}\right)^2 r_{i,e}} B_{t+2} \qquad (B2)$$

where $FROE_{t+i}$ is forecasted return on equity for year $t+i$. Specifically, we compute forecasted ROEs as follows: $FROE_{t+i} = FEPS_{t+i}/\overline{B_{t+\iota-1}}$, and $\overline{B_{t+\iota}} \stackrel{\text{def}}{=} (B_{t+i} + B_{t+i-1})/2$.

I/B/E/S provides consensus one-year-ahead ($FEPS_{t+1}$), two-year-ahead ($FEPS_{t+2}$), and three-year-ahead ($FEPS_{t+3}$) EPS forecasts, as well as an estimate of the long-term growth rate

(LTG). If the EPS forecast for a given period is not available, we substitute it by the EPS forecast for the previous period compounded by the long-term growth rate, $FEPS_{t+i}=FEPS_{t+i-1}(1+LTG)$. Alternatively, if the LTG is not available we use the EPS forecast for the first available preceding period. We require that all included observations have non-negative long-term growth, and that all $FROE$ estimates be smaller than 1.

We calculate book values of equity per share (B_t) using earnings forecasts and dividend payout (dp) in the following manner: $B_{t+1}= B_t+FEPS_{t+1}(1-dp)$. We estimate dividend payout by dividing actual dividends (Compustat item DVT) from the most recent fiscal year by the earnings over the same period (Compustat item NI). For firms with negative earnings, we follow Lee et al. (1999) and divide the actual dividends by six percent of total assets, to compute payout. Observations with computed dp greater than 1 are deleted from the study. In addition, we remove observations with negative book values.

Following Dong et al. (2012) we estimate the annualized cost of equity $r_{i,e}$ as firm specific rate using CAPM model.[10] Specifically, we estimate $\beta_t$using past 60 months of returns (requiring at least 24 observations). The market risk premium is the prior 30 year average annual premium over the risk-free rate for the CRSP value-weighted index. We winsorize the annualized M $r_{i,e}$ estimates so that no estimate is smaller than 5% or larger than 25% per year.[11]

Finally, we form the misvaluation measure as the ratio of the fundamental value at time t to the market price at time t multiplied by negative one ($-V/P$). To mitigate the impact of outliers we winsorize estimated misvaluation measure at the 1st and 99th percentile.

[10] Dong et al. (2012) show that their results are not sensitive to alternative estimates of the discount rate such as those estimated from the Fama and French (1993) three-factor model or a constant discount rate of 12.5%.
[11] This procedure affects about 12.5% of the estimates.

Appendix C: Variable Definitions

- M/B ratio is the market value of equity (price times shares outstanding from CRSP) plus assets minus the book value of equity (CEQ +TXDB from COMPUSTAT) over total assets (TA).
- ASSETS are total assets, item TA from COMPUSTAT;
- MKTCAP is firm's total market capitalization calculated as a product of share price and a number of shares outstanding from CRSP;
- AGE is a number of years since the first return appears in CRSP;
- ROA if firm's return on assets defined as earnings after depreciation (COMPUSTAT item OIADP) scaled by lagged total assets (item TA);
- R&D is research and development expense (COMPUSTAT item XRD) scaled by lagged total assets (item TA);
- IVOL is idiosyncratic volatility defined as a standard deviation of residuals from monthly regression of excess daily stock returns on excess daily market returns, averaged over prior 12 months.
- CFVOL is cash flow volatility calculated following Zhang (2006) as a standard deviation of cash flow to assets over prior 5 years
- DISP is standard deviation of the analyst's year one earnings forecasts, as reported in I/B/E/S;
- RESNA is residual analyst coverage defined following Hong et al. (2001) as a residual from the following regression: $\ln(1+\#\text{ of analysts})_{i,t} = \beta_0+\beta_1\ln(\text{size})_{i,t}+e_{i,t}$;
- S&P500 is an indicator variable that takes value of one if a firm is a member of the S&P 500 index in a given year and zero otherwise;
- DELAWARE is an indicator variable which takes value of one if a firm was incorporated in Delaware and zero otherwise;

- LEV is ratio of long-term debt (COMPUSTAT item DLTT) to market value of equity;
- CF is cash flow calculated as income before extraordinary items plus depreciation (COMPUSTAT items IB and DP) scaled by lagged total assets (item TA);
- $RET_{t-12,t-1}$ is cumulative stock return over prior 12 months;
- NS is the natural log of the ratio of the split-adjusted shares outstanding at the fiscal year end in *t* divided by the split adjusted shares outstanding at the fiscal year end in *t-1*, from COMPUSTAT;
- EI is change in book equity (CEQ) minus change in retained earnings (RE) scaled by total assets (TA);
- CI is a ratio of the capital expenditure (CAPX) to total assets (TA);
- AG is a year-on-year percentage change in total assets (TA).