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Investor Overconfidence, Firm Valuation, and Corporate Decisions

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Abstract. Behavioral theory predicts that investor overconfidence leads to overpricing because overconfident investors overestimate the quality 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 the market-to-book ratio and a misvaluation measure. The result is stronger among stocks with greater mutual fund ownership, particularly by active mutual funds. Firms with more overconfident investors also exhibit lower subsequent stock returns, issue more equity, and invest more. Overall, our findings suggest that investor overconfidence is significantly related to firm valuation and corporate decisions.

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1. Introduction

This paper examines the impact of investor overconfidence on firm valuation and corporate decisions. Investor overconfidence has been the subject of much research in the finance literature,[1] yet relatively few studies have examined its impact on firm valuation and corporate decisions.[2] 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 has a direct impact on firm valuation. 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 inflated demand will lead to overpricing.

We formalize this intuition by presenting a simple model, which builds on Odean (1998) and O'Hara (2003), in Appendix A. The central prediction of our model is that firms with overconfident investors are overvalued. To test this prediction, 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 seven overconfidence proxies suggested in the prior literature: manager's gender, manager's tenure, management structure, portfolio turnover, portfolio concentration, prior performance, and portfolio idiosyncratic risk. We then compute a stock-level overconfidence index (OCI) as the weighted average overconfidence index of all fund managers who hold the stock.

We focus on overconfidence among mutual fund managers for several reasons. First, the psychology literature suggests that experts (e.g., mutual fund managers) tend to be more overconfident than laymen (Heath and Tversky 1991, Griffin and Tversky 1992). Second, mutual funds hold a large and growing fraction of the U.S. stock market.[3] Third, detailed characteristics and holdings data are readily available for mutual funds and mutual fund managers.

We begin by testing whether investor overconfidence is associated with the market-to-book ratio (M/B). Each year we sort our sample firms into quintiles based on their OCI. We then compute the average M/B for each quintile portfolio as well as the difference in M/B between the two extreme OCI quintiles. Our results show a strong positive relation between OCI and M/B. The difference in M/B between high- and low-OCI firms is 0.63 (t-stat = 8.40). This result is economically large as it implies that the value of high- and low-OCI firms with one billion dollars of total assets differs by \$630 million. Our results persist after controlling for several previously established determinants of M/B in cross-sectional regressions.

In addition to M/B, we employ a misvaluation measure to provide more direct evidence on the relation between investor overconfidence and overvaluation. Specifically, we use the measure proposed by Rhodes-Kropf, Robinson, and Viswanathan (henceforth RKRV 2005). RKRV estimate a firm's fundamental value as a function of its book value, net income, and leverage ratio relative to its industry peers, and use the deviation from this fundamental value as their misvaluation measure. 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 measure. The RKRV measure increases monotonically across OCI portfolios. The difference between high- and low-OCI firms is economically and statistically significant at 0.38 (t-stat = 7.68).

An alternative way to test for misvaluation is to examine subsequent stock returns. Intuitively, overvalued (undervalued) stocks should earn negative (positive) abnormal returns when the mispricing is corrected. Therefore, if OCI is related to overvaluation, we would expect high-OCI stocks to underperform low-OCI stocks during subsequent periods. Consistent with this prediction, we find that raw returns, one-, three-, and four-factor alphas all decrease monotonically across OCI portfolios. More importantly, the difference in subsequent returns between high- and low-OCI portfolios, ranging between 0.29% per month and 0.48% per month, is economically and statistically significant.

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 valuation. For example, overconfident investors may be attracted to firms with greater information uncertainty (Daniel et al. 1998). To the extent that firms with more uncertain prospects tend to have higher market valuations Pastor and Veronesi (2003), we should find a positive relation between investor overconfidence and firm value. We address this concern in three ways. First, we use a firm's lagged OCI and peer companies' OCI as instruments and employ a two-stage least squares procedure to account for endogeneity. We find that our results continue to hold. Second, we conduct a difference-in-difference analysis and find that an increase in OCI is significantly related to an increase in our valuation measures. Third, we find similar results when we construct OCI using only manager characteristics and not portfolio characteristics. Our findings from these additional analyses suggest that it is unlikely that endogeneity drives the documented relation between OCI and firm overvaluation.

Having established a robust positive relation between investor overconfidence and firm valuation, we next examine its impact on corporate decisions. Recent studies suggest that corporate managers exploit stock-market mispricing in making financing and investment decisions (e.g., Baker and Wurgler 2002, Gilchrist et al. 2005, Polk and Sapienza 2009), particularly among firms with overvalued equity (Jensen 2005, Dong et al. 2012). To the extent that investor overconfidence leads to overvaluation, we expect it to also impact corporate financing and real investment. Consistent with this expectation, we find that high-OCI firms issue significantly more equity than low-OCI firms do. We also 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 after controlling for standard determinants of equity financing and corporate investment. Our findings on corporate investment are particularly important. As Baker and Wurgler (2013, p. 366) 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 overconfidence not only affects asset prices but also alters real investment.

We perform several additional analyses to confirm that the driving force behind our results is fund manager overconfidence. We find that the positive relation between investor overconfidence and firm value is stronger among stocks with higher mutual fund ownership, especially higher active mutual fund ownership. This result confirms the important role played by equity mutual funds in driving the OCI-firm value relation. We also repeat our analyses by controlling for mutual fund flows and find that our results are qualitatively unchanged. This finding indicates that we are not simply repackaging the "dumb money" effect of Frazzini and Lamont (2008).

Our paper adds to the literature on investor overconfidence. Previous studies have focused on the effect of investor overconfidence on trading volume, investor performance, and market anomalies (e.g., Barber and Odean 2000, 2001, 2002; Daniel et al. 1998, 2001; Statman et al. 2006; Grinblatt and Keloharju 2009). Our paper contributes to this literature by examining the impact of investor overconfidence on firm valuation and corporate decisions. Consistent with behavioral argument, we find a positive relation between firm valuation and investor overconfidence. We also show that firms with more overconfident investors issue more equity and make more investments.

A challenge faced by any empiricist when testing for the effect of investor overconfidence is to develop a good measure of overconfidence. We contribute to the literature by constructing a novel measure of investor overconfidence based on 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 (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 that use mutual fund data to investigate market-wide phenomena. For example, Chen et al. (2004) examine 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 gains overhang based on the portfolios of equity mutual funds.

Our paper parallels and complements the literature on CEO overconfidence (Ben-David et al. 2007; Malmendier and Tate 2005, 2008). Malmendier and Tate develop two measures of CEO overconfidence based on CEO's personal overinvestment in their own firms and CEO's media portrayal. They show that CEO overconfidence has a significant impact on corporate investment and acquisition decisions. Rather than examining CEO overconfidence, we focus on investor overconfidence. Similar to Malmendier and Tate, we develop a novel measure of investor overconfidence based on the characteristics and portfolio decisions of equity mutual fund managers and show that investor overconfidence also impacts corporate policies.

Our paper also contributes to the growing literature that examines the impact of market mispricing on corporate financing and investment decisions (e.g., Baker and Wurgler 2002, Gilchrist et al. 2005, Polk and Sapienza 2009, Dong et al. 2012). Most studies in this literature use either ex ante measures of mispricing (e.g., valuation ratios) or ex post measures of mispricing (subsequent returns). An alternative approach, suggested by Baker and Wurgler (2013), is to move closer to the root cause of mispricing, i.e., nonfundamental investor demand. In this paper we identify a new source of nonfundamental demand driven by investor overconfidence and show that it has a significant impact on equity financing and real investment.

Finally, our paper is related to a large 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 firm value increases with investors' awareness and the size of investor base. Similarly, Easley and O'Hara (2004) consider a market with complete but asymmetric information, and show that, holding the total amount of information constant, firm value decreases in the proportion of private information. While the existing literature emphasizes the amount and composition of information, we focus on the way in which investors process information and how it impacts prices.

2. Data, Sample, and Measures

2.1. Data and Sample

We combine data from several sources for the sample period 1988–2010. Stock return, Standard Industrial Classification (SIC) code, trading volume, share price, and shares outstanding are from the Center for Research in Security Prices (CRSP). We restrict our sample to common stocks (CRSP share code of 10 or 11) and remove financial firms (SIC code between 6000 and 6999). Book value of equity, total assets, R&D expense, operating income after depreciation, dividends, capital expenditure, retained earnings, and long-term debt come from COMPUSTAT annual file. We exclude firms with negative book value of equity.

We obtain mutual fund holdings from Thomson Financial. We obtain monthly fund returns, monthly total net assets, portfolio turnover, and investment objectives from the CRSP Survivorship Bias Free Mutual Fund Database. We aggregate all share classes of the same fund because they have the same underlying portfolio and have the same fund manager. We merge the Thomson holdings database with the CRSP database using the MFLINKS linking files from WRDS (Wharton Research Data Services). Fund manager names and their 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 use the investment objective criteria from Kacperczyk et al. (2008). In addition, we follow Gil-Bazo and Ruiz-Verdu (2009) and use fund names to identify and exclude index funds. We exclude stocks not held by any of our sample funds.

Elton et al. (2001) and Fama and French (2010) report data problems in the CRSP Survivorship Bias Free Mutual Fund Database prior to 1984. Most notably, prior to 1984 funds that report their returns monthly (approximately 85% of funds in the database) outperform funds that report their returns annually by a significant amount, which introduces a bias in tests that require monthly returns. Because some of our fund characteristics require three years of fund returns and our overconfidence index is a two year moving average we start our sample in 1988.

2.2. Measures of Investor Overconfidence

A challenge for any study of investor overconfidence is that overconfidence is not directly observable. Prior literature has suggested a number of proxies for overconfidence. These proxies are motivated by experimental evidence from the psychology literature and by behaviors of overconfident investors derived from theoretical models. For example, experimental evidence shows that men are more overconfident than women (Lundeberg et al. 1994, Prince 1993), suggesting that gender is correlated with overconfidence.[4] Odean (1998) shows 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. Barber and Odean (2001, 2002) find empirical evidence that portfolios of overconfident investors indeed exhibit higher turnover and higher risk; and Goetzmann and Kumar (2008) document that overconfidence is related to underdiversification. In addition, Daniel et al. (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 bad outcomes to external factors. Their models suggest that prior performance can be a proxy for overconfidence.[5] Furthermore, Gervais and Odean (2001) show that the impact of self-attribution bias weakens with time, which suggests that tenure should be negatively related to overconfidence. In addition, because self-attribution bias is likely to be 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 seven components: manager's gender, manager's tenure, management structure, portfolio turnover, portfolio concentration, prior portfolio performance, and portfolio idiosyncratic risk. For brevity, we refer the reader to Appendix B for detailed definitions of these seven variables.

We follow a procedure similar to the one used by Gompers et al. (2003) when constructing our overconfidence index. The only difference is that we have both indicator variables and continuous variables. The two indicator variables (GENDER and MANAGEMENT STRUCTURE) take values of zero or one. For the five continuous variables, we use percentile ranks. Specifically, each quarter we rank fund managers in each investment objective into percentiles based on each of the five characteristics that are not indicator variables. For example, when ranking managers on turnover, the bottom 1% of the managers with the lowest turnover are assigned a score of 0.01. Similarly, the top 1% of the managers with the highest turnover are assigned a score of 1. The percentile ranks for each variable are constructed so that the higher value corresponds to higher overconfidence. We then sum the scores on the seven components to obtain the overconfidence index for the fund manager. The index can take on values between 0 and 7 with higher 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.

The above overconfidence index is a manager-level characteristic and firm value is a stock-level characteristic. To transform the manager-level overconfidence index into a stock-level OCI we compute weighted average overconfidence index of fund managers who hold the stock.

2.3. Firm Valuation Measures

2.3.1. The Market-to-Book Ratio. The market-to-book ratio is a commonly used measure of firm valuation.[6] We follow Gompers et al. (2003) and 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). We compute market value of equity and M/B four months after the fiscal year-end to ensure that accounting data are publicly available.

2.3.2. The RKRV Misvaluation Measure. To provide more direct evidence on overvaluation, we follow Rhodes-Kropf, Robinson, and Viswanathan (RKRV 2005) and construct a misvaluation measure by decomposing the market-to-book ratio as follows:

$$m - b \equiv (m - v) + (v - b), \tag{1}$$

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:

$$\begin{aligned} m_{it} = {} & \alpha_{jt} + \beta_{1jt} b_{it} + \beta_{2jt} \ln(NI)^{+}_{it} + \beta_{3jt} I_{(<0)} \ln(NI)^{+}_{it} \\ & + \beta_{4jt} \mathrm{LEV}_{it} + \varepsilon_{it}. \end{aligned} \tag{2}$$

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), Hertzel and Li (2010), Hoberg and Phillips (2010), and Fu et al. (2013) 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.

3. Empirical Results

3.1. Descriptive Statistics

In Table 1 we present descriptive statistics for our sample firms. Panel A reports the time-series average of 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 (OCI), the market-to-book ratio (M/B), the RKRV misvaluation measure, market capitalization (MKTCAP), total assets (ASSETS), firm age (AGE), return on assets (ROA), R&D, and leverage ratio (LEV).[7]

The average MKTCAP is $1.67 billion and the average AGE is 15.95 years, indicating that our sample is tilted toward larger and older firms. The average M/B ratio is 1.99, which is consistent with recent studies. For example, Villalonga and Amit (2006) report an average M/B ratio of 2.03 for their sample firms and Roll et al. (2009) report an average M/B of 1.91. The average RKRV is close to zero because, by construction, RKRV captures the extent of overvaluation relative to industry peers. Our sample firms have an average ROA of 3.84%, which is somewhat lower than the long-term average ROA in the United States (Gebhardt et al. 2001), but consistent with declining profitability in recent periods (Irvine and Pontiff 2009).

In panel B we report the time-series average of cross-sectional correlations. 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 OCI is positively correlated with both M/B and RKRV. These correlations are statistically significant and constitute initial evidence that investor overconfidence is associated with overvaluation. In addition, OCI exhibits a negative correlation with age and a positive correlation with R&D, suggesting that younger and more R&D intensive firms attract more overconfident investors.

3.2. Investor Overconfidence and Firm Valuation

3.2.1. Portfolio Analysis. Behavioral theory predicts that firms with more overconfident investors will have higher market valuations than firms with less overconfident investors. We first test this proposition using a portfolio approach. Each June, we group firms into OCI quintile portfolios and then compute equal-weighted

Table 1. Descriptive Statistics

Panel A: Descriptive statistics

Variable	Mean	25th percentile	Median	75th percentile	Std. dev
OCI	2.995	2.370	2.970	3.572	0.882
M/B	1.991	1.068	1.425	2.211	1.647
RKRV	0.031	−0.428	0.016	0.481	0.789
MKTCAP ($ billion)	1.665	0.078	0.250	0.943	4.801
ASSETS ($ billion)	1.752	0.078	0.256	0.999	4.800
AGE (years)	15.950	5.051	10.822	21.482	15.689
ROA (%)	3.839	0.128	7.538	13.190	18.752
R&D (%)	10.850	0.800	4.652	13.580	17.020
LEV	0.469	0.007	0.124	0.473	1.000

Panel B: Correlations

	OCI	M/B	RKRV	MKTCAP	ASSETS	AGE	ROA	R&D	LEV
OCI	1.00								
M/B	0.14**	1.00							
RKRV	0.12**	0.57**	1.00						
MKTCAP	−0.02	0.10**	0.14**	1.00					
ASSETS	−0.02	−0.08**	0.05**	0.82**	1.00				
AGE	−0.11**	−0.16**	−0.03**	0.38**	0.43**	1.00			
ROA	0.03	−0.04+	0.07**	0.15**	0.10**	0.14**	1.00		
R&D	0.12**	0.38**	0.15**	−0.08**	−0.12**	−0.25**	−0.51**	1.00	
LEV	−0.06**	−0.26**	−0.19**	−0.05**	0.08**	0.06**	−0.02	−0.18**	1.00

Notes. Our sample includes only common stocks (those with a share code of 10 or 11 in CRSP) 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 2.2. M/B is the market-to-book ratio. RKRV is the misvaluation measure as defined in Rhodes-Kropf et al. (2005). 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. LEV is market leverage. Detailed variable definitions are in Appendix B. All variables other than OCI, RKRV, MKTCAP, and ASSETS are winsorized at the 1st and 99th percentile. MKTCAP and ASSETS are winsorized at the 99th percentile only. 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.

+, *, and ** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

M/B for each quintile.[8] We also compute the difference in M/B between the two extreme OCI quintiles.

Panel A of Table 2 shows that the M/B ratio increases monotonically across OCI portfolios from 1.65 for the low-OCI quintile to 2.28 for the high-OCI quintile. The difference between high- and low-OCI portfolios is highly economically and statistically significant at 0.63 ($t = 8.40$). This difference implies that a high-OCI firm with total assets of $1 billion would have a market value that is $630 million higher than that of a low-OCI firm with the same amount of total assets.

Panel A of Table 2 also reports the average RKRV for portfolios sorted on OCI. We find that the average RKRV increases from −0.17 for low-OCI firms to 0.10 for high-OCI firms. The difference in the average RKRV measure between high- and low-OCI firms is 0.27 (t-stat = 8.03), which is highly statistically significant. To gauge the economic significance of this result,

Table 2. Investor Overconfidence and Firm Valuation

Panel A: Portfolio analysis

	OCI1 (low)	OCI2	OCI3	OCI4	OCI5 (high)	OCI5 – OCI1
M/B	1.650	1.786	2.010	2.199	2.282	0.632
	(27.13)	(22.82)	(20.80)	(16.58)	(23.51)	(8.40)
RKRV	−0.171	−0.022	0.085	0.141	0.099	0.270
	(−6.96)	(−1.15)	(7.81)	(10.72)	(4.24)	(8.03)

Panel B: Cross-sectional regressions

	M/B			RKRV		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	1.320	2.424	2.289	−0.094	−0.085	−0.092
	(17.22)	(18.61)	(17.74)	(−2.45)	(−1.64)	(−1.97)
OCI^{RANK}	0.141	0.163	0.116	0.068	0.067	0.048
	(7.48)	(7.14)	(7.17)	(7.90)	(8.35)	(9.15)
Log(ASSETS)		−0.228	−0.177		−0.007	0.014
		(−11.72)	(−9.64)		(−1.56)	(3.27)
AGE		−0.007	−0.005		−0.003	−0.003
		(−5.41)	(−4.12)		(−8.45)	(−6.98)
DELAWARE		0.127	0.105		0.062	0.062
		(3.83)	(4.93)		(6.60)	(7.84)
S&P500		1.099	0.819		0.382	0.263
		(10.72)	(9.98)		(19.53)	(13.11)
R&D			4.181			1.290
			(13.43)			(7.96)
I (missing R&D)			−0.094			−0.060
			(−2.32)			(−3.91)
ROA			1.550			0.638
			(9.47)			(16.60)
LEV			−0.289			−0.179
			(−5.88)			(−10.43)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Avg. no. of obs.	3,354	3,354	3,329	3,222	3,222	3,210
Adjusted R^2	0.14	0.19	0.29	0.04	0.06	0.12

Notes. Our sample includes only common stocks (those with a share code of 10 or 11 in CRSP) 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. OCI is the weighted average overconfidence index of all mutual funds holding the stock, as defined in Section 2.2. Each year, we sort firms into overconfidence quintiles based on their most recent OCI and compute equal-weighted average M/B and RKRV for each quintile. The RRKV measure is based on Rhodes-Kropf et al. (2005) and defined in Section 2.3.2. We report time-series mean of cross-sectional average M/B (RKRV) for each OCI quintile, and the difference in M/B (RKRV) between firms in high- and low-OCI quintiles. Panel B presents the regression results. Each year we estimate regressions of M/B and RKRV on investor overconfidence and a set of control variables. OCI^{RANK} is the quintile rank of OCI variable. Control variables include the following: ASSETS, AGE, S&P500 indicator, DELAWARE indicator, ROA, R&D, missing R&D indicator, and LEV. Detailed variable definitions are in Appendix B. Industry fixed effects for Fama and French (1997) 48-industry classification are included in all regressions. We report time-series average coefficients across yearly cross-sectional regressions. Numbers in parentheses are t-statistics based on the time-series standard deviation adjusted for heteroskedasticity and first lag autocorrelation using the Newey–West (1987) approach.

note that RKRV measure is the residual from a regression of market value, expressed as a logarithm, on book value, net income, and leverage. If two firms have exactly the same intrinsic values based on their predicted regression values, then the difference in their RKRV measures would be equal to the difference in the logarithms of their market capitalizations. The difference in average RKRV measure of 0.27 implies that the ratio of the market value of high-OCI firm to the market value of low-OCI firm is 1.31.[9] Hence, the RKRV results imply that the average market value of high-OCI firms is 31% higher than the average market value of low-OCI firms.

3.2.2. Regression Analysis. Prior literature has identified a number of firm characteristics that are related to firm value such as firm age, R&D, ROA, leverage, 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:

$$M/B_{i,t} = \beta_0 + \beta_1 OCI^{RANK}_{i,t-1} + \gamma Controls_{i,t-1} + \delta Ind^{FE}_i + e_{i,t}. \tag{3}$$

OCI^{RANK} for each firm is the quintile rank of its most recent OCI.[10] The vector of control variables includes ASSETS, AGE, ROA, R&D, the S&P500 indicator, the DELAWARE indicator, and LEV. In addition, we include fixed effects (FE) for Fama and French (1997) 48 industries in each regression. To reduce the impact of outliers, we winsorize AGE, ROA, and R&D at the 1st and 99th percentiles. Following Fama and MacBeth (1973), we estimate a cross-sectional regression each year and report the average coefficients. We compute t-statistics based on the time-series variation in yearly coefficients with an adjustment for heteroskedasticity and autocorrelation (Newey and West 1987).

Panel B of Table 2 reports the results. We estimate a univariate model in the first column, and find that the coefficient on OCI^{RANK} is positive and statistically significant at 0.14 (t-stat = 7.48). This coefficient implies that firms in the highest OCI quintile have an average M/B ratio that is 0.56 higher than that of firms in the lowest OCI quintile, consistent with the result from the portfolio analysis. In Models 2 and 3, we add control variables. The coefficients on all control variables are statistically significant and consistent with those documented in the prior literature. Specifically, we find that M/B is negatively related to total assets, firm age, and leverage; and positively related to Delaware incorporation, S&P 500 index membership, R&D, and ROA. More importantly, the coefficient on OCI^{RANK} remains economically and statistically significant, ranging from 0.12 (t-stat = 7.17) to 0.16 (t-stat = 7.14). 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 0.48 and 0.64 higher than those of firms in the lowest OCI quintile. Taken together, the portfolio and regression results show strong evidence that M/B is positively associated with OCI. We interpret this finding as consistent with the hypothesis that investor overconfidence leads to overvaluation.

The cross-sectional regression results for RKRV, also reported in panel B, paint a similar picture. The coefficients on OCI^{RANK} are statistically significant in all regression specifications. To the extent that RKRV captures mispricing, our results provide support for the prediction that firms with more overconfident investors are more overvalued.

3.3. Subsequent Returns

If investor overconfidence leads to overvaluation, we should expect a price reversal as mispricing gets corrected. Therefore, firms with more overconfident investors should have lower subsequent returns than firms with less overconfident investors. We test this prediction using a portfolio approach. Each quarter, we sort all firms in our sample into five portfolios based on their end-of-quarter OCI. We then hold these five portfolios for the subsequent 12 months and calculate average monthly returns for each portfolio. We estimate CAPM one-factor alpha, Fama-French three-factor alpha, and Carhart four-factor alpha by running the following time-series regressions:

$$r_{i,t} = \alpha_i + \beta_i MKT_t + e_{i,t}, \tag{4}$$

$$r_{i,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + e_{i,t}, \tag{5}$$

$$r_{i,t} = \alpha_i + \beta_i MKT_t + s_i SMB_t + h_i HML_t + u_i UMD_t + e_{i,t}, \tag{6}$$

where MKT is the equal-weighted CRSP index return in excess of the risk-free rate; and SMB, HML, and UMD are size, value, and momentum factors (Fama and French 1996, Carhart 1997).[11] Table 3 reports average monthly raw-returns, one-factor, three-factor, and four-factor alpha for each of the five portfolios and for the difference between high- and low-OCI portfolios. Because there is a nine-month overlap in our holding periods, we adjust standard errors for serial correlation using the Newey–West (1987) procedure with nine lags.[12]

Consistent with our prediction, we find that high-OCI firms exhibit significantly lower returns than low-OCI firms do over the following 12 months. In panel A of Table 3, we find that the average raw return is 1.07% per month for low-OCI firms and only 0.71% for high-OCI firms. The difference in raw returns between high- and low-OCI firms is −0.35% per month (t-stat = −2.12). This result is economically meaningful

Table 3. Investor Overconfidence and Subsequent Returns

	OCI1 (low)	OCI2	OCI3	OCI4	OCI5 (high)	OCI5 − OCI1
			Panel A: Raw OCI			
Raw return (%)	1.066	0.815	0.754	0.686	0.715	−0.351
	(2.51)	(2.11)	(2.04)	(1.78)	(1.60)	(−2.12)
One-factor alpha (%)	0.182	−0.018	−0.080	−0.203	−0.294	−0.476
	(1.83)	(−0.23)	(−0.83)	(−1.87)	(−2.57)	(−2.97)
Three-factor alpha (%)	0.118	−0.053	−0.065	−0.137	−0.168	−0.286
	(1.24)	(−0.67)	(−0.68)	(−1.32)	(−1.73)	(−2.18)
Four-factor alpha (%)	0.236	−0.009	−0.059	−0.103	−0.087	−0.322
	(2.53)	(−0.11)	(−0.60)	(−0.97)	(−0.88)	(−2.38)
			Panel B: OCI stratified by M/B			
Raw return (%)	1.038	0.812	0.755	0.667	0.756	−0.281
	(2.48)	(2.12)	(2.02)	(1.73)	(1.71)	(−2.25)
One-factor alpha (%)	0.140	−0.028	−0.088	−0.218	−0.230	−0.370
	(1.98)	(−0.38)	(−1.02)	(−2.28)	(−1.77)	(−2.96)
Three-factor alpha (%)	0.122	−0.041	−0.077	−0.179	−0.137	−0.259
	(1.66)	(−0.63)	(−0.92)	(−1.98)	(−1.36)	(−2.75)
Four-factor alpha (%)	0.215	−0.006	−0.052	−0.129	−0.054	−0.270
	(2.76)	(−0.10)	(−0.67)	(−1.52)	(−0.60)	(−2.68)

Notes. Our sample includes only common stocks (those with a share code of 10 or 11 in CRSP) 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 2.2. In panel A, at the end of each quarter we sort firms first into overconfidence quintiles based on their end-of-quarter OCI. In panel B, at the end of each quarter we sort firms into terciles based on M/B and sequentially into overconfidence quintiles based on their end-of-quarter OCI. We then combine same OCI quintile across M/B terciles. We hold these portfolios for the subsequent 12 months. We calculate monthly equal-weighted returns for each of the five raw (stratified) OCI portfolios and for the strategy that goes long high-OCI portfolio and goes short low-OCI portfolio. We regress the time series of excess OCI portfolio returns on the equal-weighted market excess return, and size, value, and momentum factors. We report time-series average raw return, one-factor alpha, three-factor alpha, and four-factor alpha for each portfolio and for the long-short strategy. Numbers in parentheses are t-statistics based on the time-series standard deviation adjusted for heteroskedasticity and autocorrelation up to nine lags using the Newey–West (1987) approach.

and statistically significant. The difference in monthly risk-adjusted returns is −0.48% (t-stat = −2.97) for one-factor alpha, −0.29% (t-stat = −2.18) for three-factor alpha, and −0.32% (t-stat = −2.38) for four-factor alpha, all of which are statistically significant. Overall, our results support the proposition that high OCI firms are overvalued and they experience significantly lower subsequent abnormal returns.

One might be concerned that OCI is significantly related to subsequent returns because it is related to M/B, which the prior literature has shown to be a negative cross-sectional predictor for future stock returns. To mitigate this concern, we perform a stratified double sort. We first sort all sample stocks into terciles based on M/B and then sequentially sort on OCI. Next, we combine the same OCI quintile across high-, medium-, and low-M/B terciles. This procedure makes each OCI quintile M/B neutral.[13] We then examine the subsequent returns of these M/B-stratified OCI portfolios. Panel B reports the results. We continue to find that high-OCI firms exhibit lower stock returns. The difference in subsequent returns between high- and low-OCI firms is negative and statistically significant in each model specification.[14]

3.4. Endogeneity

A potential alternative explanation for the positive relation between OCI and firm valuation is that overconfident investors do not impact firm value, 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 (Daniel et al. 1998). To the extent that firms with more uncertain prospects tend to have higher market valuations (Pastor and Veronesi 2003), a preference for high information uncertainty by overconfident investors might explain our results. We address this concern in three ways.

First, we use an instrumental variable approach with two-stage least squares (2SLS). Following Fang et al. (2009), we use two instruments for OCI^{RANK}. The first instrument is the lagged OCI and the second instrument is the average OCI of two firms from the same industry as firm i that have the closest market capitalization to firm i (OCI_{COMP}). We use lagged OCI as our first instrument because lagged OCI is exogenous to firm value in the current period and helps mitigate concerns that an unobservable in year t is correlated with both OCI and firm valuation in year t. We use OCI_{COMP} as our second instrument because competitors' OCI is less likely than firm *i*'s OCI to be related to firm *i*'s unobservable characteristics that affect its valuation. The first equation of our 2SLS system models OCI^{RANK} as a function of lagged OCI, OCI_{COMP}, and all the controls for firm valuation included in Table 2. The second equation models firm value as a function of the predicted OCI^{RANK} and the controls. Following Fama and French (2002), we estimate the 2SLS system separately for each year. We report time-series average coefficients and *t*-statistics in Table 4. From the first-stage regression, it is evident that both of our instruments are strongly related to contemporaneous OCI^{RANK} in the predicted direction and they explain approximately 26% of the variation in OCI^{RANK}. In the second-stage regression, we use the predicted value of OCI^{RANK} from the first-stage regression as an explanatory variable for M/B and RKRV misvaluation measure. We find that the predicted value of OCI^{RANK} is an economically and statistically significant predictor of firm valuation in both second-stage regressions.

Second, we perform a difference-in-difference analysis. Both the firm valuation measures (M/B and RKRV) and investor overconfidence measure (OCI) are quite persistent. Therefore, one might be concerned that they are both driven by some unobserved firm characteristics. To mitigate this concern, we examine the relation between changes in OCI and changes in firm valuation. The results reported in Table 5 indicate that an increase in OCI is associated with a significant increase in M/B and RKRV.

Third, we repeat our analysis using an alternative OCI measure constructed based on manager characteristics only. As stated earlier, our overconfidence index is based on seven variables, three of which are manager characteristics (GENDER, TENURE, and MANAGEMENT STRUCTURE), while the other four are portfolio characteristics (PORTFOLIO TURNOVER, PORTFOLIO CONCENTRATION, PRIOR FUND PERFORMANCE, and IDIOSYNCRATIC RISK). Because the portfolio characteristics are indirectly related to stock characteristics, one might be concerned that the OCI-firm value relation may be driven by the portfolio characteristics. Manager characteristics, on the other hand, are not related to stock characteristics in any mechanical way. The results in Table 6 indicate that the positive OCI-firm value relation continues to hold for the overconfidence index constructed from manager characteristics only. For example, high-(low-)OCI firms exhibit an average M/B of 2.023 (1.785). The difference of 0.238 is significant both economically and statistically. Similarly, high-OCI firms also exhibit a significantly higher RKRV misvaluation measure than low-OCI firms. Overall, the results from the above three analyses suggest that our main findings are unlikely to be driven by endogeneity.[15]

Table 4. Investor Overconfidence and Firm Valuation—Two-Stage Least-Squares Regressions

	First stage	Second stage	
	OCI	M/B	RKRV
Intercept	0.441	1.094	−0.256
	(2.68)	(10.92)	(−6.63)
OCI_{lag}	0.710		
	(14.40)		
OCI_{COMP}	0.001		
	(9.33)		
OCI^{RANK}		0.274	0.091
		(7.20)	(7.76)
Log(ASSETS)	0.099	−0.184	0.013
	(3.12)	(−8.54)	(1.94)
AGE	−0.006	−0.003	−0.002
	(−9.61)	(−2.66)	(−4.21)
DELAWARE	0.020	0.091	0.056
	(1.44)	(5.02)	(7.63)
S&P500	−0.221	0.817	0.252
	(−5.95)	(8.89)	(10.28)
R&D	0.851	4.850	1.484
	(7.88)	(18.45)	(11.94)
I (missing R&D)	0.002	−0.059	−0.052
	(0.12)	(−1.81)	(−3.34)
ROA	0.569	1.766	0.659
	(6.56)	(12.22)	(13.66)
LEV	−0.056	−0.252	−0.166
	(−3.21)	(−5.21)	(−9.32)
Industry FE	Yes	Yes	Yes
Adjusted R^2	0.26	0.16	0.10

Notes. Our sample includes only common stocks (those with a share code of 10 or 11 in CRSP) 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 2.2. M/B is the market-to-book ratio. RKRV is the misvaluation measure as defined in Rhodes-Kropf et al. (2005). Detailed definition of RKRV is in Section 2.3.2. OCI^{RANK} is the quintile rank of OCI variable. Control variables include the following: ASSETS, AGE, S&P500 indicator, DELAWARE indicator, ROA, R&D, missing R&D indicator, and LEV. First-stage regressions also include lagged OCI (OCI_{lag}) and the average OCI of two firms from the same industry as firm *i*that have the closest market capitalization to firm *i* (OCI_{COMP}). Detailed variable definitions are in Appendix B. We run first-stage regressions separately for each year and use annual coefficients to obtain predicted values for the second stage. We also run second-stage regressions each year. We report average coefficients across the yearly cross-sectional regressions. Industry fixed effects for Fama and French (1997) 48-industry classification are included in all regressions. Numbers in parentheses are *t*-statistics based on the time-series standard deviation of coefficients, adjusted for heteroskedasticity and first lag autocorrelation using the Newey–West (1987) approach.

3.5. Does Investor Overconfidence Affect Equity Financing and Corporate Investment?

In this section we examine whether investor overconfidence affects corporate decisions. The inefficient markets approach to corporate finance suggests that

Table 5. Changes in Investor Overconfidence and Firm Valuation, Difference-in-Difference Analysis

	Dependent variable	
	ΔM/B	ΔRKRV
Intercept	0.148	−0.428
	(2.66)	(−3.17)
$I(\Delta OCI^{+})$	0.033	0.168
	(5.47)	(4.23)
Log(ASSETS)	−0.021	0.057
	(−4.50)	(3.08)
AGE	0.001	0.001
	(2.51)	(0.77)
DELAWARE	0.015	0.033
	(2.41)	(0.91)
S&P500	0.034	0.411
	(3.22)	(4.76)
R&D	−0.043	0.317
	(−0.42)	(1.08)
I (missing R&D)	−0.015	−0.110
	(−1.88)	(−1.51)
ROA	−0.213	−1.403
	(−3.14)	(−6.41)
LEV	−0.021	−0.144
	(−3.05)	(−5.46)

Notes. Our sample includes only common stocks (those with a share code of 10 or 11 in CRSP) 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 2.2. Each year we estimate regressions of change in firm valuation on change in OCI and a set of control variables. Firm valuation is measured by M/B and RKRV. M/B is the market-to-book ratio. RKRV is the misvaluation measure as defined in Rhodes-Kropf et al. (2005). A detailed definition of RKRV is in Section 2.3.2. $\Delta M/B$ ($\Delta RKRV$) is change in M/B (RKRV) from the previous year. $I(\Delta OCI^{+})$ is an indicator for a positive change in OCI variable. Control variables include the following: ASSETS, AGE, S&P500 indicator, DELAWARE indicator, ROA, R&D, missing R&D indicator, and LEV. Detailed variable definitions are in Appendix B. Industry fixed effects for Fama and French (1997) 48-industry classification are included in all regressions. We report average coefficients across the yearly cross-sectional regressions. Numbers in parentheses are t-statistics based on the time-series standard deviation of coefficients, adjusted for heteroskedasticity and first lag autocorrelation using the Newey–West (1987) approach.

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. Moreover, the effect of misvaluation on corporate decisions is more pronounced among firms whose equity is overvalued (Jensen 2005, Dong et al. 2012). To the extent that investor overconfidence leads to overvaluation, we expect it to also impact corporate financing and real investment.

3.5.1. Equity Financing. We first focus on equity financing. 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 year t divided by the split adjusted shares outstanding at the fiscal year-end in year $t-1$, computed using COMPUSTAT data. External equity issues (EI) is defined as the 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. For each OCI quintile, we then compute equal-weighted average measures of equity financing for the following year. Results in panel A of Table 7 indicate that the average NS is 3.20% for low-OCI firms and 5.19% for high-OCI firms. The difference in NS between high- and low-OCI firms is economically and statistically significant 1.99% (t-stat = 7.71). Similarly, the average EI increases from 6.07% for low-OCI firms to 12.60% for high-OCI firms, producing a statistically and economically significant difference of 6.53% (t-stat = 4.96).

Previous studies identified several determinants of external equity financing such as the M/B ratio and past stock 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 cross-sectional regressions each year:

$$\begin{aligned} \mathit{Equity\ Financing}_{i,t} &= \beta_0 + \beta_1 \mathrm{OCI}^{\mathrm{RANK}}_{i,t-1} + \beta_2 \mathrm{M/B}_{i,t-1} + \beta_3 \mathrm{CF}_{i,t-1} + \beta_4 \mathrm{AGE}_{i,t-1} \\ &\quad + \beta_5 \mathrm{LEV}_{i,t-1} + \beta_6 \mathrm{ROA}_{i,t-1} + \beta_7 \mathrm{RET}_{i,t-12,t-1} + e_{i,t}, \end{aligned} \tag{7}$$

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

Panel B of Table 7 presents the results. If the impact of OCI on equity financing is entirely because of 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. To fully explore whether the impact of OCI on equity financing is independent of or subsumed by the impact of

Table 6. Overconfidence and Firm Valuation—OCI Based on Managerial Characteristics Only

Panel A: Firm valuation

	OCI1 (low)	OCI2	OCI3	OCI4	OCI5 (high)	OCI5 – OCI1
M/B	1.785	1.940	2.096	2.099	2.023	0.238
	(25.69)	(22.34)	(19.15)	(19.10)	(27.64)	(7.88)
RKRV	−0.105	0.000	0.113	0.120	0.010	0.115
	(−4.40)	(−0.01)	(9.72)	(9.93)	(0.43)	(3.68)

Panel B: Cross-sectional regressions

	M/B			RKRV		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	1.578	2.621	2.434	0.010	−0.011	−0.036
	(28.73)	(19.68)	(18.89)	(0.24)	(−0.21)	(−0.79)
OCI^{RANK}	0.060	0.079	0.051	0.035	0.034	0.023
	(5.55)	(5.14)	(5.18)	(4.71)	(5.29)	(5.66)
Log(ASSETS)		−0.211	−0.163		0.000	0.020
		(−12.10)	(−9.69)		(−0.14)	(5.40)
AGE		−0.009	−0.006		−0.004	−0.003
		(−6.51)	(−5.04)		(−11.50)	(−8.70)
DELAWARE		0.135	0.109		0.065	0.064
		(3.92)	(5.02)		(6.69)	(7.89)
S&P500		1.089	0.800		0.379	0.257
		(10.95)	(10.11)		(20.18)	(13.61)
R&D			4.304			1.339
			(13.80)			(8.20)
I (missing R&D)			−0.095			−0.061
			(−2.30)			(−3.90)
ROA			1.605			0.661
			(9.37)			(16.32)
LEV			−0.300			−0.183
			(−6.10)			(−10.78)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Avg. no. of obs.	3,353	3,353	3,329	3,221	3,221	3,210
Adjusted R^2	0.12	0.17	0.28	0.03	0.05	0.12

Notes. Our sample includes only common stocks (those with a share code of 10 or 11 in CRSP) 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. Overconfidence index is based on three manager characteristics (GENDER, TENURE, and MANAGEMENT STRUCTURE). In panel A, we sort firms into overconfidence quintiles based on their most recent OCI and compute equal-weighted average M/B and RKRV for each quintile. The RRKV measure is based on Rhodes-Kropf et al. (2005) and defined in Section 2.3.2. We report time-series mean of cross-sectional average M/B (RKRV) for each OCI quintile, and the difference in M/B (RKRV) between firms in high- and low-OCI quintiles. Panel B presents results of yearly regressions of M/B and RKRV on investor overconfidence and a set of control variables. OCI^{RANK} is the quintile rank of OCI variable. Control variables include the following: ASSETS, AGE, S&P500 indicator, DELAWARE indicator, ROA, R&D, missing R&D indicator, and LEV. Detailed variable definitions are in Appendix B. Industry fixed effects for Fama and French (1997) 48-industry classification are included in all regressions. We report time-series average coefficients across yearly cross-sectional regressions. Numbers in parentheses are t-statistics based on the time-series standard deviation adjusted for heteroskedasticity and first lag autocorrelation using the Newey–West (1987) approach.

M/B, we estimate three regressions; the first regression includes OCI but not M/B, the second includes M/B but not OCI, 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 (NS or EI) is negatively related to cash flow and firm age, 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 and other determinants of equity financing, investor overconfidence still exerts a positive impact on NS and EI. The coefficient on OCI remains positive and statistically significant. This finding suggests that investor overconfidence has a positive impact on NS and EI that is incremental to other control variables including M/B and past stock returns. Overall, results in Table 7 are consistent with the idea that investor overconfidence leads to mispricing, and that corporate managers exploit market mispricing when making financing decisions.[16]

Table 7. The Effect of Investor Overconfidence on External Equity Financing

Panel A: Portfolio analysis

	OCI1 (low)	OCI2	OCI3	OCI4	OCI5 (high)	OCI5 − OCI1
NS (%)	3.201	2.939	3.050	3.816	5.193	1.992
	(8.54)	(9.33)	(8.18)	(8.68)	(9.86)	(7.71)
EI (%)	6.066	5.714	6.296	8.552	12.595	6.529
	(6.94)	(6.76)	(5.35)	(4.72)	(6.41)	(4.96)

Panel B: Multiple regressions

	NS			EI		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	0.019	0.020	0.013	0.049	0.019	0.010
	(3.58)	(3.55)	(2.34)	(5.61)	(2.41)	(1.28)
OCI^{RANK}	0.258		0.229	0.570		0.311
	(6.22)		(5.43)	(7.77)		(5.70)
M/B_{t-1}		0.408	0.383		2.594	2.563
		(5.29)	(4.86)		(9.69)	(9.55)
CF_{t-1}	−0.013	−0.020	−0.021	−0.069	−0.120	−0.121
	(−0.73)	(−1.18)	(−1.22)	(−0.89)	(−1.53)	(−1.55)
AGE	−0.001	−0.001	−0.001	−0.001	−0.001	−0.001
	(−13.58)	(−13.49)	(−13.51)	(−7.41)	(−6.67)	(−6.72)
$RET_{t-12,t-1}$	0.018	0.018	0.017	0.052	0.051	0.050
	(5.35)	(5.39)	(5.25)	(6.09)	(6.63)	(6.59)
LEV	−0.118	−0.121	−0.121	−0.306	−0.298	−0.298
	(−7.45)	(−7.03)	(−6.97)	(−5.79)	(−5.40)	(−5.38)
ROA	0.009	0.010	0.010	−0.014	−0.004	−0.004
	(5.12)	(5.54)	(5.64)	(−4.66)	(−3.06)	(−3.04)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Avg. no. of obs.	2,601	2,601	2,601	2,454	2,454	2,454
Adjusted R^2	0.10	0.10	0.10	0.17	0.19	0.19

Notes. Our sample includes only common stocks (those with a share code of 10 or 11 in CRSP) 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 2.2. Panel A reports the results of the 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 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 the change in book equity minus the 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 the results of cross-sectional regressions. Each year we estimate regressions of equity financing on investor overconfidence and a set of control variables. OCI^{RANK} is the quintile rank of the OCI variable. M/B is the 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. Industry fixed effects for Fama and French (1997) 48-industry classification are included in all regressions. 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 time-series standard deviation of coefficients, adjusted for heteroskedasticity and first lag autocorrelation using the Newey–West (1987) approach.

3.5.2. Corporate Investment. We next turn to the impact of investor overconfidence on corporate investment. To the extent that investor overconfidence leads to 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 exhibit higher levels of corporate investment than firms with less overconfident investors. We consider two measures of corporate investment, i.e., the capital investment and asset growth. We follow Baker et al. (2003) and define capital investment (CI) as the ratio of capital expenditure to total assets. We follow Cooper et al. (2008) and define the asset growth rate (AG) as the year-on-year percentage change in total assets.

Panel A of Table 8 presents the univariate portfolio results. The average CI increases from 6.14% for low-OCI firms to 7.90% for high-OCI firms. The results suggest that high-OCI firms' capital expenditure as a percentage of total assets is on average 1.75% (t-stat = 6.06) higher than that of low-OCI firms. The results for the asset growth rate are similar. The average AG increases

Table 8. The Effect of Investor Overconfidence on Corporate Investment

Panel A: Portfolio analysis

	OCI1 (low)	OCI2	OCI3	OCI4	OCI5 (high)	OCI5 – OCI1
CI (%)	6.143	6.708	7.515	7.834	7.897	1.754
	(13.09)	(14.47)	(13.26)	(13.07)	(12.24)	(6.06)
AG (%)	9.534	11.388	14.763	17.668	19.207	9.673
	(5.99)	(6.26)	(6.57)	(7.26)	(8.36)	(8.45)

Panel B: Multiple regressions

	CI			AG		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	0.096	0.096	0.090	0.032	0.018	−0.016
	(17.27)	(17.54)	(17.08)	(1.9)	(1.26)	(−1.13)
OCI^{RANK}	0.294		0.232	1.654		1.181
	(8.14)		(8.21)	(6.91)		(6.31)
Q_{t-1}		0.528	0.497		4.170	4.029
		(8.45)	(8.35)		(12.21)	(11.95)
CF_{t-1}	0.113	0.103	0.102	0.296	0.211	0.207
	(4.11)	(4.02)	(4.03)	(4.05)	(3.44)	(3.44)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Avg. no. of obs.	2,604	2,604	2,604	2,629	2,629	2,629
Adjusted R^2	0.26	0.26	0.26	0.07	0.09	0.10

Notes. Our sample includes only common stocks (those with a share code of 10 or 11 in CRSP) 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 2.2. Panel A reports the results of the 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 a 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. Industry fixed effects for Fama and French (1997) 48-industry classification are included in all regressions. 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 time-series standard deviation of coefficients, adjusted for heteroskedasticity and first lag autocorrelation using the Newey–West (1987) approach.

monotonically from 9.53% for low-OCI firms to 19.21% for high-OCI firms. The difference in AG between high- and low-OCI firms is highly economically and statistically significant at 9.67% (t-stat = 8.45). These univariate results are consistent with the idea that corporate managers exploit overconfidence-induced mispricing in their investment decisions.

Next, we follow Baker et al. (2003) and control for standard determinants of corporate investments. Specifically, each year we estimate the following cross-sectional regression:

$$\mathit{Corporate\ Investment}_{i,t} = \gamma_0 + \gamma_1 \mathrm{OCI}^{\mathrm{RANK}}_{i,t-1} + \gamma_2 Q_{i,t-1} + \gamma_3 \mathrm{CF}_{i,t-1} + e_{i,t}, \quad (8)$$

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, 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 report the average coefficients across all years and compute t-statistics using the time-series variation in estimated annual coefficients.

The results in panel B of Table 8 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 0.92% and 6.60% of

Table 9. Investor Overconfidence and Firm Valuation—Active Mutual Funds

Panel A: Portfolio analysis

	OCI1 (low)	OCI2	OCI3	OCI4	OCI5 (high)	OCI5 – OCI1
M/B	1.744	1.714	2.080	2.394	2.276	0.532
	(23.47)	(20.19)	(16.16)	(11.86)	(14.88)	(3.84)
RKRV	−0.236	−0.060	0.103	0.195	0.108	0.344
	(−9.22)	(−2.66)	(8.78)	(8.05)	(4.07)	(7.83)

Panel B: Cross-sectional regressions

	M/B			RKRV		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	1.271	2.470	2.327	−0.196	−0.076	−0.083
	(13.79)	(19.93)	(18.53)	(−4.95)	(−1.60)	(−1.86)
OCI^{RANK}	0.166	0.236	0.165	0.104	0.104	0.074
	(6.77)	(8.09)	(7.47)	(12.03)	(11.83)	(10.13)
Log(ASSETS)		−0.269	−0.207		−0.027	−0.001
		(−15.07)	(−14.52)		(−6.28)	(−0.09)
AGE		−0.008	−0.005		−0.003	−0.003
		(−6.42)	(−4.75)		(−9.67)	(−7.79)
DELAWARE		0.129	0.104		0.065	0.063
		(4.06)	(5.13)		(6.41)	(7.92)
S&P500		1.060	0.803		0.369	0.258
		(10.00)	(9.29)		(16.58)	(12.10)
R&D			4.127			1.258
			(13.96)			(8.17)
I (missing R&D)			−0.085			−0.058
			(−2.28)			(−3.81)
ROA			1.464			0.591
			(8.94)			(15.89)
LEV			−0.265			−0.168
			(−5.83)			(−10.90)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Avg. no. of obs.	3,044	3,044	3,016	2,922	2,922	2,906
Adjusted R^2	0.15	0.22	0.33	0.06	0.08	0.13

Notes. Our sample includes only common stocks (those with a share code of 10 or 11 in CRSP) 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 active mutual funds holding the stock. We define active mutual funds as a tercile of funds that have the highest portfolio turnover. In panel A, each year we sort firms into overconfidence quintiles based on their most recent OCI and compute equal-weighted average M/B and RKRV for each quintile. The RRKV measure is based on Rhodes-Kropf et al. (2005) and defined in Section 3.3. We report time-series mean of cross-sectional average M/B (RKRV) for each OCI quintile, and the difference in M/B (RKRV) between firms in high- and low-OCI quintiles. Panel B presents yearly regressions of M/B and RKRV on investor overconfidence and a set of control variables. OCI^{RANK} is the quintile rank of OCI variable. Control variables include the following: ASSETS, AGE, S&P500 indicator, DELAWARE indicator, ROA, R&D, missing R&D indicator, and LEV. Detailed variable definitions are in Appendix B. Industry fixed effects for Fama and French (1997) 48-industry classification are included in all regressions. We report time-series average coefficients across yearly cross-sectional regressions. Numbers in parentheses are t-statistics based on the time-series standard deviation adjusted for heteroskedasticity and first lag autocorrelation using the Newey–West (1987) approach.

their total assets more than low-OCI firms do. Because some of the impact of overconfidence on investment is through the M/B ratio, the economic significance of the OCI coefficients is somewhat reduced when compared to the portfolio analysis.

3.6. Additional Tests

3.6.1. Active Mutual Funds. Although we exclude index funds from our analysis, many equity mutual funds are still relatively passively managed. To the extent that managers of more active mutual funds are more likely to be overconfident and that their trading is more likely to impact stock prices, we would expect the investor overconfidence-firm value relation to be particularly strong among more actively managed funds. To test this prediction, we estimate the turnover of each fund based on the changes in their stock holdings and sort all funds into three turnover portfolios. We keep funds that are ranked in the high-turnover portfolio and construct our OCI based on this sample of more actively managed

Table 10. Investor Overconfidence and Firm Valuation—By Mutual Fund Ownership

	OCI1 (low)	OCI2	OCI3	OCI4	OCI5 (high)	OCI5 – OCI1
Panel A: By total mutual fund ownership						
M/B						
Low	1.687	1.843	2.047	2.207	2.296	0.609
	(30.55)	(27.92)	(21.11)	(16.39)	(21.15)	(7.74)
High	1.443	1.692	1.957	2.159	2.211	0.768
	(24.14)	(25.02)	(28.13)	(21.62)	(27.83)	(7.37)
High – Low						0.159
						(2.02)
RKRV						
Low	−0.194	−0.059	0.053	0.094	0.032	0.226
	(−9.63)	(−2.80)	(3.54)	(4.88)	(1.05)	(6.99)
High	−0.167	−0.010	0.092	0.151	0.161	0.328
	(−3.68)	(−0.56)	(8.91)	(11.53)	(7.03)	(5.69)
High – Low						0.102
						(1.90)
Panel B: By active mutual fund ownership						
M/B						
Low	1.656	1.835	1.991	2.100	2.265	0.609
	(28.49)	(28.02)	(25.95)	(20.07)	(20.61)	(5.19)
High	1.549	1.881	2.179	2.395	2.504	0.955
	(18.09)	(23.87)	(21.83)	(15.50)	(18.03)	(6.25)
High – Low						0.345
						(4.44)
RKRV						
Low	−0.097	0.060	0.120	0.130	0.106	0.203
	(−2.82)	(2.73)	(6.46)	(7.38)	(4.46)	(4.71)
High	−0.157	0.076	0.173	0.227	0.233	0.390
	(−3.48)	(2.94)	(9.66)	(13.14)	(10.33)	(6.88)
High – Low						0.187
						(5.40)

Notes. Our sample includes only common stocks (those with a share code of 10 or 11 in CRSP) 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. In panel A, OCI is the weighted average overconfidence index of all mutual funds holding the stock, as defined in Section 2.2. In panel B, OCI is the weighted average overconfidence index of active mutual funds holding the stock. We define active mutual funds as a tercile of funds that have the highest portfolio turnover. Each year, we sort firms into two groups based on mutual fund ownership and independently into quintiles based on their most recent available OCI. We compute equal-weighted average M/B and RKRV for each portfolio. The RRKV measure is based on Rhodes-Kropf et al. (2005) and defined in Section 2.3.2. For each mutual fund ownership group, we report time-series mean of cross-sectional average M/B (RKRV) for each OCI quintile, as well as the difference in M/B (RKRV) between firms in high- and low-OCI quintiles. Numbers in parentheses are t-statistics based on the time-series standard deviation adjusted for heteroskedasticity and first lag autocorrelation using the Newey–West (1987) approach.

funds. We then repeat our firm valuation analysis and report the results in Table 9. Overall, we continue to find a significantly positive relation between OCI and firm valuation, whether we measure it by M/B or RKRV and whether we use a portfolio approach or a regression approach.

3.6.2. Mutual Fund Ownership. To the extent that the OCI-firm value relation is driven by mutual fund manager overconfidence, one might expect this relation to be stronger among stocks with higher mutual fund ownership, especially those with higher active mutual fund ownership. To test this hypothesis, we break our sample stocks into high- and low-mutual fund ownership groups. We then repeat our portfolio analysis for both groups and present the results in Table 10. Panel A reports the results based on total mutual fund ownership and panel B reports the results for active fund ownership (as defined in Section 3.6.1).

The results in panel A suggest that the positive OCI-firm value relation holds for both high- and low-fund ownership stocks. For example, the difference in M/B between high- and low-OCI firms is 0.61 for low-fund

Table 11. Firm Valuation, Subsequent Returns, and Corporate Decisions: Controlling for Fund Flows

Panel A: Portfolio analysis of firm value

	OCI1 (low)	OCI2	OCI3	OCI4	OCI5 (high)	OCI5 − OCI1
M/B	1.633	1.836	2.014	2.178	2.274	0.641
	(26.31)	(26.60)	(21.16)	(15.87)	(23.81)	(8.53)
RKRV	−0.149	−0.010	0.077	0.117	0.104	0.253
	(−6.85)	(−0.78)	(6.19)	(10.20)	(5.22)	(8.90)

Panel B: Cross-sectional regressions

	M/B			RKRV		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	1.352	2.437	2.290	−0.069	−0.086	−0.098
	(17.58)	(18.83)	(17.75)	(−1.64)	(−1.57)	(−2.08)
OCI^{RANK}	0.132	0.141	0.102	0.059	0.057	0.043
	(7.39)	(7.02)	(7.09)	(8.58)	(9.23)	(9.84)
Log(ASSETS)		−0.215	−0.168		−0.001	0.018
		(−12.06)	(−10.17)		(−0.37)	(5.29)
AGE		−0.008	−0.005		−0.004	−0.003
		(−6.24)	(−4.62)		(−10.52)	(−7.99)
DELAWARE		0.128	0.105		0.062	0.061
		(3.86)	(4.94)		(6.70)	(7.92)
S&P500		1.088	0.807		0.377	0.258
		(10.73)	(9.96)		(20.53)	(13.64)
R&D			4.230			1.310
			(13.73)			(8.10)
I (missing R&D)			−0.094			−0.061
			(−2.32)			(−3.89)
ROA			1.579			0.652
			(9.36)			(16.32)
LEV			−0.294			−0.181
			(−6.04)			(−10.73)

Panel C: Subsequent returns

	OCI1 (low)	OCI2	OCI3	OCI4	OCI5 (high)	OCI5 − OCI1
Raw return (%)	1.027	0.949	0.688	0.700	0.705	−0.322
	(2.81)	(2.72)	(1.98)	(1.96)	(1.70)	(−1.75)
One-factor alpha (%)	0.143	0.034	−0.234	−0.278	−0.407	−0.550
	(1.37)	(0.35)	(−2.81)	(−2.41)	(−2.71)	(−3.05)
Three-factor alpha (%)	0.076	−0.001	−0.174	−0.136	−0.194	−0.270
	(0.76)	(−0.01)	(−2.08)	(−1.30)	(−1.65)	(−2.36)
Four-factor alpha (%)	0.241	0.110	−0.105	−0.090	−0.090	−0.332
	(2.64)	(1.34)	(−1.35)	(−0.92)	(−0.79)	(−2.82)

ownership stocks and is 0.77 for high-fund ownership stocks. Both numbers are highly statistically significant. More importantly, the difference between high- and low-fund ownership stocks, i.e., 0.16, is statistically significant at the 5% level. The results for the RKRV measure are similar. The difference in RKRV between high- and low-OCI firms is 0.23 for low-fund ownership stocks and is 0.33 for high-fund ownership stocks. The difference between these two numbers is statistically significant at the 10% level.

The results in panel B indicate that the difference between high- and low-fund ownership stocks is much larger when we focus on more actively managed funds. For example, the difference in M/B between high- and low-OCI firms is 0.61 for low- active fund ownership stocks and is 0.96 for high- active fund ownership stocks. The difference between these two numbers is highly statistically significant. Similarly, the difference in RKRV between high- and low-OCI firms is 0.2 for low-fund ownership stocks and is 0.39 for high-fund ownership stocks, and the difference between these two numbers is again highly significant. Overall, we show in Table 10 that the OCI-firm value relation is stronger among stocks with greater mutual

Table 11. (Continued)

Panel D: Equity issuance						
	NS			EI		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	0.019	0.019	0.013	0.050	0.018	0.009
	(3.34)	(3.40)	(2.17)	(5.37)	(2.25)	(1.08)
OCI	0.244		0.218	0.537		0.305
	(5.75)		(5.16)	(6.98)		(5.67)
M/B_{t-1}		0.004	0.004		0.026	0.026
		(5.31)	(4.94)		(9.75)	(9.68)
CF_{t-1}	−0.013	−0.020	−0.021	−0.068	−0.120	−0.121
	(−0.71)	(−1.18)	(−1.21)	(−0.88)	(−1.53)	(−1.54)
AGE	−0.001	−0.001	−0.001	−0.001	−0.001	−0.001
	(−13.44)	(−13.34)	(−13.35)	(−7.25)	(−6.63)	(−6.52)
$RET_{t-12,t-1}$	0.018	0.018	0.018	0.052	0.050	0.050
	(5.37)	(5.40)	(5.27)	(6.08)	(6.61)	(6.56)
LEV	−0.117	−0.121	−0.121	−0.306	−0.298	−0.298
	(−7.52)	(−7.03)	(−7.02)	(−5.81)	(−5.38)	(−5.37)
ROA	0.009	0.010	0.010	−0.014	−0.004	−0.004
	(5.10)	(5.54)	(5.61)	(−4.69)	(−2.98)	(−2.97)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Avg. no. of obs.	2,601	2,601	2,601	2,454	2,454	2,454
Adjusted R^2	0.10	0.10	0.10	0.17	0.19	0.19

fund ownership, particularly with greater active fund ownership.

3.6.3. Control for the "Dumb Money" Effect. Frazzini and Lamont (2008) use mutual fund flows as a measure of individual investor sentiment and find that high sentiment predicts low future returns. They also find that high sentiment is associated with high equity issuance. Although we do not include mutual fund flows in our construction of OCI, we do include prior fund performance. To the extent that fund flows are positively related to fund performance, one might be concerned that our results capture the dumb money effect of Frazzini and Lamont (2008). To test this possibility, we control for fund flows in our analyses. We obtain the original FLOW data from 1988 through 2004 from Andrea Frazzini and follow the Frazzini and Lamont (2008) methodology to extend the FLOW variable through 2010.[17] We then stratify the OCI with respect to FLOW measure to remove the impact of fund flows.

We repeat all our analyses using the stratified OCI quintiles and report the results in Table 11. Results in panel A indicate a significant positive relation between OCI and firm valuation after controlling for fund flows. For example, high- (low-) OCI firms exhibit an average M/B of 2.274 (1.633). The difference of 0.641 is both economically and statistically significant. Similarly, high-OCI firms exhibit a significantly higher RKRV misvaluation measure. These results are robust to the control of various firm characteristics as reported in panel B. Panel C confirms the results that high-OCI firms have significantly lower subsequent stock returns than low-OCI firms even after controlling for fund flows. Results in panel D and panel E show that the high-OCI firms issue more equity and invest more. Overall, we find that our main findings are robust to the control of fund flows, suggesting we are not simply repackaging Frazzini and Lamont's (2008) dumb money effect.

4. Conclusions

In this paper we examine the impact of investor overconfidence on firm valuation, financing behavior, and real investment. Overconfident investors overestimate the precision of their information and underestimate risk, which results in a lower required risk premium and a higher price for the risky security. Thus, theory predicts that investor overconfidence leads to 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 two overvaluation measures. This result is stronger among stocks with greater mutual fund ownership, particularly by active mutual funds. In addition, we find that stocks with more overconfident owners exhibit significantly

Table 11. (Continued)

Panel E: Corporate investment

	CI			AG		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	0.097	0.096	0.091	0.038	0.018	−0.012
	(17.24)	(17.82)	(17.10)	(2.15)	(1.29)	(−0.81)
OCI	0.250		0.196	1.475		1.046
	(7.45)		(7.31)	(6.49)		(6.01)
lagCF		0.005	0.005		0.042	0.041
		(8.48)	(8.46)		(12.26)	(12.13)
lagM/B	0.114	0.103	0.102	0.298	0.211	0.208
	(4.11)	(4.03)	(4.03)	(4.03)	(3.44)	(3.43)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Avg. no. of obs.	2,603	2,603	2,603	2,629	2,629	2,629
Adjusted R^2	0.25	0.26	0.26	0.07	0.09	0.09

Notes. Our sample includes only common stocks (those with a share code of 10 or 11 in CRSP) 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 2.2. FLOW is defined following Frazzini and Lamont (2008) as the stock's actual percent of the total dollar value of mutual fund holdings divided by the stock's market capitalization minus the counterfactual percent. Each year, we sort firms first into terciles based on FLOW measure and sequentially into overconfidence quintiles based on their end-of-quarter OCI. We then combine same OCI quintile across FLOW measure terciles. Panel A presents results of the portfolio analysis of firm value. We compute equal-weighted average firm valuation for each quintile. Firm valuation is measured by M/B or RKRV. M/B is the market-to-book ratio. The RRKV measure is defined in Rhodes-Kropf et al. (2005). Detailed definition of RKRV is in Section 2.3.2. We report time-series mean of cross-sectional average firm valuation measures for each OCI quintile, as well as the difference in firm valuation measures between firms in high- and low-OCI quintiles. Panel B presents the regression results. Each year we estimate regressions of firm valuation measures on stratified OCI quintiles and a set of control variables. Control variables include the following: ASSETS, AGE, S&P500 indicator, DELAWARE indicator, ROA, R&D, missing R&D indicator, and LEV. Detailed variable definitions are in Appendix B. Industry fixed effects for Fama and French (1997) 48-industry classification are included in all regressions. We report time-series average coefficients across yearly cross-sectional regressions. Numbers in parentheses are t-statistics based on the time-series standard deviation adjusted for heteroskedasticity and first lag autocorrelation using the Newey–West (1987) approach. Panel C presents results of the subsequent return analysis. At the end of each quarter, we sort firms first into stratified OCI quintiles. We hold these portfolios for the subsequent 12 months. We calculate monthly equal-weighted returns for each of the five stratified OCI portfolios and for the strategy that goes long high-OCI portfolio and goes short low-OCI portfolio. We report time-series average raw return, one-factor alpha, three-factor alpha, and four-factor alpha for each portfolio and for the long-short strategy. Numbers in parentheses are t-statistics based on the time-series standard deviation adjusted for heteroskedasticity and autocorrelation up to nine lags using the Newey–West (1987) approach. Panel D presents regression analyses for external equity financing. Equity financing is measured as either net stock issues (NS) or external equity issues (EI). NS is 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 the change in book equity minus the change in retained earnings scaled by total assets. Panel E presents regression analyses for 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.

lower returns over subsequent periods, consistent with the overpricing story. Finally, we find that firms with more overconfident investors issue more equity and invest more, even after controlling for standard determinants of equity financing and corporate investment. Overall, our results suggest that investor overconfidence has a significant impact on firm value, equity financing, and investment decisions.

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Appendix A. The Model
In this appendix we present a simple model to analyze the effect of investor overconfidence on asset prices. The model is an extension of O'Hara (2003) and Easley and O'Hara (2004). The setup of our model is as follows. There is one period. At the beginning of the period traders choose their portfolios and at the end of the 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 the 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 traders 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, Daniel et al. 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 $\delta > 0$. The traders choose their demands for bond b and for risky asset x to maximize their expected utility. 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. 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. We find the equilibrium price by solving the market clearing 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*

$$p = am + bs_1 + cs_2 - dx + e\bar{x}, \tag{A.1}$$

where a, b, c, d, and e are given in the Internet appendix.

Proof. See the Internet appendix.

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

Proposition 2. *The expected price-to-fundamental ratio $E(p/m)$ is increasing in the degree of investor overconfidence*:

$$\frac{dE(p/m)}{dk} > 0. \tag{A.2}$$

Proof. See the Internet appendix.

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.

Proposition 3. *The expected return $E(\tilde{v} - pR)$ is decreasing in the degree of investor overconfidence*:

$$\frac{dE(\tilde{v} - pR)}{dk} < 0. \tag{A.3}$$

Proof. See the Internet appendix.

Proposition 3 states that everything else equal, the more overconfident the informed traders are, the lower is the expected return on the risky asset.

Daniel et al. (2001) also derive price and return equations when investors are overconfident. However, they do not emphasize the impact of investor overconfidence on market prices and expected returns per se. Rather, the focus of Daniel et al. (2001) is to examine whether investor overconfidence can explain cross-sectional return anomalies such as the book-to-market effect. Scheinkman and Xiong (2003) examine the impact of investor overconfidence on asset prices in the context of speculative bubbles. In their model the mispricing arises from a speculative demand based on the difference between the current and the likely future price. In contrast, in our model the mispricing is a result of excess demand driven by underestimation of risk.

Appendix B. Variable Definitions

- ASSETS are total assets, item TA from COMPUSTAT;
- MKTCAP is firm's total market value of equity, calculated as the product of share price and number of shares outstanding from CRSP;
- M/B is the market value of equity (price times shares outstanding from CRSP) plus assets (TA) minus the book value of equity (CEQ +TXDB from COMPUSTAT), all over total assets (TA);
- 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 (TA);
- R&D is research and development expense (COMPUSTAT item XRD) scaled by lagged total assets (TA);
- I (missing R&D) is an indicator variable equal to one if R&D is missing and equal to zero otherwise;
- S&P500 is an indicator variable set to one if a firm is a member of the S&P 500 index in a given year, and set to zero otherwise;
- DELAWARE is an indicator variable set to one if a firm was incorporated in Delaware, and set to 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 (TA);
- $\text{RET}_{t-12,\,t-1}$ is cumulative stock return over prior 12 months;
- NS is the natural log of the ratio between the split-adjusted shares outstanding at the end of fiscal year t and the split adjusted shares outstanding at the end of fiscal year $t-1$, from COMPUSTAT;
- EI is the change in book equity (CEQ) minus change in retained earnings (RE) scaled by TA;
- CI is a ratio of the capital expenditure (CAPX) to TA;
- AG is a year-on-year percentage change in TA.
- GENDER is an indicator variable that equals one for funds with a solo, male manager and equals zero otherwise. We determine a manager's gender by matching the manager's first name to several name lists and databases including the list of popular names published by United States Social Security Administration, http://www.babynameguide.com, and http://babynamesworld.parentsconnect.com. If a manager's first name is gender neutral, we use various sources including the fund company's website and fund prospectus to determine the manager's gender.
- TENURE is a number of months since that manager started managing the fund.
- MANAGEMENT STRUCTURE is an indicator variable that equals one if a fund is managed by solo manager and zero otherwise.
- PORTFOLIO TURNOVER is the minimum of buys and sells divided by total net assets, as reported in CRSP Mutual

Fund Database. Because it uses the minimum of buys and sells, this definition of turnover is not affected by fund flows.

- PORTFOLIO CONCENTRATION is measured by the Herfindahl concentration index, which is the sum of the squared portfolio weights across all stocks in the portfolio.
- PRIOR FUND PERFORMANCE is measured as prior 36-month four-factor alpha of the fund.
- IDIOSYNCRATIC RISK is a standard deviation of four-factor model residuals measured over past 36 months.

Endnotes

[1] See, for example, Odean (1998), Daniel et al. (1998, 2001), Barber and Odean (2000, 2001, 2002), Gervais and Odean (2001), Statman et al. (2006), and Grinblatt and Keloharju (2009).

[2] Daniel et al. (2001) and Scheinkman and Xiong (2003) theoretically explore the impact of investor overconfidence on market valuation. Alti and Tetlock (2014), who estimate a structural model of biased beliefs, firm behavior, and asset returns, provide evidence that investor overconfidence is associated with overvaluation.

[3] According to the Investment Company Institute (2015), mutual funds held 30% of the U.S. stock market at the end of 2014.

[4] Barber and Odean (2001) present empirical evidence suggesting that men are more overconfident than women.

[5] Recent 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.

[6] See, for example, Morck et al. (1988), Yermack (1996), Baker and Wurgler (2002), Gompers et al. (2003), Dong et al. (2006), and DeAngelo et al. (2010).

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

[8] We use the latest OCI available prior to the fiscal year-end to ensure that OCI is known at the time of M/B measurement.

[9] $\text{Log}(MV_{high}) - \log(MV_{low}) = \log(MV_{high}/MV_{low}) = 0.27$. Therefore, $MV_{high}/MV_{low} = e^{0.27} = 1.31$.

[10] Our results (reported in the Internet appendix) are qualitatively similar when we use raw OCI in this regression.

[11] We use equal-weighted CRSP return in excess of the risk-free rate as the market factor because our OCI portfolios are equal weighted. Using value-weighted CRSP return does not alter our inferences; i.e., the difference in alphas between high- and low-OCI portfolios are significantly negative.

[12] Our results are robust to alternative lag adjustments, as shown in the Internet appendix.

[13] Sias (2007) uses a similar procedure to remove the effect of size from changes in institutional ownership. Using the standard double sort procedure generates similar results.

[14] We show in the Internet appendix that the underperformance of high-OCI firms persists for two to three years. There are at least two reasons why the correction of mispricing associated with investor overconfidence takes a long time. First, overpricing is more difficult to arbitrage away than underpricing because shorting is costly (Stambaugh et al. 2012). Second, overconfidence is an innate characteristic of people and therefore is persistent.

[15] In addition to the above-mentioned analyses, we also control for numerous proxies of information uncertainty including firm age, cash flow volatility, dispersion of analyst forecasts, and residual analyst coverage in our cross-sectional regressions and find similar results (reported in the Internet appendix).

[16] Our evidence is also consistent with Bolton et al. (2013), who model financing and investment decisions of firms that face stochastic financing conditions.

[17] We thank Andrea Frazzini for providing us with the FLOW data.

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