Abnormal Investment and Firm Performance*

Abstract

We find a negative relation between abnormal investment and future stock performance. Such a negative relation is mainly driven by under-investment, not over-investment. Our results are robust to various estimation methods and investment models. Both delayed market reaction and agency issues may lead to the apparently anomalous return predictability of under-investment. First, market investors may not react promptly to the fundamental information contained in under-investment about a firm's future profitability, asset growth, and financial distress probability. Second, the negative relation between under-investment and future stock returns is more pronounced for firms with lower investor monitoring and higher agency costs.

JEL classification: G12; G14; G30; M4
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1. Introduction

In an efficient capital market, firms with better future growth options usually have higher equity valuation. To exercise these growth options, firms with a higher market valuation should have a lower payout ratio and invest more on projects with positive net present value (NPV). However, Lee et al. (2016) document that there is a negative correlation between capital expenditures and industry Tobin's Q since the middle of the 1990s. Furthermore, previous studies document an investment growth anomaly that there is a negative relation between firm-level capital investment and future stock returns.[1] In the capital budgeting context, Hou et al. (2015) argue that given expected cash flows, lower costs of capital lead to higher NPV of new projects and higher firm investment. Since lower costs of capital is also associated with lower expected stock returns, researchers observe a negative investment-return relation.[2] Mao & Wei (2016) also provide a mispricing-based explanation that if firm-level investment is mispriced by the market due to investor expectational errors (Cooper et al. 2008) or limits to arbitrage (Lam & Wei 2011), subsequent realized stock returns largely reflect the corrections of market expectations.

Unlike the previous literature on the relation between investment and stock returns, we focus on firm abnormal investment, which is the gap between actual and predicted investment levels. All information on changes in future firm cash flows, including firm investment decisions, will be instantaneously transferred into a firm's stock prices in an efficient market. Therefore, abnormal investment may reflect shocks to a firm's long-run growth opportunities and carry new information about the firm's fundamentals in the future. For instance, Chen et al. (2007) and Bakke & Whited (2010) show that managers use private information when making their investment decisions. If market investors fully incorporate such new information into stock prices contemporaneously, we should not observe an empirical association between abnormal investment and future stock returns. However,

[1] A large literature documenting the negative investment-return relation includes Gomes et al. (2003), Titman et al. (2004), Liu et al. (2009), Polk & Sapienza (2009), and Kogan & Papanikolaou (2013).

[2] Please refer to Hou et al. (2015) for details.

as Mao & Wei (2016) suggested, if market investors react to such new information and update their expectations on a firm's future growth with a delay, the current abnormal investment may exhibit certain predictability of future stock returns.

A firm's abnormal investment may also be a proxy for agency costs due to conflicts of interests. On the one hand, the managers of a firm with poor investment opportunities and high free cash flow have an incentive to over-invest for their own benefits, e.g. empire building, rather than for the benefits of shareholders (Jensen 1986). Fairfield et al. (2003) and Titman et al. (2004) provide empirical evidence that over-investment may generate inefficiency and impair firms' stock performance. On the other hand, agency issues may also be associated with firm under-investment. Due to the conflict of interest between shareholders and bondholders, overhang debts prevent shareholders from capturing the benefits of positive NPV investment opportunities, giving rise to firm under-investment (Myers 1977). The conflict of interest between managers and shareholders may also lead to firm under-investment. Hart (1983) and Bertrand & Mullainathan (2003) propose the "lazy manager" hypothesis that managers prefer a quiet life and choose not to spend effort on firm investment. Guerrieri & Kondor (2012) and Aghion et al. (2013) offer the "career concern" hypothesis that managers forgo positive NPV projects because the risk associated with new investment may cost them their jobs. Besides the delayed market reaction explanation, the empirical relation between abnormal investment and future stock returns may reflect the agency cost reduction in firm market value.

Using a large sample of U.S. public firms during 1974–2017, we adopt an accounting-based investment model proposed by Richardson (2006) to decompose firm investment into predicted and abnormal components. "Abnormal investment" is defined as the absolute value of the difference between actual and predicted investment, which measures the degree of a firm's investment deviating from its predicted level. We also define over-investment (under-investment) as the absolute value of the abnormal investment which is greater (less) than zero. Next, we sort firms into decile portfolios at the end of June over our sample period, based on the ranks of most recent estimated abnormal investment, under-investment, and over-investment. The decile portfolios are rebalanced every year. After adjusting for common systematic risk factors (Fama & French's (1993) three factors, Carhart's (1997) momentum factor, and Pástor & Stambaugh's (2003) liquidity factor), we find that both abnormal investment and under-investment are negatively related to the performance of the decile portfolios. However, we do not find any evidence that over-investment affects the performance of the decile portfolios. A portfolio taking a long position on the firms with bottom decile under-investment and a short position on the firms with top decile under-investment generates a positive and statistically significant five-factor model alpha. The long-short portfolio's annualized five-factor model alpha is 5.04%, which is also economically significant.

We then employ the Fama & MacBeth (1973) regressions to examine the empirical association between abnormal investment and future stock returns, controlling for firm characteristics.[3] We find that abnormal investment is negatively correlated with future stock returns. When we include both investment and abnormal investment in the same regression, we find that the variation in abnormal investment retains the power of explaining future stock returns, while the coefficient of investment is statistically insignificant. Consistent with the portfolio analysis results, our multivariate regression shows a negative relation between under-investment and future stock returns. However, we cannot find a similar relation between over-investment and stock returns. Taken together, our results suggest that it is the under-investment that mainly drives the negative relation between abnormal investment and future stock returns.

We next examine the two potential mechanisms (discussed above) through which under-investment leads to a decrease in future stock returns: (1) *the market delayed reaction channel* and (2) *the agency cost channel*. With respect to the first mechanism, we first investigate whether under-investment conveys information about future profitability, asset growth, and financial distress. After controlling for firm characteristics, we find that

[3]Fama & MacBeth (1973) regressions correct for the cross-sectional correlation among standard errors. In addition, all sample years have equal weights when estimating Fama & MacBeth (1973) regression coefficients, while the panel regression coefficients are biased toward the sample years with more observations.

under-investment is negatively associated with the change in earnings and the change in assets over the next year. With one standard deviation increase in under-investment, a firm's earnings growth rate over the next year will decrease 0.06%, which is about 60% of the sample mean of earnings growth rates. A one standard deviation increase in under-investment will also be associated with a 0.63% decrease in a firm's asset growth rate over the next year, which is 5.73% of the sample mean of asset growth rates. Using Shumway's (2001) bankruptcy prediction model, we find that firms with under-investment are more likely to experience future financial distress. With one standard deviation increase in under-investment, the probability of financial distress will increase 0.30%, which is 5.77% of the sample mean of unconditional financial distress probabilities.

These results confirm that under-investment contains information about firm fundamentals in the future. In an efficient market, investors should promptly incorporate the information carried by abnormal investment into stock prices. To show that the negative relation between under-investment and future stock returns is partly due to the delayed market reaction to under-investment, we employ an empirical test which is similar to the research design used by Abarbanell & Bernard (1992) and Shane & Brous (2001) in their examinations of the post-earnings announcement drift. We show that after controlling for the *future* change in earnings, the *future* change in assets, and the likelihood of *future* financial distress, the relation between under-investment and future stock returns is not statistically significant. About 47.06% of the negative association between under-investment and future stock returns is due to the association between under-investment and future firm fundamentals, supporting *the market delayed reaction channel*.

To explore the second mechanism, *the agency cost channel*, we investigate whether the negative relation between under-investment and future stock returns is more pronounced for firms with weaker external monitoring or higher agency costs. If under-investment is driven by potential agency issues, then market investors will adjust firm value according to under-investment related agency costs, leading to lower stock returns. We first classify firm–year observations with under-investment into two sub-samples using the annual industry medians of blockholder ownership, the ownership of a firm's blockholders who hold more than 5% of the firm's outstanding shares. Firms with blockholder ownership above the median are classified as those with stronger external monitoring and lower agency costs. We find that the negative relationship between under-investment and future stock returns is only statistically significant in the low blockholder ownership sub-sample. We next divide firm–year observations with under-investment into two sub-samples based on the two direct proxies of agency costs proposed by Ang et al. (2000): expense ratio and asset utilization ratio. Higher expense ratios are associated with less efficiency and higher agency costs, while higher asset utilization ratios are associated with greater efficiency and lower agency costs. We find that although the negative relation between under-investment and future stock returns is statistically significant in both partitions, the economic impact of under-investment on future stock returns is larger for firms with higher agency costs. Combined, these findings support *the agency cost channel* that agency conflicts may lead to firm under-investment and hurt firm value.[4]

Finally, we conduct a set of robustness tests to validate our main findings. First of all, we re-estimate the impact of abnormal investment, under-investment, and over-investment on future stock returns using a panel regression with the year and industry fixed effects. To mitigate the concern about econometric issues in estimating the investment model, we reconstruct our three abnormal investment proxy variables using a single panel regression between 1974 and 2017 and rolling panel regressions with five-year estimation windows. To mitigate any concern on the potential model misspecification in Richardson's (2006) framework, we estimate the predicted investment using the two alternative investment models developed by Harvey et al. (2004) and Titman et al. (2004). These robustness tests generally support our main findings that there is a negative relation between abnormal investment and future stock returns and that the negative relation is mainly driven by

[4]If stock markets are efficient, agency costs associated with under-investment may lead to a contemporaneous change in stock prices and should not be associated with lower future stock returns. We acknowledge that in an efficient market, the agency cost channel would also require that investors underreact to the implications of agency costs for firm investment decisions.

under-investment, not over-investment. In our supplementary tests, we examine whether the negative relation between under-investment and future stock returns is due to the firm-specific information carried by under-investment or the potential positive association between under-investment and the systematic financial distress risk factor. We do not find evidence supporting the systematic financial distress risk exposure explanation. We also investigate the impact of market recessions on the negative relation between abnormal investment and future stock returns. We find that the negative relation between abnormal investment and future stock returns is much weaker during market recession periods than non-recession periods, suggesting that, during market recession periods, market investors are more likely to react to the negative information carried by under-investment without a delay.

Our paper is closely related to Titman et al. (2004), which also investigates the association between abnormal capital investment and subsequent stock performance. Titman et al. (2004) find that firms with the most over-investment are likely to under-perform during the following five years. This empirical relation is stronger for firms with more cash flows or fewer debts. Our paper differs from Titman et al. (2004) in two dimensions. First, Titman et al. (2004) measure the abnormal capital investment as the deviation of a firm's capital expenditures from its average capital expenditures over the past three years, whereas our abnormal investment is estimated based on an accounting-based framework which controls for the cross-sectional and time-series variations of firms' growth opportunity, leverage, cash holding, age, size, stock returns, and historical investment. Second, Titman et al. (2004) find that firms with the least abnormal capital investment tend to outperform firms with the highest abnormal capital investment in terms of stock returns. Our paper shows that after adjusting for the cross-sectional and time-series variations in firm characteristics, it is under-investment that drives the negative relation between abnormal investment and future stock returns, not over-investment.

The remainder of the paper is structured as follows. Section 2 presents our data source, investment model, and summary statistics of the key variables in our empirical analyses. Section 3 discusses our main empirical results. Section 4 provides robustness test results and further discussions. Finally, Section 5 concludes.

2. Sample, variables, and summary statistics

2.1. Data source and sample selection

Our sample starts with U.S. firm–year observations with available stock return data in the Centre for Research in Security Prices (CRSP) and accounting information in the Compustat Fundamentals Annual files. Following Richardson (2006), we delete firm–year observations without U.S. ordinary common shares, with a negative book value of equity, and with the absolute value of the free cash flow to total assets ratio being greater than one. We also exclude financial firms (SIC codes 6000–6999) from our sample because the investment decisions of financial firms may not convey the same information as those of non-financial firms. After applying these data cleaning filters, we arrive at our main sample of 122,180 firm–year observations over the fiscal year 1974–2017. For the common stocks of our sample firms, we collect their systematic risk factor return data, including the market ($MKTRF$), size (SMB), and book-to-market (HML) from Wharton Research Data Services (WRDS). To apply Fama & French's (2015) five-factor model, we collect the profitability (RMW) and investment factor (CMA) from Kenneth R. French's website. Finally, BAA and AAA rating bond yield data are collected from the Federal Reserve's H-15 report and stock market model $Beta$s are calculated by Eventus. Detailed definitions of all the variables and their data sources are described in Appendix A.

2.2. Measures of abnormal investment

Our objective in this paper is to study the empirical association between firm-level abnormal investment and stock returns. Abnormal investment is the deviation from the investment level which would be predicted by a firm-specific investment model. Following

Richardson (2006) and Stoughton et al. (2017), we estimate the following accounting-based investment model and use the regression residuals as our proxy for the firm-level abnormal investment:

$$
\begin{aligned}
INew_{i,t} = & \alpha + \beta_1 \frac{V}{P}_{i,t-1} + \beta_2 Leverage_{i,t-1} + \beta_3 Cash_{i,t-1} + \beta_4 Age_{i,t-1} + \beta_5 Size_{i,t-1} \\
& + \beta_6 Return_{i,t-1} + \beta_7 INew_{i,t-1} + \sum Industry_j + \sum Year_t + \epsilon_{i,t}
\end{aligned} \tag{1}
$$

where $INew_{i,t}$ is the new investment for firm i in year t, defined as the difference between $ITotal_{i,t}$ and $IMaintenance_{i,t}$. $ITotal_{i,t}$ is the overall investment and $IMaintenance_{i,t}$ is the investment expenditure to maintain assets in place. The existing financial economics studies indicate that a firm's new investment depends on future growth opportunities, financial constraints, and other firm characteristics (Hubbard 1998). Firm growth opportunities are measured by V/P_{t-1}, where V is the value of assets in place and P is the firm's market value (Ohlson 1995, Feltham & Ohlson 1996).[5] A firm's market value (P) is the sum of the value of assets in place (V) and the value of future growth opportunities, therefore V/P is negatively related to a firm's future growth opportunities. The financial constraints are measured by firm leverage ratios ($Leverage_{t-1}$) and cash holdings ($Cash_{t-1}$). The other firm characteristics controlled in Equation (1) include firm age (Age_{t-1}), the natural log of total assets ($Size_{t-1}$), cumulative stock returns over the previous year ($Return_{t-1}$), and the lag of new investment ($INew_{t-1}$). We also include the Fama–French 48 industry fixed effects ($\sum Industry_j$) to control for the variation of firm investment across industries and the year fixed effects ($\sum Year_t$) to control for the time-series variation of firm investment related to stock market trends and business cycles. To mitigate the influence of outliers, we follow Richardson (2006) and winsorize all financial variables in Equation (1) at the 1st and 99th percentiles.

The fitted value of the accounting-based investment model, $INew^*_{i,t}$, is taken as the predicted level of new investment for firm i at year t. Then we define firm i's abnormal investment ($AInvt_{i,t}$) as the absolute value of the deviation from the predicted investment:

[5] Please refer to Richardson (2006) for the detailed definition of V/P.

$AInvt_{i,t} = |INew_{i,t} - INew^*_{i,t}|$. $AInvt_{i,t}$ indicates the deviation of investment from its predicated value, without distinguishing between under- and over-investment. Our investment model in Equation (1) allows us to further differentiate between firm i's under- and over-investment. If $INew_{i,t} < INew^*_{i,t}$, then the under-investment proxy variable is defined as $Under_{i,t} = |INew_{i,t} - INew^*_{i,t}|$. If $INew_{i,t} > INew^*_{i,t}$, then the over-investment proxy variable is defined as $Over_{i,t} = |INew_{i,t} - INew^*_{i,t}|$. Since market investors may react differently to the information conveyed by under- or over-investment, it is important for us to differentiate the direction of abnormal investment in our empirical analyses. We measure the general abnormal investment, over-investment, and under-investment in absolute value, so that the estimated coefficients of these three proxies are comparable to each other in our empirical analyses.

To investigate the empirical association between the firm-level abnormal investment and future stock returns, we need to avoid the "look ahead bias" due to the use of future information in estimating the current abnormal investment. In other words, the information used to estimate abnormal investment should be available to market investors before stock returns are measured. For each year t between 1980 and 2017, we estimate a historical panel regression on a sample of firm–year observations between 1974 and year $t-1$. For example, a firm's abnormal investment in 1980 is estimated by running a panel regression based on firm–year observations between 1974 and 1979, and a firm's abnormal investment in 1981 is estimated by running a panel regression based on firm–year observations between 1974 and 1980, and so on. In our robustness tests, we estimate abnormal investment with two alternative regression methods. First, we follow Richardson (2006) and Stoughton et al. (2017) to estimate Equation (1) by a single panel regression between 1974 and 2017. Second, for abnormal investment in year t, we estimate Equation (1) by a five-year rolling window between year $t-4$ and year t.

2.3. Summary statistics

Table 1 presents the descriptive statistics of all the variables in our main empirical analyses. The number of observations, mean, standard deviation, 1st percentile, 25th percentile, median, 75th percentile, and 99th percentile are reported from left to right, in sequence for each variable. The mean and standard deviation of *INew* are 0.07 and 0.11, which are comparable to those (0.08 and 0.13) reported in Richardson (2006).

Panel A of Table 2 summarizes the regression coefficients estimated by the investment model. For each year t between 1980 and 2017, we run a panel regression of Equation (1) based on firm–year observations between 1974 and year $t-1$. We only report the time-series average of the coefficients estimated by thirty-eight historical panel regressions from 1980 to 2017. Year and Fama–French 48 industry fixed effects are controlled in these regressions. The t-values of regression coefficients are based on standard errors clustered by firm. The numbers of positive and negative coefficients at the 1% statistical significance level are reported in parentheses. The negative coefficients of V/P_{t-1} suggest that firms with better future growth opportunities make a higher investment. Since a lower leverage ratio and higher cash holdings indicate lower financial constraints, the negative coefficients of $Leverage_{t-1}$ and the positive coefficients of $Cash_{t-1}$ show that firms with lower financial constraints make a higher investment. The negative coefficients of Age_{t-1} suggest that firms in the later stage of their life cycle tend to invest less, while the positive coefficients of $Size_{t-1}$ suggests that larger firms tend to make a higher investment. $Return_{t-1}$ captures additional variations in investment expenditure that are not explained by growth opportunities and financial constraints but may temporarily affect firms' investment decisions. The positive coefficients of $Return_{t-1}$ suggest that firms with higher past stock performance tend to invest more. The positive coefficients of $INew_{t-1}$ suggest that new investment expenditure is increasing in prior investment activities. The signs of these coefficients are all consistent with Richardson (2006). The average R^2 of the thirty-eight historical panel regressions is 0.342, suggesting that the investment model can explain a large portion of the cross-sectional and time-series variations in firm-level investment.

Panel B of Table 2 presents the descriptive statistics of the predicted firm investment $INew^*$ and our abnormal investment proxy variables. We observe that about 59.0% (41.0%) of the firm–year observations in our sample have a lower (higher) investment than the predicted investment level. The means (standard deviations) of our three abnormal investment proxies, $AInvt$, $Under$, and $Over$, are 0.057 (0.064), 0.049 (0.046), and 0.070 (0.082), respectively. Since the mean of the predicted new investment $INew^*$ is 0.069, our three abnormal investment proxy variables are economically important.

3. Empirical results

This section presents our main empirical findings.

3.1. Decile portfolio analysis

To examine the empirical association between firm-level abnormal investment and future stock returns, we begin by forming decile portfolios based on firm-level abnormal investment and estimating the performance of these decile portfolios. Following Fama & French's (1993) portfolio construction method, we sort all stocks into decile portfolios based on one of their most recent estimated investment and abnormal investment proxies *INew*, *AInvt*, *Under*, and *Over*, at the end of June in each year of 1980–2017. Stocks with the lowest (highest) investment or abnormal investment measures are allocated to portfolio 1 (10). Then we calculate the value-weighted monthly returns of these decile portfolios over the next twelve-month holding period.[6] To evaluate the performance of these decile portfolios, we estimate their returns in excess of the market portfolio and portfolio alphas using a five factor model. The five factor model includes Fama & French's (1993) three factors, Carhart's (1997) momentum factor, and Pástor & Stambaugh's (2003) liquidity

[6] Our results are robust to the equally weighted portfolios.

factor:

$$R_{p,t} - Rf_t = \alpha + \beta_1(MKTRF_t) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \beta_5 LIQ_t + \epsilon_t \quad (2)$$

where $R_{p,t}$ denotes the portfolio p's return over month t, Rf_t denotes the risk-free return measured by the one-month Treasury bill rate over month t, $MKTRF_t$ denotes the excess return for the market portfolio over month t, SMB_t denotes the return of a size factor mimicking portfolio over month t, HML_t denotes the return of a value factor mimicking portfolio over month t, MOM_t denotes the return of a momentum factor mimicking portfolio over month t, and LIQ_t denotes the return of a liquidity factor mimicking portfolio over month t.

Table 3 reports the excess returns and alpha of the decile portfolios. The last column reports the excess return and alpha of a portfolio that takes a long position on stocks in the corresponding portfolio 1 and a short position on stocks in the corresponding portfolio 10. For stocks sorted by the investment proxy *INew*, both the excess returns and alphas of the decile portfolios increase from decile 1 portfolios to decile 10 portfolios. The five-factor model alpha of the portfolio taking a long position on stocks in portfolio 1 and a short position on stocks in portfolio 10 is negative and statistically significant.

For stocks sorted by the abnormal investment proxy *AInvt*, both the excess returns and alphas of the decile portfolios decrease from decile 1 portfolios to decile 10 portfolios in terms of both statistical significance and value. The five-factor model alpha of the portfolio taking a long position on stocks in portfolio 1 and a short position on stocks in portfolio 10 is positive and statistically significant. The annualized five-factor alpha of the long–short portfolio is 3.72% (= 0.31%∗12), which is economically significant. For stocks sorted by the under-investment proxy *Under*, we also observe a decreasing pattern for the excess returns and alphas of the decile portfolios. Using the five-factor model alpha as an example, the alpha of portfolio 1 is 0.05% and the alpha of portfolio 10 is −0.38%. The five-factor model alpha of the portfolio taking a long position on stocks in portfolio 1 and a short position on stocks in portfolio 10 is positive and statistically significant. The annualized five-factor model alpha is 5.04% ($= 0.43\% * 12$), which is also economically significant. For stocks sorted by the over-investment proxy *Over*, we do not find a similar decreasing pattern for the excess returns and alphas of the decile portfolios. The excess return and five-factor model alpha of the long–short portfolio are statistically insignificant. These results suggest that the negative relation between abnormal investment and future stock returns is mainly explained by under-investment, not by over-investment.

3.2. Abnormal investment and future stock returns

In this section, we investigate the empirical association between firm-level abnormal investment and future stock returns using the following multivariate regression:

$$\begin{aligned} BHR_{i,t+1} = & \alpha + \beta_1 Investment\ components_{i,t} + B * Control\ variables_{i,t} \\ & + \sum Industry_j + \epsilon_{i,t} \end{aligned} \tag{3}$$

where $BHR_{i,t+1}$ is one-year buy-and-hold returns starting from the beginning of the fourth month after the end of firm i's fiscal year t. To make sure that all the information on our explanatory variables are available to the market investors when we measure stock returns, we follow the previous literature and forward the stock returns by three months. *Investment components* is one of the following three variables: $AInvt_t$, $Under_t$, and $Over_t$. Our control variables include market-to-book ratio (MTB_t), leverage ($Leverage_t$), cash holdings ($Cash_t$), firm size ($Size_t$), and lag one-year buy-and-hold returns (BHR_t). We also control for the industry fixed effects based on the Fama–French 48 industry classification. Since stock returns are the dependent variable in Equation (3) and have cross-sectional correlation, we adopt the Fama & MacBeth (1973) regression to estimate Equation (3). The Fama & MacBeth (1973) regression helps to correct for the cross-sectional correlation among standard errors. Furthermore, the panel regression coefficients may be affected by the years with more observations. This concern is also mitigated by the Fama & MacBeth

(1973) regression, in which all years are treated as equally important.

We present the Fama & MacBeth (1973) regression results in Table 4. In column (1), the coefficient of $AInvt_t$ is negative and statistically significant, suggesting that abnormal investment is still negatively associated with future stock returns after controlling for firm characteristics. Next, we separate firm–year observations into those with under-investment and those with over-investment. Columns (2) and (3) of Table 4 show that both under-investment and over-investment are negatively associated with future stock returns. However, in terms of the coefficient value and statistical significance level, the negative relation between under-investment and future stock returns is much stronger than the relation between over-investment and future stock returns, suggesting that the negative relation between abnormal investment and future stock returns is mostly driven by under-investment.

In columns (4)–(6), we include both abnormal investment components and $INew_t$ in the multivariate regressions. Column (4) shows that the coefficient of $INew_t$ is statistically insignificant while the coefficient of $AInvt_t$ remains negative and statistically significant at the 1% level. A one standard deviation increase in $AInvt$ is associated with a 0.86% ($= 0.064 * -0.135$) decrease in firm annual buy-and-hold stock returns, which accounts for 5.51% (= 0.86%/15.6%) of an average firm's annual buy-and-hold stock returns. As shown in column (5), after including $INew_t$ in the multivariate regressions, the coefficient of $Under_t$ remains negative and statistically significant at the 1% level. A one standard deviation increase in $Under$ results in a 2.06% ($= 0.046 * -0.447$) decrease in firm annual buy-and-hold stock returns, which is equivalent to 13.21% (= 2.06%/15.6%) of an average firm's annual buy-and-hold stock returns. Column (6) shows that the coefficient of $Over_t$ turns into positive but only statistically significant at the 10% level, after controlling for $INew_t$. After controlling for $INew_t$, we do not find the evidence shown in (Titman et al. 2004) that firms increasing capital investments achieve negative stock returns subsequently.

Overall, the multivariate regression results reported in Table 4 are consistent with those documented in our quintile portfolio analysis. Taken together, the results in Table 4 have the following three implications. First, when a firm's actual investment deviates from its predicted level, its future stock performance is weaker. Second, it is under-investment per se rather than over-investment that explains the negative relation between abnormal investment and future stock returns. Last, there is no consistent evidence supporting the investment puzzle documented in the previous studies that firms investing above the predicted investment level have a worse future stock performance.

3.3. Potential mechanisms

So far, we have decomposed firm-level investment into the predicted and abnormal components. Our findings show that the negative association between investment and future stock returns is mainly due to abnormal investment. In this section, we investigate the two potential channels through which abnormal investment has a negative impact on future stock returns.

3.3.1. Delayed market reaction to under-investment

In a standard project valuation model, managers should incorporate their private information about the firms' future profitability and distress risk into their investment decisions (Chen et al. 2007). Bakke & Whited (2010) also find that managers may incorporate private investor information when making investment decisions. Therefore, abnormal investment may provide the market with new information about the evolution of the firms' future fundamentals. When market imperfections prevent investors from processing the new information embedded in firms' abnormal investment, stock prices may not fully react to such forward-looking information. Then the contemporaneous stock prices cannot fully reflect the fundamental information conveyed by abnormal investment, leading to stock misvaluation (*the delayed market reaction channel*).

To test this channel, we first investigate whether abnormal investment captures the information relevant to three firm fundamentals: future profitability, future asset growth, and the likelihood of future financial distress. To test whether abnormal investment predicts future profitability or asset growth, we adopt the following two panel regressions:

$$\begin{aligned}\Delta Earnings_{i,t\ to\ t+1} =& \alpha + \beta_1 Abnormal\ investment_{i,t} + B * Control\ variables_{i,t} \\ &+ \sum Year_t + \sum Industry_j + \epsilon_{i,t}\end{aligned} \tag{4}$$

$$\begin{aligned}\Delta Assets_{i,t\ to\ t+1} =& \alpha + \beta_1 Abnormal\ investment_{i,t} + B * Control\ variables_{i,t} \\ &+ \sum Year_t + \sum Industry_j + \epsilon_{i,t}\end{aligned} \tag{5}$$

where $\Delta Earnings_{t\ to\ t+1}$ is equal to $(Earnings_{t+1} - Earnings_t)/Assets_t$ and $\Delta Assets_{t\ to\ t+1}$ is equal to $(Assets_{t+1} - Assets_t)/Assets_t$. *Abnormal investment* is one of the three abnormal investment proxies: $AInvt_t$, $Under_t$, and $Over_t$. The control variables in Equation (4) include the book-to-market ratio (BTM_t), total assets ($Size_t$), capital structure ($Leverage_t$), and current earnings ($Earnings_t$). The control variables in Equation (5) include BTM_t, $Size_t$, and $Leverage_t$. Year and Fama–French 48 industry fixed effects are also included in these two regressions.

On the one hand, Jensen (1986) indicates that managers with an empire building tendency have an incentive to over-invest and grow their firms beyond the optimal size. Arif & Lee (2014) show that firms with higher capital spending are more likely to experience a decrease in future earnings. On the other hand, managers who anticipate potential future financial constraints may forgo positive NPV projects, which negatively affect firms' future profitability. Table 5 reports the panel regression results. In columns (1)–(3), the dependent variable is the change in earnings over the next one-year horizon. The coefficient of *AInvt* in column (1) is -0.011 and statistically significant at the 1% level. A one standard deviation increase in *AInvt* results in a 0.07% ($= 0.064 * -0.011$) decrease in future annual earnings growth rate, which is about 70% ($= 0.07\%/0.10\%$) of an average firm's annual earnings growth rate in our sample. Column (2) shows that the coefficient of *Under* in column (2) is -0.013 and statistically significant at the 5% level. A one standard deviation increase in *Under* results in a 0.06% ($= 0.046 * -0.013$) decrease in future earnings growth rate, which is about 60% ($= 0.06\%/0.10\%$) of an average firm's annual earnings growth rate in our sample. We also find weak evidence that over-investment is negatively related to future profitability. The coefficient of *Over* in column (3) is -0.005 and statistically significant at the 5% level. These results suggest that abnormal investment, especially under-investment, negatively predicts future profitability, which may explain the negative relation between under-investment and future stock returns. In columns (4)–(6), the dependent variable is the change in total assets over the next one-year horizon. The coefficients of *AInvt* and *Over* are positive and statistically significant, while the coefficient of *Under* is negative and statistically significant. A one standard deviation increase in *Under* results in a 0.63% ($= 0.046 * -0.136$) decrease in future annual asset growth rate, which is about 5.73% ($= 0.63\%/11.0\%$) of an average firm's annual assets growth rate in our sample. These results indicate that it is the under-investment which contains the negative information about firm future asset growth. Such negative information also helps to explain the negative relation between under-investment and future stock returns.

Second, we direct our attention to whether abnormal investment contains the information of future financial distress. On the one hand, stockholders have an incentive to take riskier projects than bondholders do, since stockholders only have limited liability. Firms with a potential bankruptcy risk may choose to borrow money from debt holders and over-invest on risky projects. On the other hand, it is costly for firms with financial constraints to raise money from the external credit market. Such firms may choose to under-invest and forgo projects with positive net present value. We follow Shumway's (2001) bankruptcy prediction model to estimate the relation between abnormal investment and the probability of future financial distress. Specifically, we run the following logit regression of distress probability on our abnormal investment proxies:

$$\begin{aligned} Delist_{i,t\ to\ t+3} =& \alpha + \beta_1 Abnormal\ investment_{i,t} + B * Control\ variables_{i,t} \\ & + \sum Year_t + \sum Industry_j + \epsilon_{i,t} \end{aligned} \tag{6}$$

where $Delist_{i,t\ to\ t+3}$ is equal to one if the firm i is delisted due to performance-related reasons in the next three years, and zero otherwise. The control variables are profitability

(*Profit*), leverage (*Leverage*), market value of equity to total market values (*MVE/Total MV*), abnormal returns in the prior fiscal year (*AB*), stock return volatility (*Volatility*), firm size (*Size*). We also control for year and Fama–French 48 industry fixed effects in Equation (6).

Table 6 presents the marginal effect results of the bankruptcy prediction model. In column (1), we only include the control variables. The coefficients of all the control variables are statistically significant and their signs are generally consistent with Shumway (2001). The coefficients of *AInvt* and *Under* are positive and statistically significant at the 1% level in columns (2)–(4), while the coefficient of *Over* is not statistically significant in columns (3) and (5). The Pseudo R^2 and the area under the receiver operating characteristic (ROC) curve are larger in columns (2)–(4) than those in column (1), suggesting that adding under-investment in the bankruptcy prediction model increases the model's ability to identify financial distresses firms. A one standard deviation increase in *Under* is associated with a 0.30% ($= 0.046 * 0.065$) increase in the probability of future financial distress. Given that the sample mean value of the unconditional probability of financial distress is 5.20%, such an increase in the probability of financial distress is equivalent to 5.77% (= 0.30%/5.20%) of the sample mean. These results support the view that abnormal investment carries information on the probability of future financial distress. More importantly, it is under-investment, not over-investment, that appears to have incremental value for predicting future financial distress.

We have shown that under-investment contains additional information about future changes in profitability, changes in asset growth, and the likelihood of financial distress. If stock prices incorporate the information carried by under-investment immediately, then we should not observe an empirical relation between under-investment and future stock returns. However, the negative relation between under-investment and future stock returns we have documented suggests that market investors may fail to fully react to such information. To test *the delayed market reaction channel*, we follow the empirical design of Caskey et al. (2012), and examine the following regression model[7]:

$$BHR_{i,t+1} = \alpha + \beta_1 Under_{i,t} + B_1 * Control\ variables_{i,t} + B_2 * Future\ fundamentals_{i,t} + \sum Industry_j + \epsilon_{i,t} \quad (7)$$

where the dependent variable is next year's stock returns and the control variables are the ratio of book value to market value of equity ($BTM_{i,t}$), the natural log of market value of equity ($Ln(MVE)_{i,t}$), and market systematic risk measured by the beta of the standard market model ($Beta_{i,t}$). *Future fundamentals* include next year's change in debt ($\Delta Debt_{t\ to\ t+1}$), next year's change in earnings ($\Delta Earnings_{t\ to\ t+1}$), next year's asset growth ($\Delta Asset_{t\ to\ t+1}$), and performance related delisting indicator variable over the next three years ($Delist_{t\ to\ t+3}$). Adding *Future fundamentals* one by one into Equation (7) will reduce the value and the statistical significance of the coefficient on $Under_{i,t}$, if the return predictability of under-investment is partially due to the market's delayed reaction to the information carried by under-investment.

Table 7 presents the Fama & MacBeth (1973) regression results of Equation (7). Without adding fundamentals, the coefficient of *Under* in column (1) is -0.238 and statistically significant at the 1% level. In columns (2)–(4), we add the three fundamental variables one by one in Equation (7). The coefficients of *Under* decreases in terms of both value and statistical significance. These results suggest that the negative relation between under-investment and future stock returns could be partially explained by the market's failure to efficiently incorporate the fundamental information carried by under-investment into stock prices. In column (5), we include all the three fundamental variables together in Equation (7), the coefficient of *Under* is -0.126 and statistically insignificant. About 47.06% ($= (0.238 - 0.126)/0.238$) of the negative association between under-investment and future stock returns is due to the future changes in firm fundamentals conveyed by under-investment.

[7] Abarbanell & Bernard (1992) and Shane & Brous (2001) also use similar analyses to study the post-earnings announcement drift.

In sum, the empirical findings in this section support *the delayed market reaction channel* that market investors do not fully incorporate the future fundamentals associated with under-investment into the contemporaneous stock prices, which results in a negative relation between under-investment and future stock returns.

3.3.2. Agency costs

In the previous section, we document the market inefficiency channel through which under-investment may lead to lower future stock returns. However, even if there is no delayed market reaction to the fundamental information conveyed by under-investment, we may still observe a negative relation between under-investment and future stock returns due to agency problems. If under-investment is due to the conflicts of interests between shareholders and bondholders or between managers and shareholders, then the agency costs related to under-investment have a negative impact on firm value and are associated with lower future stock returns (*the agency cost channel*).

Myers (1977) first discusses the debt overhang problem that the existence of debt may lead to an under-investment problem because a firm with outstanding debt has an incentive to forgo positive NPV investment opportunities if the benefits of the new projects accrue to bondholders instead of shareholders. Bergman & Callen (1991) also identify the possibility of opportunistic under-investment by firm managers in debt renegotiation. Bergman & Callen (1991) argue that if managers act strictly in the shareholders' interests, due to the conflicts of interests between bondholders and shareholders, managers may optimally use their discretion over firm investment decisions to force concessions from the firms' creditors by threatening to sap firm value through under-investment. Therefore the conflict of interests between shareholders and bondholders may lead to under-investment. In addition, firms may under-invest due to the conflict of interests between managers and shareholders. With asymmetric information and the lack of external monitoring, managers may prefer a "quiet life" (e.g., Hart 1983, Bertrand & Mullainathan 2003), since it is costly for them to make complicated investment decisions. Moreover, managers may be risk averse and intentionally choose not to invest in risky projects due to "career concerns". Instead of being lazy, managers may worry about losing their jobs if their new projects have unfavorable outcomes due to random factors (Aghion et al. 2013). Both "quiet life" and "career concerns" may explain why managers bypass positive NPV projects, leading to inferior future stock returns.

To test *the agency cost channel*, we adopt sub-sample analyses and divide firm–year observations with under-investment into two sub-samples based on the annual industry medians of *Blockholder Ownership*, *Expense Ratio*, and *Asset Utilization Ratio*. If the negative relation between under-investment and future stock returns is partly due to the agency costs, then such negative relation is likely to be more pronounced among firms subject to a poorer external monitoring environment. Edmans (2014) reviews the theoretical and empirical studies on blockholders and summarizes the "voice" and "exit" channels through which blockholders may engage in corporate governance. *Blockholder Ownership* is defined as the ownership of a firm's blockholders who hold more 5% of the firm's outstanding shares. A higher *Blockholder Ownership* indicates better corporate governance quality and fewer agency costs. We examine whether the negative relation between under-investment and future stock returns can be explained by the cross-sectional differences in *Blockholder Ownership*. Columns (1) and (2) of Table 8 report the results of sub-sample analyses for firms with low and high *Blockholder Ownership*. The coefficient of $Under_t$ remains negative for both sub-samples, but is only statistically significant in the low *Blockholder Ownership* partition.

Next, we adopt two direct proxies for agency costs proposed by Ang et al. (2000): *Expense Ratio* and *Asset Utilization Ratio*.[8] *Expense Ratio* is defined as operating expenses scaled by total sales, which is a measure of how effectively a firm's managers control operating costs, including excessive perquisite consumption and other direct agency costs. *Expense Ratio* is positively related to agency costs. *Asset Utilization Ratio* is defined as

[8]Other commonly used proxies for agency costs from the previous literature, such as managerial ownership and anti-takeover rights, are only available for firms included in the S&P 1500 index.

total sales scaled by total assets, which is a measure of how effectively a firm's managers deploy its assets. In the contrary to *Expense Ratio*, *Asset Utilization Ratio* is negatively related to agency costs. Columns (3)–(4) and (5)–(6) of Table 8 report the results of sub-sample analyses for firms with low and high *Expense Ratio* and *Asset Utilization Ratio*, respectively. The coefficients of $Under_t$ remain negative and statistically significant for both sub-samples. However, the coefficients of $Under_t$ are larger in terms of the absolute value in high *Expense Ratio* and low *Asset Utilization Ratio* partitions, suggesting that the negative relation between under-investment and future stock returns is more pronounced in firms with high agency costs.

Taken as a whole, we also find evidence supporting *the agency cost channel* that the negative relation between under-investment and future stock returns is due to the agency costs associated with under-investment.[9]

4. Robustness tests and further discussions

In this section, we provide the results of robustness tests and further discussions on our results.

4.1. Robustness to omitted variable bias

To address the endogeneity concern in terms of omitted variable bias, we adopt Oster's (2019) identification test. We choose the baseline regression specification reported in column (5) of Table 4. Since Oster's (2019) identification test only applies to OLS regressions, we estimate the specification in column (5) of Table 4 using an OLS regression. The coefficient of $Under_t$ is -0.451 and the R^2 of the regression is 0.107 which are very close to -0.447 and 0.126 reported in column (5) of Table 2. Following the identification method proposed by Oster (2019), we use Stata code *psacalc* to calculate the estimation

[9] To formally test the statistical significance of the differences in coefficients between two sub-samples, we compare the mean differences in the thirty-eight regression coefficients from the Fama & MacBeth (1973) regressions. We find that the mean differences are statistically significant at the 5% level for *Blockholder Ownership* and *Asset Utilization Ratio*.

bounds. We assume that δ is equal to 1 in the analysis, meaning that the observed and unobserved factors have an equally important effect on the coefficient of $Under_t$. We also define the R_{max} upper bound as 1.3 times the R^2 (0.107) that controls for all observables. R_{max} specifies the maximum R^2 which would result if all unobservables were included in our baseline regression. The estimation bounds are $(-0.451, -0.499)$, which show very limited movement in the coefficient and do not include zero. We also estimate Oster's Delta, which indicates the degree of selection on unobservables relative to observables that would be required to fully explain our result by omitted variable bias. According to Oster (2019), high Delta values indicate that the unobservables have less effect on the coefficient of interest than the observables. Oster's Delta is equal to 15.73, which is reassuring, because it is very unlikely that unobservables are more than 15 times as important as all observables included in column (5) of Table 4.

4.2. Abnormal investment and future stock returns: Alternative econometric estimation methods

Our main results reported in Table 4 rely on the abnormal investment proxies estimated by historical panel regressions. Also, the empirical relation between abnormal investment and future stock returns is estimated by Fama & MacBeth (1973) regressions. In this section, we check whether our main results are robust to alternative econometric estimation methods. Table 9 reports the results of these robustness tests.

In Panel A, B, and C, we report the robustness test results for *AInvt*, *Under*, and *Over*, respectively. In column (1), the abnormal investment proxies are estimated by the historical panel regressions between 1974 and year t. In column (1), we use a panel regression to examine the empirical relation between the abnormal investment proxies and future stock returns. In columns (2)–(3), we follow Richardson (2006) and Stoughton et al. (2017) to estimate the abnormal investment proxies by running a single panel regression of Equation (1) between 1974 and 2017. Then we examine the empirical relation between the abnormal investment proxies and future stock returns using a panel regression and a Fama & MacBeth (1973) regression in columns (2) and (3), respectively. In columns (4)–(5), we estimate the abnormal investment proxies by rolling panel regressions with five-year fixed windows. Specifically, for abnormal investment in year t, we estimate Equation (1) with a five-year rolling window from year $t-4$ to year t. Then we examine the empirical relation between the abnormal investment proxies and future stock returns using a panel regression and a Fama & MacBeth (1973) regression in columns (4) and (5), respectively. The coefficients of the control variables in Equation (1) are suppressed for brevity.

Panel A of Table 9 shows that the coefficients of *AInvt* remain negative and statistically significant. Panel B of Table 9 shows that the coefficients of *Under* are negative and statistically significant at the 1% level in all the respective columns. Panel C of Table 9 shows that the coefficients of *Over* are positive and statistically significant, except in column (3). The coefficients of under-investment are generally larger than those of over-investment in the corresponding columns. Overall, our main results remain robust to these alternative econometric estimation methods. We still find a negative relation between abnormal investment and future stock returns, which is mainly driven by under-investment.

4.3. Alternative measures of abnormal investment

In our empirical analyses, we measure the level of abnormal investment following an accounting-based investment model proposed by Richardson (2006). As a result, the inferences drawn from our empirical analyses are contingent on the reliability of the investment expectation model. In this section, we check whether our main results are robust to two alternative measures of abnormal investment which have been developed in the previous investment literature. First, we follow Harvey et al. (2004) and use industry median investment as the benchmark investment level. We measure *AInvt* as the absolute value of the difference between a firm's investment and its industry median investment. In addition, *Under* is the absolute value of the difference when a firm's investment is less than its industry median investment and *Over* is the absolute value of the difference when a firm's investment is greater than its industry median investment. Second, we follow Titman et al. (2004) and use a firm's average capital expenditure during the previous three years as its benchmark investment level. We measure *AInvt* as the absolute value of the difference between a firm's capital expenditure in year $t-1$ and its average capital expenditures during the previous three years. Similarly, *Under* is the absolute value of the difference when a firm's investment is less than its benchmark investment level and *Over* is the absolute value of the difference when a firm's investment is greater than its benchmark investment level.[10]

Table 10 presents the Fama & MacBeth (1973) regression results of future stock returns on alternative abnormal investment proxy variables. For both alternative measures, the coefficients of *Under* are negative and statistically significant. The coefficients of *AInvt* and *Over* are negative and statistically significant for Harvey et al.'s (2004) measure, but statistically insignificant for Titman et al.'s (2004) measure.[11] These results suggest that the negative relation between under-investment and future stock returns remains robust to these two alternative measures of abnormal investment.

4.4. Systematic financial distress risk and the relation between under-investment and future stock returns

Section 3.3.1 shows that abnormal investment carries information on future firm fundamentals. We further provide evidence that the negative relation between under-investment and future stock returns is partly due to the fact that markets fail to fully react to the information on firm-specific financial distress conveyed by under-investment. Besides the delayed market reaction explanation, an alternative explanation of our findings is that firms with low under-investment have high exposure to systematic financial distress risk. According to this alternative explanation, the high abnormal returns of firms with

[10]Please refer to Harvey et al. (2004) and Titman et al. (2004) for the detailed definitions of abnormal investment.

[11]If we define *AInvt* as the raw difference, instead of the absolute value of the difference, the coefficient of *AInvt* is -0.250 and statistically significant at the 1% level for Harvey et al.'s (2004) measure, and is -0.013 and statistically insignificant for Titman et al.'s (2004) measure.

low under-investment stem from the high risk-premium of systematic financial distress risk. To differentiate our market delayed reaction explanation and the alternative risk-premium-based explanation, we augment the Fama & French (2015) five-factor model by an additional systematic financial distress risk factor FDR:

$$\begin{aligned} R_{p,t} - Rf_t =& \alpha + \beta_1 MKTRF_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + \\ & \beta_6 FDR_t + \epsilon_{p,t} \end{aligned} \tag{8}$$

where $R_{p,t}$ denotes the portfolio p's return over month t, Rf_t denotes the risk-free return measured by the one-month Treasury bill rate over month t; $MKTRF_t$, SMB_t, HML_t, RMW_t, and CMA_t are returns of Fama & French (2015) five factors [12]; and FDR_t is the factor mimicking portfolio return for systematic financial distress risk in month t. FDR_t is estimated by a hedge portfolio that takes a long position on BAA rated bonds and a short position in AAA rated bonds. We collect the monthly bond yields from the Federal Reserve's H-15 reports and convert bond yields to returns using the log-linear approximation defined in Campbell et al. (1997).

At the end of every June over our sample period 1980–2017, we sort firms into five equally weighted portfolios based on their most recent *Under*. Portfolio 1 (5) include firms with the lowest (highest) under-investment. Table 11 presents the results of time-series regressions of portfolio excess returns on the six systematic risk factors. We do not find evidence that firms with low under-investment have high exposure to the systematic financial distress factor. The coefficients of FDR actually increase from 0.0035 for portfolio 1 to 0.0054 for portfolio 5, suggesting that firms with high under-investment have high exposure to the financial distress factor. Our empirical result does not support the alternative risk-premium-based explanation. Furthermore, the alphas of these five portfolios decrease monotonically from portfolio 1 to 5. The annualized return spread between

[12] RMW_t denotes the profitability factor and is measured by the return of a profitability factor mimicking portfolio over month t. CMA_t denotes the investment (CMA) factor and is the return of an investment factor mimicking portfolio over month t. Fama & French (2015) show that over the sample period of 1963–2013, adding the profitability and investment factors makes the value factor redundant since the time series of HML returns are completely explained by the other four factors.

portfolio 1 and 5 is 8.16%. Overall, our results show that the negative relation between under-investment and future stock returns remains robust after controlling for the systematic financial distress risk factor. Therefore, it is more likely that the negative relation between under-investment and future stock returns is due to market inefficiencies, such as delayed reaction to under-investment or potential agency costs.

4.5. The impact of market recessions on our results

Our sample covers two notorious stock market downturns: the burst of the internet bubble between 2000 and 2002 and the recent financial crisis between 2007 and 2009. Both stock returns and firm investment strategies are notably affected by these two negative market-level shocks. In untabulated tests, we examine the impact of these two market recessions on the empirical relation between abnormal investment and future stock returns. The results of Fama & MacBeth (1973) regressions show that the relation between under-investment and future stock returns is not statistically significant during these two periods, suggesting that stock markets are less likely to react to negative information with a delay during the recession periods. Outside of these two recession periods, the negative relation between under-investment and future stock returns remain statistically significant.

The previous psychology and economics studies suggest that investors' sensitivity to news is most pronounced when they are going through hard times. In the psychology literature, Smith & Ellsworth (1985) find that people's emotions, such as anxiety, hope, and sadness, are associated with a greater sense of uncertainty. Tiedens & Linton (2001) show that the reliance on heuristic versus systematic processing varies with emotions. Consistent with these findings, the behavioral economics literature suggests that investor behavior differs in times of anxiety and fear versus periods of prosperity and tranquillity (Akerlof & Shiller 2010, Garcia 2013). For example, Hirshleifer & Shumway (2003) and Cortés et al. (2016) show that stock returns and credit approval rates are affected by weather. Edmans et al. (2007) also show that stock returns are affected by the outcomes of major sporting events. One potential explanation of our empirical findings is that market investors tend to pay more attention to the negative firm-specific information during the market downturns so that stock prices are more likely to fully reflect the negative firm-specific information during the recession periods.

4.6. The impact of short-sale constraint and stock liquidity on our results

In this section, we try to reconcile our empirical findings with the limits to arbitrage literature. For example, Li et al. (2014) find that the low-volatility stock anomaly is concentrated among illiquid stocks. In the *delayed market reaction channel*, we argue that market investors do not fully incorporate the future fundamentals associated with under-investment into the contemporaneous stock prices, which results in a negative relation between under-investment and future stock returns. The delayed investor reaction might be attributed to short-sale constraint and stock liquidity. Stocks with high short-sale constraint is subject to the arbitrage limits, while illiquid stocks tend to have lower institutional ownership and higher agency costs than liquid stocks. Hence, we expect that the negative relation between under-investment and future stock returns is stronger among stock with high short-sale constraint and low liquidity.

To investigate this possibility, we employ a cross-sectional analysis and divide our samples based on the annual industry medians of total institutional ownership (*TIO*) and Amihud's (2002) illiquidity measure (*Illiq*). The high short-sale constraint sub-sample includes firm–year observations with below the median of *TIO*.[13] The liquid sub-sample includes firm–year observations with below the median of *Illiq*. Table 12 shows that in our baseline regression, the coefficients of $Under_t$ remain negative and statistically significant for both sub-samples. However, columns (1)–(2) show that the coefficient of $Under_t$ is larger in terms of the absolute value in the short-sale constraint sub-sample than in the unconstraint sub-sample, consistent with our expectation that the negative relation between

[13] Previous studies suggest that it is generally easy to borrow and short-sell stocks with high institutional ownership.

under-investment and future stock returns is stronger among stock with high short-sale constraints. Columns (3)–(4) show that the coefficient of $Under_t$ is larger in terms of the absolute value in the illiquid sub-sample than in the liquid sub-sample, consistent with our expectation that the negative relation between under-investment and future stock returns is stronger among stock with low liquidity.

4.7. Alternative return periods

To estimate if our results are robust to alternative return windows, we replace the dependent variable, one-year buy-and-hold return, in our baseline regressions by one-month, three-month, six-month, and two-year buy-and-hold returns, respectively. Table 13 shows that our baseline results are robust to buy-and-hold returns measured over one-month, three-month, and six-month windows. However, we find that the coefficient of $AInvt_t$ is negative and statistically significant at the 10% level, the coefficient of $Under_t$ is positive and statistically significant at the 10% level, and the coefficient of $Over_t$ is negative and statistically significant at the 1% level over two-year window. Our finding with respect to the long-term stock return is consistent with Titman et al. (2004) who show that firms increasing their investment the most tend to underperform their benchmarks over the following five years. The reversal of our main results in the long-run is consistent with the market efficiency view that the delayed reaction of investors to firm under-investment is temporary and will eventually be corrected in the long-run.

4.8. Additional robustness test results

In this section, we further discuss our robustness test results. First, Fama & French (2008) point out that microcap stocks comprise 60% of the stocks in the U.S. market, but on average only account for 3% of the market capitalization. Microcap stocks also tend to disproportionately inhabit stock return anomalies because the cross-sectional dispersion of anomaly variables tends to be the highest among them. To test whether our main results are driven by small stocks, we drop stocks with stock prices less than \$5 from our sample. Table 14 shows that our baseline regression results remain robust.

Second, we replace the control variable, the lagged one-year buy-and-hold return (BHR_t), by short-term reversals ($BHR_{(-1,0)}$), momentum ($BHR_{(-12,-1)}$), and long-term reversals ($BHR_{(-36,-12)}$). $BHR_{(-1,0)}$ is the buy-and-hold return measured over a one-month period before t, $BHR_{(-12,-1)}$ is the buy-and-hold return measured from twelve months to one month before t, and $BHR_{(-36,-12)}$ is the buy-and-hold return measured from thirty-six months to twelve months before t. Table 15 shows that our main results remain robust.

Third, acquisitions (particularly stock-financed deals) predict poor subsequent stock returns, which could have important implications for stock return prediction models. Since our measure of investment includes acquisitions, it is possible that the periods of measured under-investment immediately follow major deals. To mitigate this concern, we exclude acquisition expenses from our investment measures. Untabulated results show that our baseline regression results remain qualitatively the same.

Fourth, the abnormal investment variable in Titman et al. (2004) takes negative values for under-investment and positive values for over-investment. In contrast, our abnormal investment variable (*AInvt*) is in its absolute value term, suggesting that large positive values of abnormal investment can reflect either substantial under- or over-investment. We use variables *Under* and *Over* to distinguish between under- and over-investment in our empirical analyses. Following Titman et al. (2004), we define *Raw_AInvt* as the difference between our actual and predicted investment model without taking absolute value. We replace *AInvt* by *Raw_AInvt* in columns (1) and (4) of Table 4. Untabulated results show that the coefficient of *Raw_AInvt* in column (1) is -0.004 and statistically insignificant, suggesting that future stock returns are not negatively related to firm investment. The coefficient of *Raw_AInvt* in column (4) is 0.338 and statistically significant at the 1% level, suggesting that firms with over-investment tend to outperform those with under-investment.

Fifth, Cooper et al. (2008) document a negative relation between asset growth and subsequent stock returns. Since asset growth captures common return effects across the components of a firm's total investment or financing activities, it can predict cross-sectional stock returns (Cooper et al. 2008). In Columns (4)–(6) of Table 4, we have controlled for the proxies of firm total investment (*INew*) and financing activities (*Leverage*). To alleviate the concern that our abnormal investment measures simply capture the asset growth effect, we directly add asset growth as a control variable in these three regression specifications. Following Cooper et al. (2008), asset growth in year t is defined as the percentage change in total assets from fiscal year $t-2$ to fiscal year $t-1$. Untabulated results show that all the coefficients of our abnormal investment variables remain robust, and the coefficients of asset growth are negative and statistically significant.

5. Conclusions

In a standard firm growth model, corporate earnings which are not paid out as dividends will be invested in positive NPV projects. The book value of firm equities will increase accordingly. In a dynamic financial market, a firm's actual investment may deviate from its model predicted investment level due to random economic shocks or managerial discretion. If the deviation is due to random economic shocks, then the gap between the actual and model predicted investment conveys information about the firm's future fundamentals. The return predictability of abnormal investment may be explained by possible market inefficiencies, such as a market delayed reaction to the fundamental information contained in abnormal investment. If the deviation is due to managerial discretion, then abnormal investment may impact future stock returns through the costs of agency problems.

We employ Richardson's (2006) investment model to decompose firm investment into two components: abnormal investment and model predicted investment. We find that when both investment and abnormal investment are considered simultaneously, future stock returns tend to be more closely associated with abnormal investment, rather than investment. More importantly, we find that the negative relation between abnormal investment and future stock returns is mainly driven by under-investment instead of over-investment. We provide weak evidence on a positive relation between over-investment and future stock returns. We then investigate two mechanisms through which under-investment is negatively associated with future stock returns. With respect to *the delayed market reaction channel*, we show that under-investment conveys fundamental information about firms' future profitability, asset growth, and the likelihood of financial distress. The negative relation between under-investment and future stock returns can be partially explained by the market investors' delayed reaction to the fundamental information in under-investment. We then show that the negative relation between under-investment and future stock returns is more pronounced for firms with less external monitoring and higher agency costs, which supports the *the agency cost channel*. Combined, these results support the notion that market inefficiency along with agency costs associated with under-investment helps to explain the negative empirical relation between under-investment and future stock returns. The earlier investment studies show that high (low) corporate investment predicts low (high) future returns (e.g., Titman et al. 2004). Our paper contributes to the previous literature by showing that after adjusting for firm growth opportunities along with other characteristics in our investment model and stock return prediction model, under-investment, instead of over-investment, is negatively associated with future stock returns.

Appendix A

Table A1. Variable definitions

This table provides variable definitions and corresponding data sources. Compustat refers to the Capital IQ from Standard & Poor's database, CRSP refers to the Centre for Research in Security Prices, FF refers to Kenneth French's data library, WRDS refers to the Fama French & Liquidity Factors database on Wharton Research Data Services, and 13F refers to the Thomson Reuters 13F Database.

Variable	Definition	Source
Asset	Total assets (millions).	Compustat
ITotal	Annual total investment expenditure divided by *Asset*: [Capital expenditure (CAPX) + R&D Expenditure (XRD) + Acquisitions (AQC) − Sale of Property, Plant and Equipment (SPPE)]/*Asset* (Richardson 2006).	Compustat
IMain	Annual required investment expenditure to maintain assets in place divided by *Asset*: Depreciation and Amortization (DPC)/*Asset* (Richardson 2006).	Compustat
INew	Investment expenditure on new projects divided by *Asset*: *ITotal* − *IMain* (Richardson 2006).	Compustat
AInvt	Abnormal investment proxy variable: $\lvert INew - \widehat{INew} \rvert$, where $\widehat{INew}_t$ is estimated by a historical panel regression over the period 1974 to year $t-1$.	CRSP & Compustat
Under	Under-investment proxy variable: $\lvert AInvt \rvert$ if $AInvt<0$.	CRSP & Compustat
Over	Over-investment proxy variable: $\lvert AInvt \rvert$ if $AInvt>0$.	CRSP & Compustat
MVE	Market value of equity (millions): Common Outstanding Shares (CSHO) * Stock Price (PRCC_F).	Compustat
V/P	Growth opportunity: Assets in place/*MVE*, where the assets in place are estimated as $(1-\alpha r)BV + \alpha(1+r)X - \alpha rd$, $\alpha{=}\omega/1+r-\omega$, $r = 12\%$, $\omega = 0.62$, BV is the Book Value of Common Equity (CEQ), X is Operating Income After Depreciation (OIADP), and d is annual Dividend (DVC) (Ohlson 1995, Richardson 2006).	Compustat
Leverage	Leverage ratio: [Short-term Debt (DLC) + Long-term Debt (DLTT)]/ [DLC + DLTT + CEQ] (Richardson 2006).	Compustat
Cash	Cash holdings: Cash and Short-term Investment (CHE) divided by *Asset* (Richardson 2006).	Compustat

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Table A1 - continued from previous page

Variable	Definition	Source
Age	Firm age: the natural log of (1+ the number of years the firm has been listed on CRSP as of the start of year) (Richardson 2006).	CRSP
Size	Firm size: the natural log of *Asset* (Richardson 2006).	Compustat
Return	The percentage change in firm market value over the previous year: $MV_t/MV_{t-1} - 1$ (Richardson 2006).	CRSP
R_p	The monthly return on quintile portfolio p by abnormal investment proxies.	CRSP & Compustat
MKTRF	The monthly excess return on the market portfolio (Fama & French 1993).	FF
SMB	The monthly average return on the three small portfolios minus the average return on the three big portfolios (Fama & French 1993).	FF
HML	The monthly average return on the two value portfolios minus the average return on the two growth portfolios (Fama & French 1993).	FF
RMW	The monthly average return on the two robust operating profitability portfolios minus the average return on the two weak operating profitability portfolios (Fama & French 2015).	FF
CMA	The monthly average return on the two conservative investment portfolios minus the average return on the two aggressive investment portfolios (Fama & French 2015).	FF
FDR	Systematic financial distress risk: monthly return on a hedge portfolio with a long position in BAA rated bonds and a short position on AAA rated bonds. We follow Campbell et al. (1997) to convert yields to returns.	Federal Reserve H-15 reports
BHR	One-year buy-and-hold returns starting from the fourth month after a fiscal year end and we require at least 6 available monthly returns.	CRSP & Compustat
MTB	Market-to-Book ratio: $[MV + \text{DLC} + \text{DLTT}]/Asset$ (Stoughton et al. 2017).	Compustat
Earnings	Firm earnings: [Income Before Extraordinary Items (IB) + Interest Expense(XINT)] /*Asset*.	Compustat
BVE	Book value of equity (millions): CEQ + Preferred Treasury Stock (TSTKP) − Preferred Dividends In Arrears (DVPA).	Compustat
BTM	Book-to-Market ratio: BVE/MVE.	Compustat
Profit	Profitability: Net Income (NI)/*Asset*.	Compustat
AR	Abnormal returns: a firm's buy-and-hold return during the fiscal year subtracted by the value-weighted market index.	CRSP

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Table A1 - continued from previous page

Variable	Definition	Source
Volatility	Volatility: the standard deviation of the residuals from the regression of monthly stock returns on the value-weighted market index return.	CRSP
Delist	An indicator variable for performance-rated delisting which equals one if a firm delists within three years of the fourth month after the fiscal year end with a CRSP delisting code 500 or between 520 and 584, and zero otherwise. (Shumway 2001).	CRSP & Compustat
Δ*Earnings*	The change in earnings: $(Earnings_{t+1} - Earnings_t)/Asset_t$.	Compustat
Δ*Asset*	The change in assets: $(Assets_{t+1} - Assets_t)/Asset_t$.	Compustat
Beta	Beta of a standard market model, using the most recent 255 trading days' returns and CRSP value-weighted index returns as the proxy for market returns.	CRSP & Eventus
Blockholder Ownership	The percentage ownership of blockholders who hold more than 5% of a firm's outstanding shares.	13F
Expense Ratio	Operating expenses divided by total sales. Operating expenses are defined as total expenses less cost of goods sold, interest expense, and managerial compensation (Ang et al. 2000).	Compustat
Asset Utilization Ratio	Total sales divided by total assets (Ang et al. 2000).	Compustat

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Table 1. Summary statistics

This table presents the summary statistics of the variables used in our main empirical analysis. For the variables included in our investment model Equation (1), the sample consists of 122,180 firm–year observations over the period 1974–2017. For the rest of the variables, the sample period is 1980–2017. The number of observations, mean, standard deviation, 1st percentile, 25th percentile, median, 75th percentile, and 99th percentile are reported from left to right, in sequence for each variable. See Appendix A for variable definitions.

Variables	**Obs.**	**Mean**	**S.D.**	**p1**	**p25**	**Median**	**p75**	**p99**
Asset	122,180	2028.2	13000	2.258	33.780	137.9	714.4	33756.2
Itotal	122,180	0.119	0.112	-0.029	0.043	0.088	0.160	0.580
Imain	122,180	0.048	0.034	0.000	0.026	0.04	0.059	0.204
INew	122,180	0.070	0.110	-0.154	0.002	0.042	0.109	0.523
MVE	122,180	1416.8	4589.4	1.313	23.726	114.0	641.0	34164.1
V/P	122,180	0.788	0.706	-0.456	0.342	0.619	1.041	3.727
Leverage	122,180	0.312	0.248	0.000	0.076	0.297	0.497	0.917
Cash	122,180	0.155	0.193	0.000	0.024	0.075	0.212	0.872
Age	122,180	2.427	0.896	0.693	1.792	2.485	3.091	4.290
Size	122,180	5.099	2.136	0.815	3.653	5.075	6.711	10.425
Return	122,180	0.241	0.809	-0.798	-0.182	0.085	0.421	4.549
MTB	108,135	1.473	1.341	0.273	0.720	1.020	1.663	8.391
BHR	108,135	0.156	0.609	-0.825	-0.198	0.069	0.367	2.904
Earnings	95,356	0.014	0.192	-0.769	0.009	0.059	0.092	0.238
BE	95,356	855.6	4360.8	0.954	20.382	86.932	397.1	13519.1
BTM	95,356	0.728	0.874	0.050	0.329	0.562	0.907	3.228
Profit	122,072	0.006	0.200	-0.742	-0.001	0.042	0.080	0.248
AR	122,072	0.058	0.748	-0.875	-0.293	-0.048	0.227	2.649
Volatility	122,072	0.121	0.091	0.027	0.068	0.100	0.149	0.445
Delist	59,706	0.052	0.222	0.000	0.000	0.000	0.000	1.000
Beta	59,706	0.784	0.629	-0.568	0.349	0.734	1.162	2.481
Δ*Earnings*	59,706	0.001	0.029	-0.037	0.000	0.000	0.000	0.045
Δ*Debt*	59,706	0.041	0.325	-0.354	-0.032	0.000	0.047	1.001
Δ*Asset*	59,706	0.110	0.481	-0.438	-0.038	0.046	0.154	1.648
FDR	455	1.539	0.668	0.741	1.073	1.384	1.776	4.447

Table 2. Analysis of investment expenditure

Panel A. Coefficients of investment prediction regressions. This panel summarizes the regression coefficients estimated by the investment model Equation (1). The dependent variable is new investment expenditure ($INew_t$). The independent variables are growth opportunity (V/P_{t-1}), leverage ($Leverage_{t-1}$), cash holdings ($Cash_{t-1}$), firm age (Age_{t-1}), firm size ($Size_{t-1}$), past stock performance ($Return_{t-1}$), and the lag of new investment expenditure ($INew_{t-1}$). We estimate the investment model using thirty-eight historical panel regressions. For each year t between 1980 and 2017, we run a panel regression using firm–year observations between 1974 and year $t-1$. We only report the time-series average of the coefficients estimated by these historical panel regressions. Year and Fama–French 48 industry fixed effects are controlled in all regressions. The coefficients of the year and industry fixed effects are suppressed for brevity. See Appendix A for variable definitions. The t-values of regression coefficients are based on standard errors clustered by firm. The numbers of positive and negative coefficients at the 1% statistical significance level are reported in parentheses.

Dependent variable: $INew_t$	
V/P_{t-1}	-0.010
	(Negative 38, Positive 0)
$Leverage_{t-1}$	-0.033
	(Negative 38, Positive 0)
$Cash_{t-1}$	0.078
	(Negative 0, Positive 38)
Age_{t-1}	-0.004
	(Negative 38, Positive 0)
$Size_{t-1}$	0.003
	(Negative 0, Positive 38)
$Return_{t-1}$	0.012
	(Negative 0, Positive 38)
$INew_{t-1}$	0.409
	(Negative 0, Positive 38)
Constant	0.037
	(Negative 0, Positive 38)
Average Observations	70,598
Average adj. R^2	0.342
Year fixed effects	Yes
Industry fixed effects	Yes
Number of historical panels	38

Panel B. Descriptive statistics of abnormal investment. This panel presents the descriptive statistics of the abnormal investment variables estimated by the investment model Equation (1). The main sample covers 108,273 firm–year observations over the period 1980–2017. The number of observations, mean, standard deviation, 1st percentile, 25th percentile, median, 75th percentile, and 99th percentile are reported from left to right, in sequence for each variable. See Appendix A for variable definitions.

Variables	**Obs.**	**Mean**	**S.D.**	**p1**	**p25**	**Median**	**p75**	**p99**
$INew^*$	108,273	0.069	0.064	-0.039	0.026	0.055	0.099	0.285
$INew$ - $INew^*$	108,273	0.000	0.086	-0.195	-0.043	-0.011	0.027	0.311
AInvt	108,273	0.057	0.064	0.001	0.017	0.037	0.073	0.319
Under	63,932	0.049	0.046	0.001	0.018	0.036	0.065	0.221
Over	44,341	0.070	0.082	0.001	0.015	0.039	0.092	0.384

Table 3. Decile portfolio analysis

This table presents the results of the decile portfolio analysis of the relation between firm abnormal investment and stock returns. We sort stocks into decile portfolios based on the most recently estimated *INew*, *AInvt*, *Under*, and *Over* at the end of June for each year from 1980–2017. Portfolio 1 (10) includes stocks with the lowest (highest) abnormal investment measures. For each quintile portfolio, we calculate its value-weighted monthly returns. Then we estimate its excess returns and five-factor model alpha based on monthly portfolio returns. The five factors include market, size, value, momentum, and liquidity. The last column reports the corresponding factor model alpha of a portfolio that takes a long position on stocks in portfolio 1 and a short position on stocks in portfolio 10. The t-statistics are reported in brackets. $***$, $**$, and $*$ denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Decile portfolios										
Factor models	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1 minus 10**
					Stocks sorted by *INew*						
Excess return	0.29%	0.67%***	0.82%***	0.82%***	0.77%***	0.76%***	0.80%***	0.76%***	0.80%***	0.68%**	-0.39%
	[1.05]	[2.71]	[3.71]	[3.93]	[3.54]	[3.50]	[3.46]	[2.85]	[2.83]	[2.18]	[-0.92]
Five-factor model alpha	-0.43%***	-0.07%	0.09%	0.09%	0.06%	0.05%	0.05%	0.08%	0.07%	-0.05%	-0.38%**
	[-3.89]	[-0.71]	[1.12]	[1.27]	[0.76]	[0.74]	[0.73]	[0.93]	[0.73]	[-0.51]	[-2.39]
					Stocks sorted by *AInvt*						
Excess return	0.82%***	0.82%***	0.76%***	0.79%***	0.80%***	0.77%***	0.65%***	0.63%**	0.67%**	0.62%**	0.19%
	[3.78]	[3.74]	[3.47]	[3.53]	[3.55]	[3.17]	[2.57]	[2.42]	[2.35]	[2.16]	[0.54]
Five-factor model alpha	0.13%*	0.11%	0.07%	0.06%	0.09%	0.02%	-0.03%	-0.14%*	-0.06%	-0.18%**	0.31%***
	[1.94]	[1.54]	[0.94]	[0.89]	[1.33]	[0.34]	[-0.45]	[-1.86]	[-0.69]	[-1.99]	[2.59]
					Stocks sorted by *Under*						
Excess return	0.76%***	0.78%***	0.75%***	0.80%***	0.79%***	0.70% ***	0.76%***	0.62%**	0.63%**	0.26%	0.50%
	[3.46]	[3.44]	[3.46]	[3.61]	[3.40]	[2.90]	[2.97]	[2.26]	[2.26]	[0.77]	[1.26]
Five-factor model alpha	0.05%	0.06%	0.05%	0.09%	0.06%	0.00%	0.08%	-0.06%	-0.03%	-0.38**%	0.43%**
	[0.55]	[0.79]	[0.60]	[1.10]	[0.78]	[0.04]	[0.82]	[-0.65]	[-0.24]	[-2.54]	[2.41]
					Stocks sorted by *Over*						
Excess return	0.78%***	0.93%***	0.76%***	0.76%***	0.81%***	0.80%***	0.73%***	0.83%***	0.88%***	0.81%***	-0.03%
	[3.38]	[4.00]	[3.33]	[3.13]	[3.18]	[2.94]	[2.77]	[3.00]	[3.04]	[2.80]	[-0.08]
Five-factor model alpha	0.10%	0.24%**	0.07%	0.01%	0.02%	0.01%	-0.08%	0.09%	0.05%	0.02%	0.07%
	[0.97]	[2.44]	[0.62]	[0.09]	[0.19]	[0.12]	[-0.69]	[0.75]	[0.38]	[0.17]	[0.42]

Table 4. Investment, abnormal investment, and stock performance

This table presents the Fama & MacBeth (1973) regression results of firm future stock returns on abnormal investment proxy variables. The dependent variable is BHR_{t+1}, one-year buy-and-hold returns starting from the fourth month after the end of fiscal year t. The independent variables of interest are the abnormal investment proxies, estimated by the investment expenditure Equation (1): $AInvt_t$, $Under_t$, and $Over_t$. See Appendix A for variable definitions. The t-statistics of Fama–MacBeth regression coefficients are reported in brackets. The coefficients of the Fama–French 48 industry fixed effects are suppressed for brevity in the respective columns. $***$, $**$, and $*$ denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$AInvt_t$	-0.165***			-0.135**		
	[-3.62]			[-2.65]		
$Under_t$		-0.249***			-0.447***	
		[-3.20]			[-4.54]	
$Over_t$			-0.094*			0.352*
			[-1.73]			[1.73]
$INew_t$				-0.053	-0.400***	-0.399**
				[-1.25]	[-2.85]	[-2.43]
MTB_t	-0.032***	-0.034***	-0.034***	-0.031***	-0.031***	-0.029***
	[-5.02]	[-5.27]	[-5.05]	[-4.90]	[-4.96]	[-4.06]
$Leverage_t$	-0.031	-0.031	-0.025	-0.032	-0.041	-0.040
	[-1.19]	[-1.10]	[-0.83]	[-1.21]	[-1.45]	[-1.42]
$Cash_t$	0.048	0.055	0.037	0.046	0.074**	0.088*
	[1.24]	[1.61]	[0.63]	[1.27]	[2.39]	[1.89]
$Size_t$	-0.002	-0.002	-0.003	-0.001	-0.000	-0.002
	[-0.34]	[-0.49]	[-0.65]	[-0.30]	[-0.04]	[-0.43]
BHR_t	-0.033	-0.031	-0.040	-0.032	-0.028	-0.045
	[-1.24]	[-1.26]	[-1.38]	[-1.22]	[-1.10]	[-1.54]
Constant	0.243***	0.143**	0.197**	0.244***	0.135**	0.189**
	[3.43]	[2.58]	[2.51]	[3.40]	[2.37]	[2.40]
Observations	108,135	63,856	44,279	108,135	63,856	44,279
Average adj. R^2	0.107	0.121	0.145	0.109	0.126	0.149
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of groups	38	38	38	38	38	38

Table 5. Information in abnormal investment about future earnings and asset growth

This table presents the panel regression results of the change in earnings and change in assets on abnormal investment proxy variables. Our sample consists of 95,356 firm–year observations with available data for the analysis during 1980–2017. The dependent variable in columns (1)–(3) is the change in firm earnings over a one-year horizon normalized by total assets: $\Delta Earnings_{t\ to\ t+1}$=$(Earnings_{t+1} - Earnings_t)/Assets_t$. The dependent variable in columns (4)–(6) is the change in firm total assets over a one-year horizon normalized by total assets: $\Delta Assets_{t\ to\ t+1}$=$(Assets_{t+1} - Assets)_t/Assets_t$. The independent variables of interest are firm abnormal investment proxies: $AInvt_t$, $Under_t$, and $Over_t$. See Appendix A for variable definitions. Year and Fama–French 48 industry fixed effects are controlled for in all regressions. The t-statistics reported in brackets are clustered by firm. $***$, $**$, and $*$ denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Δ***Earnings***$_{t\ to\ t+1}$			Δ***Assets***$_{t\ to\ t+1}$		
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$AInvt_t$	-0.011***			0.163***		
	[-3.77]			[4.93]		
$Under_t$		-0.013**			-0.136**	
		[-2.30]			[-2.36]	
$Over_t$			-0.005**			0.208***
			[-1.97]			[5.11]
BTM_t	-0.002***	-0.003***	-0.001***	-0.111***	-0.103***	-0.116***
	[-9.12]	[-7.10]	[-5.71]	[-23.73]	[-23.80]	[-12.63]
$Size_t$	0.000***	0.000**	0.000**	-0.013***	-0.012***	-0.015***
	[3.57]	[2.50]	[2.46]	[-10.65]	[-7.23]	[-9.10]
$Leverage_t$	0.002***	0.000	0.004***	-0.096***	-0.100***	-0.109***
	[3.38]	[0.42]	[3.13]	[-11.00]	[-9.59]	[-7.72]
$Earnings_t$	-0.046***	-0.056***	-0.034***			
	[-9.74]	[-6.84]	[-12.06]			
Constant	0.004***	0.005**	0.002***	0.319***	0.295***	0.370***
	[3.12]	[2.18]	[2.98]	[14.80]	[11.38]	[13.12]
Observations	95,356	56,190	39,166	95,356	56,190	39,166
Average adj. R^2	0.071	0.087	0.053	0.0405	0.0363	0.0474
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 6. Abnormal investment and future financial distress

This table reports the logit regression results (marginal effect reported) of future financial distress on abnormal investment proxy variables. Our regression design follows Shumway's (2001) bankruptcy prediction model. The dependent variable is $Delist_{t\ to\ t+3}$, an indicator variable that equals one if a firm is delisted in the next three years due to performance reasons, and zero otherwise. The independent variables of interest are firm abnormal investment proxies: $AInvt_t$, $Under_t$, and $Over_t$. See Appendix A for variable definitions. Year and Fama–French 48 industry fixed effects are controlled for in all regressions. The z-values reported in brackets are clustered by firm. $***$, $**$, and $*$ denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
$AInvt_t$		0.019***			
		[2.66]			
$Under_t$			0.059***	0.065***	
			[5.50]	[4.95]	
$Over_t$			0.004		0.002
			[0.51]		[0.24]
$Profit_t$	-0.026***	-0.024***	-0.024***	-0.023***	-0.028***
	[-9.88]	[-9.42]	[-9.13]	[-6.88]	[-6.76]
$Leverage_t$	0.053***	0.053***	0.054***	0.061***	0.047***
	[16.49]	[16.45]	[16.75]	[14.54]	[9.54]
$MVE/Total\ MV_t$	-0.008***	-0.008***	-0.008***	-0.009***	-0.009***
	[-15.80]	[-15.27]	[-15.07]	[-11.96]	[-9.60]
AR_t	-0.032***	-0.032***	-0.032***	-0.035***	-0.029***
	[-15.80]	[-15.78]	[-15.75]	[-13.22]	[-9.06]
$Volatility_t$	0.030***	0.031***	0.030***	0.034***	0.026***
	[5.00]	[5.02]	[4.96]	[3.84]	[3.62]
$Size_t$	-0.007***	-0.007***	-0.007***	-0.007***	-0.006***
	[-9.68]	[-9.56]	[-9.63]	[-8.25]	[-5.41]
Observations	94,962	94,962	94,962	55,987	36,378
Pseudo R^2	0.228	0.229	0.230	0.238	0.219
Area under ROC curve	0.873	0.874	0.875	0.877	0.869
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes

Table 7. Under-investment and stock returns: Controlling for fundamentals

This table presents the Fama & MacBeth (1973) regression results of annual buy-and-hold returns on under-investment and firm future fundamentals. The dependent variable is buy-and-hold stock return BHR_t, 12-month buy-and-hold returns starting from the fourth month after the fiscal year t end. The independent variable of interest is $Under_t$. Firm fundamentals include the change in earnings ($\Delta Earnings_{t\ to\ t+1}$), the change in assets ($\Delta Assets_{t\ to\ t+1}$), performance related delist indicator variable ($Delist_{t\ to\ t+3}$). We follow Caskey et al. (2012) and use the following three control variables: book-to-market (BTM_t), stock beta ($Beta_t$), and firm size ($Size_t$). See Appendix A for variable definitions. The t-statistics of Fama–MacBeth regression coefficients are reported in brackets. $***$, $**$, and $*$ denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
$Under_t$	-0.238***	-0.187**	-0.134*	-0.132*	-0.126
	[-2.97]	[-2.41]	[-1.73]	[-1.72]	[-1.64]
$\Delta Earnings_{t\ to\ t+1}$		4.022***			3.410***
		[4.78]			[4.36]
$\Delta Assets_{t\ to\ t+1}$			0.180***		0.165***
			[9.86]		[9.21]
$Delist_{t\ to\ t+3}$				-0.421***	-0.322***
				[-20.34]	[-13.51]
BTM_t	0.060***	0.072***	0.089***	0.072***	0.094***
	[4.93]	[5.25]	[6.35]	[5.87]	[6.72]
$Beta_t$	0.041*	0.044*	0.033	0.038	0.032
	[1.74]	[1.82]	[1.37]	[1.65]	[1.35]
$Size_t$	-0.002	-0.007	-0.005	-0.010*	-0.008
	[-0.34]	[-1.24]	[-0.85]	[-1.82]	[-1.38]
Constant	0.110	0.147	0.065	0.174	0.090
	[1.04]	[1.49]	[0.65]	[1.64]	[0.89]
Observations	59,768	53,403	53,403	59,768	53,403
Average adj. R^2	0.103	0.118	0.126	0.130	0.142
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Number of groups	35	35	35	35	35

Table 8. Abnormal investment and stock returns: Agency costs

This table reports the cross-sectional relation between under-investment, agency costs, and annual buy-and-hold returns. In the Fama & MacBeth (1973) regressions, the dependent variable is buy-and-hold stock return BHR_{t+1}, 12-month buy-and-hold returns starting from the fourth month after the fiscal year t end, and the independent variable of interest is $Under_t$. We divide firm–year observations with under-investment into two sub-samples based on the annual industry medians of *Blockholder Ownership*, *Expense Ratio*, and *Asset Utilization Ratio*. The high (low) sub-samples include firm–year observations with above (below and equal to) median corresponding variables. The control variables are the same as those reported in Table 4. See Appendix A for variable definitions. Fama–French 48 industry fixed effects are controlled for in all regressions. The t-statistics of Fama–MacBeth regression coefficients are reported in brackets. $***$, $**$, and $*$ denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Blockholder Ownership$_t$		***Expense Ratio$_t$***		***Asset Utilization Ratio$_t$***	
	Low	**High**	**Low**	**High**	**Low**	**High**
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$Under_t$	-0.455***	-0.078	-0.272**	-0.404***	-0.472***	-0.263**
	[-3.18]	[-0.44]	[-2.07]	[-2.93]	[-4.74]	[-2.24]
$INew_t$	-0.343**	0.093	-0.237**	-0.303*	-0.279***	-0.217
	[-2.57]	[0.32]	[-2.27]	[-1.97]	[-2.84]	[-1.66]
MTB_t	-0.029***	-0.019**	-0.019***	-0.034*	-0.029***	-0.034***
	[-4.12]	[-2.37]	[-3.53]	[-1.95]	[-4.71]	[-4.83]
$Leverage_t$	0.012	-0.007	0.001	-0.076	-0.031	-0.001
	[0.34]	[-0.19]	[0.05]	[-1.35]	[-1.10]	[-0.02]
$Cash_t$	0.095**	0.012	0.064*	0.084***	0.110***	0.115**
	[2.50]	[0.23]	[1.69]	[2.87]	[4.50]	[2.68]
$Size_t$	-0.006	-0.000	-0.004	0.018	0.006	-0.005
	[-1.23]	[-0.03]	[-0.95]	[0.87]	[1.20]	[-1.04]
BHR_t	-0.053*	-0.046	-0.062**	0.015	-0.040	-0.016
	[-1.87]	[-1.36]	[-2.09]	[0.26]	[-1.30]	[-0.47]
Constant	0.258***	0.240**	0.190***	0.052	0.206**	0.169**
	[2.80]	[2.04]	[2.91]	[0.23]	[2.51]	[2.09]
Observations	22,562	20,566	33,542	29,913	32,470	31,317
Average adj. R^2	0.180	0.194	0.164	0.157	0.163	0.154
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of groups	38	38	38	38	38	38

Table 9. Abnormal investment and future stock returns: Alternative econometric estimation methods

This table presents the robustness test results of future stock return on three abnormal investment proxies between 1980 and 2017. The dependent variable is BHR_{t+1}, 12-month buy-and-hold returns starting from the fourth month after the fiscal year t end. The independent variables of interest are $AInvt_t$, $Under_t$, and $Over_t$ in Panels A, B, and C, respectively. In column (1), the abnormal investment proxies are estimated by Equation (1) with the historical panels starting from 1974. In columns (3)–(4), the abnormal investment proxies are estimated by Equation (1) with the whole panel period of 1974–2017. In columns (5)–(6), the abnormal investment proxies are estimated by Equation (1) with five-year rolling windows between year $t-4$ and year t. The other independent variables are the same as those reported in Table 4. See Appendix A for variable definitions. In columns (1)–(2) and (4), we use panel regressions to estimate the relation between abnormal investment and future stock returns. In columns (3) and (5), we use a Fama & MacBeth (1973) regression to estimate the relation between abnormal investment and future stock returns. In columns (1), (2), and (4), we control for year and Fama–French 48 industry fixed effects and cluster standard errors by year and industry (Petersen 2009). The t-statistics of panel and Fama–MacBeth (FM) regression coefficients are reported in brackets. $***$, $**$, and $*$ denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Panel A. Abnormal investment				
	Historical panel	***Whole panel***		***Rolling panel***	
	Panel	***Panel***	***FM***	***Panel***	***FM***
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
$AInvt_t$	-0.147***	-0.163***	-0.143***	-0.146***	-0.133**
	[-4.03]	[-4.46]	[-2.81]	[-3.95]	[-2.67]
Control variables	Yes	Yes	Yes	Yes	Yes
Observations	108,087	108,135	108,135	108,135	108,135
Average adj./Adj. R^2	0.119	0.119	0.109	0.119	0.109
Year fixed effects	Yes	Yes	No	Yes	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Number of groups			38		38

Panel B. Under-investment

Variables	***Historical panel*** ***Panel*** (1)	***Whole panel*** ***Panel*** (2)	***Whole panel*** ***FM*** (3)	***Rolling panel*** ***Panel*** (4)	***Rolling panel*** ***FM*** (5)
$Under_t$	-0.451***	-0.420***	-0.421***	-0.299***	-0.404***
	[-6.65]	[-6.18]	[-4.05]	[-4.37]	[-3.77]
Control variables	Yes	Yes	Yes	Yes	Yes
Observations	63,825	62,830	62,830	62,578	62,578
Average adj./Adj. R^2	0.107	0.117	0.128	0.118	0.125
Year fixed effects	Yes	Yes	No	Yes	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Number of groups			38		38

Panel C. Over-investment

Variables	***Historical panel*** ***Panel*** (1)	***Whole panel*** ***Panel*** (2)	***Whole panel*** ***FM*** (3)	***Rolling panel*** ***Panel*** (4)	***Rolling panel*** ***FM*** (5)
$Over_t$	0.296***	0.220**	0.339	0.185**	0.282**
	[3.28]	[2.41]	[1.66]	[2.12]	[2.09]
Control variables	Yes	Yes	Yes	Yes	Yes
Observations	44,262	45,305	45,305	45,557	45,557
Average adj./Adj. R^2	0.140	0.125	0.148	0.122	0.143
Year fixed effects	Yes	Yes	No	Yes	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Number of groups			38		38

Table 10. Alternative measures of abnormal investment

This table presents the Fama & MacBeth (1973) regression results of firm future stock returns on abnormal investment proxy variables. The dependent variable is BHR_{t+1}, 12-month buy-and-hold returns starting from the fourth month after the fiscal year t end. The independent variables of interest are the abnormal investment estimated by investment models developed in Harvey et al. (2004) and Titman et al. (2004). In columns (1)–(3), the abnormal investment is defined as the absolute value of the difference between a firm's capital investment expenditure and its industry median investment level. In columns (4)–(6), the abnormal investment is defined as the absolute value of the difference between a firm's capital investment expenditure at year $t-1$ and its average capital investment expenditure in the past three years. See Appendix A for variable definitions. Fama–French 48 industry fixed effects are controlled for in all regressions. The t-statistics of Fama–MacBeth regression coefficients are reported in brackets. $***$, $**$, and $*$ denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Harvey et al. (2004)			***Titman et al. (2004)***		
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$AInvt_t$	-0.250***			-0.013		
	[-2.85]			[-1.49]		
$Under_t$		-0.466**			-0.023*	
		[-2.27]			[-1.80]	
$Over_t$			-0.281*			-0.014
			[-1.95]			[-1.41]
$INew_t$	-0.059	0.003	-0.113**	-0.086**	-0.055	-0.011
	[-1.46]	[0.06]	[-2.63]	[-2.28]	[-1.55]	[-0.10]
MTB_t	-0.031***	-0.038***	-0.027***	-0.029***	-0.028***	-0.031***
	[-4.52]	[-4.89]	[-4.23]	[-3.86]	[-3.44]	[-4.12]
$Leverage_t$	-0.034	-0.009	-0.047*	-0.033	-0.031	-0.019
	[-1.31]	[-0.30]	[-1.81]	[-1.26]	[-1.13]	[-0.57]
$Cash_t$	0.040	0.050	0.063	0.021	0.039	0.029
	[1.13]	[1.49]	[1.31]	[0.63]	[1.03]	[0.53]
$Size_t$	-0.001	-0.004	-0.000	-0.002	-0.002	-0.008
	[-0.29]	[-0.78]	[-0.04]	[-0.47]	[-0.39]	[-1.10]
BHR_t	-0.032	-0.042	-0.030	-0.043	-0.052*	-0.010
	[-1.24]	[-1.61]	[-1.06]	[-1.59]	[-1.82]	[-0.27]
Constant	0.284***	0.364***	0.245***	0.216***	0.247**	0.163*
	[4.38]	[3.76]	[2.72]	[2.94]	[2.44]	[1.83]
Observations	108,402	54,943	54,602	81,566	46,528	35,038
Average adj. R^2	0.109	0.128	0.139	0.116	0.129	0.161
Number of groups	38	38	38	38	38	38
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 11. Under-investment and systematic distress risk

This table presents the time-series regressions of portfolio returns controlling for six risk factors. At each end of June over the period 1980–2017, firms are divided into five equally weighted portfolios based on *Under*. The dependent variable is the monthly excess returns of the corresponding under-investment quintile portfolio in year t. The independent variables are the returns of factor mimicking portfolios: market (*MKTRF*), size (*SMB*), book-to-market (*HML*), profitability (*RMW*), investment (*CMA*), and financial distress risk (*FDR*). The financial distress risk factor return is the return of a mimicking portfolio that longs BAA bonds and shorts AAA bonds. We download monthly bond yield data from the Federal Reserve's H-15 report and convert bond yields to returns using the log-linear approximation defined in Campbell et al. (1997). The t-statistics are presented in the brackets. $***$, $**$, and $*$ denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Under **portfolio**	**Alpha**	***MKTRF***	***SMB***	***HML***	***RMW***	***CMA***	***FDR***	**Obs.**	**Adj.** R^2
1 (Lowest)	-0.0026	1.0033	0.7385	0.2733	0.0010	0.0002	0.0035	455	0.9069
	[-1.33]	[51.01]	[25.05]	[7.41]	[2.59]	[0.38]	[3.03]		
2	-0.0033	0.9792	0.6860	0.2933	0.0007	-0.0002	0.0031	455	0.9054
	[-1.72]	[50.82]	[23.75]	[8.12]	[1.83]	[-0.31]	[2.79]		
3	-0.0039	1.0024	0.7689	0.2968	-0.0001	-0.0006	0.0041	455	0.9031
	[-1.88]	[47.92]	[24.52]	[7.57]	[-0.25]	[-1.11]	[3.35]		
4	-0.0047	1.0129	0.7917	0.1473	-0.0011	0.0000	0.0039	455	0.8953
	[-2.08]	[44.13]	[23.01]	[3.43]	[-2.54]	[-0.05]	[2.89]		
5 (Highest)	-0.0094	1.0049	0.8537	0.1131	-0.0041	-0.0012	0.0054	455	0.8634
	[-3.21]	[33.90]	[19.21]	[2.04]	[-7.19]	[-1.39]	[3.13]		

Table 12. Abnormal investment and stock returns: Short-sale constraints and Stock liquidity

This table reports the cross-sectional relation between under-investment and annual buy-and-hold returns with respect to short-sale constraints and stock liquidity. In the Fama & MacBeth (1973) regressions, the dependent variable is buy-and-hold stock return BHR_{t+1}, 12-month buy-and-hold returns starting from the fourth month after the fiscal year t end, and the independent variable of interest is $Under_t$. We divide firm–year observations with under-investment into two sub-samples based on the annual industry medians of total institutional ownership (TIO) and Amihud's (2002) illiquidity measure ($Illiq$). The high short-sale constraint sub-sample includes firm–year observations with below the median of TIO. The liquid sub-sample includes firm–year observations with below the median of $Illiq$. The control variables are the same as those reported in Table 4. See Appendix A for variable definitions. Fama–French 48 industry fixed effects are controlled for in all regressions. The t-statistics of Fama–MacBeth regression coefficients are reported in brackets. $***$, $**$, and $*$ denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Short-sale constraint		**Stock liquidity**	
	Low TIO_t Constraint	**High TIO_t Unconstraint**	**Low $Illiq_t$ Liquid**	**High $Illiq_t$ Illiquid**
Variables	**(1)**	**(2)**	**(3)**	**(4)**
$Under_t$	-0.510***	-0.317**	-0.214**	-0.475***
	[-3.22]	[-2.21]	[-2.04]	[-4.04]
$INew_t$	-0.412***	-0.533	-0.166	-0.448***
	[-2.92]	[-1.02]	[-1.21]	[-3.70]
MTB_t	-0.041***	0.001	-0.015***	-0.047***
	[-5.12]	[0.03]	[-2.78]	[-5.43]
$Leverage_t$	0.010	-0.038	-0.034	0.067
	[0.25]	[-0.77]	[-1.07]	[0.63]
$Cash_t$	0.100**	0.025	0.071**	0.055
	[2.55]	[0.52]	[2.13]	[1.61]
$Size_t$	-0.004	0.009	0.005	-0.023
	[-0.88]	[0.95]	[1.02]	[-1.24]
BHR_t	-0.048**	-0.004	-0.046	-0.009
	[-2.13]	[-0.08]	[-1.34]	[-0.24]
Constant	0.297**	0.231*	0.025	0.522***
	[2.53]	[1.95]	[0.37]	[3.24]
Observations	21,472	21,668	32,095	31,719
Average adj. R^2	0.176	0.215	0.189	0.147
Industry fixed effects	Yes	Yes	Yes	Yes
Number of groups	38	38	38	38

Table 13. Alternative return periods

This table presents the Fama & MacBeth (1973) regression results of firm future stock returns on abnormal investment proxy variables. The dependent variables are one-month, three-month, six-month, and two-year buy-and-hold returns starting from the fourth month after the end of fiscal year t. The independent variables of interest are the abnormal investment proxies, estimated by the investment expenditure Equation (1): $AInvt_t$, $Under_t$, and $Over_t$. The control variables are the same as those reported in Table 4. See Appendix A for variable definitions. The t-statistics of Fama–MacBeth regression coefficients are reported in brackets. The coefficients of the control variables and the Fama–French 48 industry fixed effects are suppressed for brevity in the respective columns. $***$, $**$, and $*$ denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	One-month return			**Three-month return**			**Six-month return**			**Two-year return**		
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
$AInvt_t$	-0.022*			-0.060***			-0.143***			-0.066*		
	[-1.99]			[-3.49]			[-5.79]			[-1.68]		
$Under_t$		-0.131***			-0.247***			-0.390***			0.158*	
		[-8.02]			[-4.59]			[-5.87]			[1.64]	
$Over_t$			0.075**			0.167**			0.344*			-0.494***
			[2.33]			[2.60]			[1.80]			[-3.44]
$INew_t$	-0.025***	-0.096***	-0.100***	-0.023	-0.178***	-0.196***	-0.040*	-0.275***	-0.409**	-0.022	0.115	0.371***
	[-3.42]	[-4.04]	[-3.21]	[-1.33]	[-3.52]	[-3.09]	[-1.70]	[-3.11]	[-2.52]	[-0.55]	[0.96]	[3.42]
Constant	-0.025**	-0.040***	-0.027*	-0.036	0.011	0.008	-0.026	-0.024	-0.031	0.062	0.127	-0.005
	[-2.31]	[-2.83]	[-1.85]	[-1.18]	[0.34]	[0.27]	[-0.50]	[-0.63]	[-0.58]	[0.96]	[1.45]	[-0.07]
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	108,125	63,965	44,160	108,125	63,965	44,160	108,125	63,965	44,160	108,125	63,965	44,160
Average adj. R^2	0.082	0.096	0.120	0.084	0.099	0.122	0.102	0.119	0.140	0.393	0.401	0.421
Number of groups	38	38	38	38	38	38	38	38	38	38	38	38
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 14. Dropping micro-cap stocks

This table presents the Fama & MacBeth (1973) regression results of firm future stock returns on abnormal investment proxy variables. We drop micro-cap stocks with stock price less than $5 from our sample. The dependent variable is BHR_{t+1}, one-year buy-and-hold returns starting from the fourth month after the end of fiscal year t. The independent variables of interest are the abnormal investment proxies, estimated by the investment expenditure Equation (1): $AInvt_t$, $Under_t$, and $Over_t$. The control variables are the same as those reported in Table 4. See Appendix A for variable definitions. The t-statistics of Fama–MacBeth regression coefficients are reported in brackets. The coefficients of the control variables and the Fama–French 48 industry fixed effects are suppressed for brevity in the respective columns. $***$, $**$, and $*$ denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$AInvt_t$	-0.164***			-0.142**		
	[-4.09]			[-2.62]		
$Under_t$		-0.246***			-0.338***	
		[-3.29]			[-4.21]	
$Over_t$			-0.104**			0.357*
			[-2.31]			[1.71]
$INew_t$				-0.042	-0.184*	-0.416**
				[-0.93]	[-1.89]	[-2.43]
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Observations	75,878	44,125	31,753	75,878	44,125	31,753
R-squared	0.132	0.159	0.167	0.133	0.161	0.171
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of groups	38	38	38	38	38	38

Table 15. Controlling for short-term reversals, momentum, and long-term reversals

This table presents the Fama & MacBeth (1973) regression results of firm future stock returns on abnormal investment proxy variables. The dependent variable is BHR_{t+1}, one-year buy-and-hold returns starting from the fourth month after the end of fiscal year t. The independent variables of interest are the abnormal investment proxies, estimated by the investment expenditure Equation (1): $AInvt_t$, $Under_t$, and $Over_t$. In addition to the control variables (MTB_t, $Leverage_t$, $Cash_t$, and $Size_t$) in our baseline regression, we control for short-term reversals ($BHR_{(-1,0)}$), momentum ($BHR_{(-12,-1)}$), and long-term reversals ($BHR_{(-36,-12)}$). See Appendix A for variable definitions. The t-statistics of Fama–MacBeth regression coefficients are reported in brackets. The coefficients of the control variables and the Fama–French 48 industry fixed effects are suppressed for brevity in the respective columns. $***$, $**$, and $*$ denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
$AInvt_t$	-0.166***			-0.153***		
	[-3.82]			[-3.01]		
$Under_t$		-0.255***			-0.409***	
		[-3.55]			[-4.49]	
$Over_t$			-0.083			0.292*
			[-1.37]			[1.77]
$INew_t$				-0.029	-0.303**	-0.338**
				[-0.75]	[-2.59]	[-2.69]
$BHR_{(-1,0)}$	0.575***	0.574***	0.598***	0.574***	0.571***	0.583***
	[21.74]	[21.66]	[13.39]	[21.86]	[22.25]	[16.40]
$BHR_{(-12,-1)}$	-0.076***	-0.077***	-0.084***	-0.076***	-0.074***	-0.086***
	[-3.18]	[-3.26]	[-3.21]	[-3.17]	[-3.16]	[-3.37]
$BHR_{(-36,-12)}$	-0.014**	-0.015*	-0.019**	-0.014*	-0.011	-0.018**
	[-2.10]	[-1.97]	[-2.42]	[-2.02]	[-1.57]	[-2.25]
Constant	0.215***	0.182**	0.125*	0.214***	0.184**	0.146**
	[2.87]	[2.04]	[1.82]	[2.83]	[2.06]	[2.18]
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Observations	108,135	63,856	44,279	108,135	63,856	44,279
Average adj. R^2	0.157	0.172	0.192	0.158	0.175	0.195
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of groups	38	38	38	38	38	38