The real effects of investor sentiment

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Abstract

Do inefficiencies in the capital markets have real consequences? Or are they simply wealth transfers from noise traders to arbitrageurs? We study firm business investment to find such consequences. We find a positive relation between investment and each of our three measures of mispricing controlling for investment opportunities and financial slack. Our results are robust to various alternative specifications. Consistent with the predictions of our model, we find that firms with higher research and development intensity (suggesting less transparency and longer periods of information asymmetry) have investment that is more sensitive to mispricing.

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The market efficiency hypothesis assumes security prices always fully reflect available information. Over the last decade that paradigm has come under attack. Shleifer (2000), Barberis and Thaler (2001), and Hirshleifer (2001) summarize three related strands of literature. First, theoretical work argues that arbitrage has limited effectiveness. Second, experimental evidence shows that agents hold beliefs that are not completely correct and/or make choices that are normatively questionable. Finally, empirical work documents phenomena where almost certainly prices deviate from fundamental value. Put together, this body of work constitutes the young field of behavioral finance. Despite its success, behavioral finance has yet to document any significant impact of mispricing on the real economy. Without such an impact, these behavioral anomalies may just represent an interesting sideshow.

An obvious channel through which mispricing in the stock market can influence the economy is business investment policy. This avenue seems promising as aggregate investment is subject to sharp swings. In this paper, we consider how stock market inefficiencies might affect individual firms' investment decisions and document the extent to which systematic mispricings do.

We model the investment decision under asymmetric information of a manager that maximizes shareholders' wealth. We show that under some general conditions a manager of a mispriced firm may invest inefficiently, if the period of asymmetry of information is sufficiently long. In the second part of the paper, we test the predictions of our model. We rely on three different proxies for mispricing in the capital markets - discretionary accruals, issuances/repurchases, and price momentum - as well as a summary "mispricing metric" generated using a firm-level vector autoregression. These proxies represent distinctly different ways in which behavioral finance has attacked the efficient markets hypothesis.

Several authors have argued that discretionary accruals, defined as earnings which are abnormally due to mostly non-cash items, represent earnings manipulation (e.g., Chan et al. (2001)). If firms are opaque and investors not sophisticated enough to distinguish earnings in the form of cash versus earnings in the form of non-cash items, managers may keep stock prices high. Previous research documents that high discretionary accruals forecast negative stock returns. We find a positive relation between discretionary accruals and investment, while attempting to control for investment opportunities and cash flow. Our results indicate the sensitivity of excess investment to discretionary accruals has increased in the last half of the 1990's, a period of increased participation by relatively uninformed investors and a prevalence of firms with intangible assets. Consistent with the earnings manipulation story, we find that discretionary accruals are significantly higher for firms with few institutional investors. Finally, we find that the effect is strongest for those firms with a strong net equity issuance.

The amount of net equity issuance activity is our second mispricing proxy. Equity issuance and repurchase as well as dividend initiation and omission have been recognized as signals of firm quality since the theoretical work by Myers and Majluf (1984) and Miller and Rock (1985). Empirical evidence suggests that the information in these signals is not fully incorporated until several years post event. Our findings show that controlling for investment opportunities and cash flow, firms invest more (less) when their firm has had net equity issuance (repurchase) activity.

The first two measures of mispricing directly stem from specific inside information that is either distorted by managers or slowly interpreted by the market. Our final measure looks instead to price momentum. Yearly excess returns at either the firm or industry level exhibit positive serial correlation. The information contained in the initial excess return can be due to any general type of news. We find a positive relation between investment and the two measures of momentum. Firms overinvest when their stock price has increased over the past year consistent with momentum being an overreaction phenomenon.

We summarize these results by estimating a firm-level vector autoregression which includes our three main mispricing proxies as well as measures of risk . By forecasting future returns and risks, we are able to generate a mispricing metric. We find that investment moves positively with this measure. This is comforting as alternative explanations as to why our three proxies come in individually do not obviously extend to this summary measure.

In agreement with the predictions of our model, we find that firms with higher research and development intensity have investment that is more sensitive to all three types of mispricing. Our results suggest that mispricing in the stock market impacts the real choices firms make. Not only do inefficiencies transfer wealth from one group of investors to another, inefficiencies may drive capital towards inappropriate projects.

It is important to point out that in most cases our variables may measure both overpricing and underpricing. Therefore we characterize not only situations where firms invest too much but also circumstances where firms do not invest enough. Investor sentiment, whether irrational exuberance or excessive pessimism, has real effects.

The next section reviews the literature. In section II we motivate our empirical work by detailing a simple model of firm investment. We describe the data and report the results in section III. Section IV concludes.

I Previous research

Researchers have long known that the stock market has information concerning real investment. A broader question concerns the exact nature of this relation. Perhaps the best known description of that relation is "Q" theory. Brainard and Tobin (1968) and Tobin (1969) propose that a firm will invest until $Q = 1$ where Q is defined as the ratio between the stock-market valuation of existing real capital assets and their current replacement cost. That theory explicitly depends on "the values of existing capital goods, or of titles to them, to diverge from their current reproduction cost." Clearly, that divergence can be due to mispricing.

However, in most of the subsequent theoretical literature, researchers assume financial markets are efficient. In particular, models by Abel (1980) and Hayashi (1982) focus on marginal adjustment costs that prevent Q from equaling 1. Thus investment should be related to the firm's marginal Q. If asset pricing is rational, the stock market appropriately values the average Q of this out-of-steady-state outcome. As a consequence, a majority of empirical research explains investment with Tobin's Q. To the extent that the relation between Q and investment is weak, most researchers have looked to the twin problems of asymmetric information and agency without abandoning the efficient market hypothesis. See Stein (2001) for a survey of this literature.

However, several researchers have deserted the efficient markets assumption in this context. Abel and Blanchard (1986) argues that stock market inefficiencies might explain the weak performance of Q-theory. If markets are inefficient, deviation from fundamental values is random error that smears information in average Q concerning a firm's marginal investment opportunities. This skepticism concerning the equivalence of price and fundamentals has no real consequences. Abel and Blanchard (1986) presume that managers ignore this noise and invest optimally. Only the econometrician is inconvenienced.

Some researchers have considered the possibility that inefficient capital markets may actually affect corporate investment policies. One of the early papers examining that possibility is Morck, Shleifer and Vishny (1990). The authors suggest that investor sentiment can exert pressure on managers to avoid under-priced long-term projects. Manager myopia facilitates this pressure as hiring and firing is usually linked to the performance of the stock. Stein (1988) and Shleifer and Vishny (1990) formally model such a short-horizons theory. In these models, market inefficiencies can lead to suboptimal business investment. More recently, Stein (1996) provides a useful framework to consider such short-termism along with the standard problem of asymmetric information. Stein shows that the presence of financing frictions may cause managers that are financially constrained to respond to deviations from fundamental value more so than those that are not constrained. In those situations, market inefficiencies may actually be helpful.

Despite this theoretical promise, there are few empirical results documenting that investment does respond to mispricing. Morck, Shleifer and Vishny (1990) concludes "the market may not be a complete sideshow, but nor is it very central." An exception is Baker, Stein, and Wurgler (2001). They find that stock prices have a stronger impact on the investment of firms that need external equity to finance their investments. Their results provide evidence that undervaluation may deter investments.

II The Model

We present a model of the firm's investment decision where investment decisions are affected by market (mis)valuation of the company. We model this decision in order to motivate our empirical analysis and to identify the assumptions necessary for investor sentiment to cause inefficient investment. In the model benevolent managers with private information about the quality of the firm's investment may invest inefficiently on behalf of shareholders. This inefficiency occurs because the investment decision serves as a signal of firm value and can be used to manipulate stock prices to the advantage of shareholders. Inefficient investment equilibria do not arise from any conflict of interest between owners and managers, but are the optimal investment policy when the stock market evaluates the firm on the basis of expected return on investment. The model shares many features with the asymmetry-of-information literature (e.g., Myers and Majluf (1984), Lucas and MacDonald (1990)) with one major distinction: consistent with recent literature in behavioral finance, investors do not update their beliefs in a Bayesian fashion.

A Setup

There is a continuum of firms. There are three types of agents: managers of firms, old shareholders, and new shareholders (or more simply the market). All agents are risk-neutral. The model has three dates and there is no discounting.

At time t_0, the firm value is V_0. At time t_1, the manager of the firm faces an investment opportunity. Only the manager sees the quality of the project $\theta^i \in \Theta = \{\theta^g, \theta^b\}$ with probability $P = \{P^g, 1-P^g\}$. In this respect, our model is similar to Myers and Majluf (1984) and Lucas and MacDonald (1990). The manager can decide to invest or not $a^i \in A = \{I, DI\}$. The market and current shareholders cannot observe θ^i, but can observe a^i. If the manager decides not to invest the value of the firm is V_0. If the manager invests in a bad project $I(\theta^b)$ then the true value of the firm is $V_0 + V_b$ where $V_b < 0$. If the manager invests in a good project, $I(\theta^g)$, then the true value of the firm is $V_0 + V_g$, $V_g > 0$.

Assumption 1. The returns from good and bad projects (V_g and V_b) are common knowledge.

Assumption 2. At some point in time, $t_1 + m$, the market discovers the quality of the project θ^i. This discovery follows a Poisson process with mean arrival rate p. Therefore, a small p indicates, on average, a long period of information asymmetry.[1]

[1]Lucas and MacDonald(1990) also assume short-term information asymmetries between managers and

B Shareholders' preferences

The utility function of each shareholder j is $U_j = U_j(c^t)$, where c^t denotes consumption at time t.

Assumption 3. Each shareholder j will need liquidity at some point in time, $t + u$, where u is distributed according to a Poisson process with mean arrival rate $q_j \in [0, \infty)$. A small q_j suggests that particular shareholder is a long-term shareholder that intends to sell his stocks many years after the initial investment. However, he does not know exactly when this will happen. A short-term investor has a large q_j.

Assumption 4. After a liquidity shock. the investor j sells his stocks at the market price, consumes, and dies.

Shareholders only care about consumption at the time at which they suffer the liquidity shock. Income comes only from selling the stock at that time and is P^{t_1+u}. The indirect utility function of shareholder j is linear in income. Define shareholder j's expected level of income at time t_1 as

$$Y_j^{t_1} \equiv \int_{u=0}^{\infty} P^{t_1+u} q_j e^{-q_j u} du \qquad (1)$$

where $q_j e^{-q_j u}$ is the probability that the shareholders will not suffer from a liquidity shock until time $t_1 + u$, where $u \in (0, \infty)$.

Assumption 5: Managers maximize the wealth of the average existing shareholder. Denote q as the mean arrival rate of the mean shareholder.

C The value of the stock

The value of the stock depends on whether the quality of the project has been revealed or not. Define λ as the investors' belief concerning the probability that the project is a bad quality project given that the manager invested, $\lambda \equiv Pr(\theta^i = \theta^b \mid a^i = I)$. In our model, we will allow investors to form biased forecasts and/or update their beliefs in a non Bayesian fashion. In this respect, we deviate from the previous literature on asymmetric information

outside investors.

and investment decisions because we are interested in studying the consequences of market inefficiency on investment decisions.[2] We motivate this assumption on two different grounds. First, individuals systematically violate Bayes rule and other maxims of probability theory in their predictions of uncertain outcomes (see Kahneman and Tversky, 1973). The behavioral literature calls beliefs based on heuristic rather than Bayesian rationality "investor sentiment". Second, we argue that managers may effectively be able to manipulate information, by disseminating information that may lead to biased beliefs (see Laroque and Benabou (1992)). In the empirical analysis, we use proxies of both sentiment and manipulation to measure the extent of mispricing.

Once the project type is revealed, the market is able to evaluate correctly the change to the original value of the firm (V_g or V_b if the manager invested in a good or bad project and zero if the manager did not invest). Therefore, for $t_1 + u$ where $u > m$ there is no asymmetric information concerning the quality of the project and thus the market valuation of the firm is:

$$\begin{aligned} P^{t_1+u} &= V_0 \text{ if } a^i = DI \\ P^{t_1+u} &= V_0 + V_b \text{ if } \theta^i = \theta^b \text{ and } a^i = I \\ P^{t_1+u} &= V_0 + V_g \text{ if } \theta^i = \theta^g \text{ and } a^i = I \end{aligned}$$

Before the quality of the project is revealed the market values the firm based on its beliefs concerning the quality of the project and therefore the expected value of the project. Thus, for $t_1 + u$ where $0 \leq u \leq m$, the market valuation of the firm depends on whether the manager of the firm has invested or not.

$$\begin{aligned} P^{t_1+u} &= V_0 \text{ if } a^i = DI \\ P^{t_1+u} &= V_0 + \lambda(V_b) + (1-\lambda)V_g \text{ if } \ a^i = I \end{aligned}$$

[2] Stein (1996), Baker, Stein and Wurgler (1996) also assume that firms may be mispriced.

Therefore the representative shareholder's expected income at time t_1, $Y^{t_1}\left(\theta^i, a^i\right)$, may be calculated by substituting for P^{t_1+u} in equation (??):

$$Y^{t_1}\left(\theta^i, a^i\right) = V_0 \text{ if } a^i = DI$$

$$Y^{t_1}\left(\theta^i, a^i\right) = V_0 + \frac{q\left[\lambda(V_b) + (1-\lambda)V_g\right] + p[V_b]}{q+p} \text{ if } a^i = I \text{ and } \theta^i = \theta^b$$

$$Y^{t_1}\left(\theta^i, a^i\right) = V_0 + \frac{q\left[\lambda(V_b) + (1-\lambda)V_g\right] + p[V_g]}{q+p} \text{ if } a^i = I \text{ and } \theta^i = \theta^g$$

Intuition: Current shareholders' expected level of income is a weighted average of the share price before and after the value of the project becomes public information. The larger q is (more impatient investors on average), the higher the weight on the "share price under mispricing". The larger p is (short-term maturity of the project), the higher the weight on the share price under symmetric information.

D The investment decision

Definition. Define $\delta \equiv Pr(\theta^i = \theta^b \mid a^i = DI)$ and $R \equiv \frac{V_g}{-V_b}$.

In any period, firms are assumed to follow a pure strategy of investing or not. We define an equilibrium as a system of beliefs $[\delta^*(\theta^b \mid DI), \lambda^*(\theta^b \mid I)]$ and a strategy profile σ^* with support on a set of pure strategies $A = \{I, DI\}$. We will focus on pure strategy equilibria of this game.

D.1 Overinvestment equilibrium

Proposition 1: When $\lambda < \frac{(q+p)}{q}\frac{V_b}{(V_g - V_b)} + 1$, the set of strategy and beliefs $[a^i = I \text{ if } \theta^i = \theta^g, a^i = I \text{ if } \theta^i = \theta^b, \lambda, \delta]$ is a pooling equilibrium in which the manager will always invest regardless on the quality of the project.

Proof: see the Appendix.

Intuition: When the market is optimistic enough about the expected value of the project (λ is small) and the length of the period of asymmetric information is sufficiently large (smaller p), the manager invests in the project regardless of its real value. The small λ and the long period result in a high perceived value of the firm before the true quality of the project is revealed. For managers with bad projects, the market's tendency to overvalue the project during the expected period of asymmetric information, t_1 until $t_1 + m$, more than compensates for the future "punishment" the market imposes on the firm at time t_1+m when the firm becomes correctly priced at $V_0 + V_b < V_0$. Firms with poor investment opportunities may pretend as if these investments are positive NPV if the gains from having overpriced equity compensate for the eventual losses from the value-destroying investment.

Note that the above condition may be satisfied under two different circumstances. First, the overinvestment equilibrium may occur if investors are rational and the stock is correctly priced given all relevant available information ($\lambda = (1 - P_g)$).[3] The resulting overinvestment cannot be predicted with publicly available information. This case is considered in Myers and Majluf (1984). In their model mispricing is due only to adverse selection problems: ex-ante valuation is correctly based on all relevant public information. However, managers with private information take inefficient decisions which affect future prices. Alternatively, overinvestment occurs when $\lambda < (1 - P_g)$ either because investors have biased beliefs or because managers are able to manipulate investors beliefs as in Benabou and Laroque (1992). These two cases have very different empirical implications. If beliefs are rational and managers do not manipulate information, there is overinvestment but it is not predictable using ex-ante variables. If instead investors have biased beliefs, then ex-ante measures of investors' sentiment and stock price manipulation do predict overinvestment.

D.2 Underinvestment equilibrium

Proposition 2. When $\lambda > \frac{(q+p)}{q}\frac{R}{(R-1)}$, the set of strategy and beliefs $[a^i = DI$ if $\theta^i = \theta^g$, $a^i = DI$ if $\theta^i = \theta^b, \delta = 1 - P_g, \lambda]$ is a pooling equilibrium in which the manager will never invest regardless on the quality of the project.

Proof: see the Appendix.

Intuition: The lower the probability the market attributes to the project being a good one after observing the manager's investment decision, the lower the payoff associated with

[3] In this case the equilibrium described above is a Perfect Bayesian Equilibrium: investors update their forecast in a Bayesian fashion.

the decision to invest. So, if the market is pessimistic about the quality of the project (λ is high), the manager will not undertake any investment regardless of the quality of the investment. If the true value of the project is revealed soon enough after the investment decision, the underinvestment outcome will not be an equilibrium. Specifically, the underinvestment outcome will not exist for $p > \frac{1}{R}q$.

D.3 Separating equilibrium

Proposition 3: The separating equilibrium of this game in which the manager invests if the project is good and does not invest if the project is bad $[a^i = I$ if $\theta^i = \theta^g$, $a^i = DI$ if $\theta^i = \theta^b, \delta = 1, \lambda = 0]$ exists if and only if $p > Rq$.

Proof: see the Appendix.

Intuition: Only when the period of asymmetric information and uncertainty about the quality of the project is short relative to the expected investment horizon of the average shareholder do managers have the incentive to invest efficiently.

Note that in the model managers invest inefficiently even though they do not have to rely on equity to finance the firm's investment. An extension of the model may consider the cases in which the firm cannot finance all desired investment internally and has to rely on outside equity.[4]

III Empirical analysis

A Data

Most of our data comes from the merged CRSP-COMPUSTAT database, made available to us through Wharton Research Data Services. We study only December fiscal year-end firms to eliminate the usual problems caused by the use of overlapping observations. Our sample includes firms over the period 1963-2000. We ignore firms with negative accounting numbers for book assets, capital, or investment. We drop firms with sales less than 10 million, and

[4] Stein (1998) and Baker, Stein, and Wurgler (2001) model such case in a different framework and find that financially constrained firms have investment policies that are more sensitive to stock prices.

extreme observations (details in Appendix II).

We intersect the initial sample with the Zacks database. That database provides analyst consensus estimates of earnings one, two, and five years out. We use the Spectrum database to calculate the percentage of shares outstanding owned by institutions.

Table 1 reports summary statistics for our sample of firms.

B Methodology

Our model in section I argues that an important determinant of firm investment is the degree of firm mispricing. Firms that are overpriced (underpriced) have a rational incentive to invest more (less). Throughout the paper, we estimate linear models of firm investment. A very large previous literature has studied the properties of that central firm decision.[5] Our typical specification regresses firm investment on a proxy for mispricing, on a proxy for Tobin's Q, and on firm cash flow, controlling for firm (α_i) and year (γ_t) fixed effects:

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha_i + \gamma_t + b_1 MISPRICE_{i,t} + b_2 Q_{i,t-1} + b_3 \frac{CF_{i,t-1}}{K_{i,t-2}} + \varepsilon_{i,t} \tag{2}$$

The dependent variable is individual firms' investment-capital ratios ($\frac{I_{i,t}}{K_{i,t-1}}$) where investment, $I_{i,t}$, is capital expenditure and capital, $K_{i,t-1}$, is beginning-of-year net property, plant, and equipment. Tobin's Q, $Q_{i,t-1}$ is beginning of period market-to-book. Market value of assets equals the book value of assets plus the market value of common stock less the sum of book value of common stock and balance sheet deferred taxes. $CF_{i,t-1}/K_{i,t-2}$ equals the sum of earnings before extraordinary items and depreciation over beginning-of-year capital.

Our analysis critically depends on identifying situations where firms are mispriced. The problem with that identification is the classic joint hypothesis problem of Fama (1970). Predictable movements in price may just as well be a result of compensation for risk as a consequence of bias in investors' expectations. The model of market equilibrium is what distinguishes those two possibilities: One researcher's anomaly is another researcher's risk factor.

[5] See Stein (2001) for a recent summary of that literature.

As a consequence, we identify mispricing in the capital markets using three different measures. These measures operate through different channels: firm opaqueness / information distortion, slow incorporation of information, and overreaction to firm stock performance.

C Discretionary accruals and investments

Our first proxy, discretionary accruals, relies on firm opaqueness and earnings quality. Accruals represent the difference between a firm's accounting earnings and its underlying cash flow. Large positive accruals indicate that earnings are much higher than the cash flow generated by the firm. The differences arises because of accounting conventions as to when, and how much, revenues and costs are recognized. There is a large accounting literature that studies earning management and the nature of information contained in the accruals and cash flow components of earning. The common view is that the accrual and the cash flow component of current earnings have different implication for the assessment of future earnings. Current earnings are less likely to persist if they are attributable to the accrual component of earnings as opposed to the cash flow component (see Bernstein (1993), Sloan (1996)).

A large body of evidence also shows that investors focus on earnings and fail to distinguish between the accruals and cash flow component of earnings (see Maines and Hand (1996), Hand (1990)). An alternative way to address the same question is to study the relationship between accruals or discretionary accruals and stock returns. Discretionary accruals are those accruals which are abnormal. Sloan (1996) shows that firms with relatively high (low) levels of accruals experience negative (positive) future abnormal stock returns concentrated around future earning announcements. Chan, Chan, Jegadeesh, and Lakonishok (2001) finds that firms with high (low) discretionary accruals do poorly (well) over the subsequent year. As most of the abnormal performance is concentrated in the firms with high discretionary accruals, they argue that these firms are manipulating earnings in order to keep their stock price artificially high.

D'Avolio, Gildor, and Shleifer (2001) argues that in recent years firms have had stronger incentives to distort the information they provide. In particular, D'Avolio, Gildor, and Shleifer (2001) points out that earnings quality, as measured by discretionary accruals, has decreased in recent years.

Accruals ($ACCR_{i,t}$) equal the change in accounts receivable (COMPUSTAT item 2) plus the change in inventories (COMPUSTAT item 3) plus the change in other current assets (COMPUSTAT item 68) minus the change in accounts payable (COMPUSTAT item 70) minus the change in other current liabilities (COMPUSTAT item 72) minus depreciation and amortization (COMPUSTAT item 14).[6] Accruals are scaled by total assets (COMPUSTAT item 6). We construct discretionary accruals following Chan, Chan, Jegadeesh, Lakonishok (2001):

$$
\begin{aligned}
DACCR_{i,t} &= ACCR_{i,t} - E_t(ACCR_{i,t}) \\
E_t(ACCR_{i,t}) &= \frac{\sum_{k=1}^{5} ACCR_{i,t-k}}{\sum_{k=1}^{5} SALES_{i,t-k}} SALES_{i,t}
\end{aligned}
$$

where $E_t(ACCR_{i,t})$ is modelled as a constant proportion of firm sales.

We estimate the basic regression:

$$
\frac{I_{i,t}}{K_{i,t-1}} = \alpha_i + \gamma_t + b_1 DACCR_{i,t} + b_2 Q_{i,t-1} + b_3 \frac{CF_{i,t-1}}{K_{i,t-2}} + \varepsilon_{i,t} \tag{3}
$$

Column (1) of Table 2 displays the results of regression (??). Controlling for investment opportunities and financial slack, firms with high discretionary accruals invest more. The coefficient of investment on discretionary accruals, b_1, measures 0.2010 with an associated t-statistic of 6.17. Firms with abnormally soft earnings invest more than the standard model would indicate. This effect is economically important. A typical (one-standard deviation) change in a typical firm's level of discretionary accruals is associated with roughly a two percent change in that firm's investment to capital ratio.

The specification in column (1) of Table 2 is our baseline specification. The rest of the table analyzes the robustness of the relation between discretionary accruals and firm investment to different specifications as well as to several control variables. One potential problem with our baseline regression is that we measure average Q at the beginning of the year in which we measure the firm's investment. It may be the case that over the year

[6] See Sloan (1996).

the firm's investment opportunities change and as a consequence our discretionary accruals measure is picking up this change in investment opportunities.

Therefore, in column (2) of Table 2, we add to the baseline specification, end-of-period $Q_{i,t}$. Controlling for any changes in Q over the investment period has no effect on our result. Investment opportunities as measured by end-of-period Tobin's Q are not statistically significant and the estimated coefficient is less than 1/20 than that on $Q_{i,t-1}$ in the baseline regression. Moreover, the estimated coefficient on discretionary accruals and the statistical significance of that estimate do not change.

Our controls for investment opportunities may be inadequate if there is a lag between when a firm has investment opportunities and when the actual investment is measured. These lags may be for such superficial reasons as accounting practices or due to more fundamental sorts of frictions. The next two specifications include lags of Q in response. In column (3), we add Q_{t-2} to the specification in column (2). Though lagged investment opportunities explain firm investment, discretionary accruals still have a positive and significant effect on firm investment. Column (4) adds Q_{t-3} to our specification. This variable is not significant and our results do not change. We conclude that the timing of our Tobin's Q variable is not an issue.

One potential problem with our baseline regression is that discretionary accruals may just reflect information concerning the firm's profitability and/or degree of financial constraints not contained in Q.[7] Firms with high discretionary accruals may have very profitable growth options that their average Q only partially reflects. These firms should invest more. However, the evidence suggests that firms with soft earnings are firms with poor growth opportunities. Chan, Chan, Jegadeesh, and Lakonishok (2001) show that firms with high discretionary accruals are at a turning point in their fortunes. Firms with high accruals subsequently have a marked deterioration in their cash flows. It seems hard to argue that

[7]Abel and Blanchard (1986) construct aggregate marginal Q and find little support for the view that the low explanatory power of average Q is because it is a poor proxy for marginal Q. Similarly, Gilchrist and Himmelberg (1995) exploit Abel and Blanchard's technique at the level of the individual firm. Though their marginal Q series seems to perform better than Tobin's Q, qualitative features of the relation between investment, Q, and financial slack do not change.

the average Q for this type of firm systematically understates marginal Q.

Nevertheless, we clean up Tobin's Q using analysts' estimates of future earnings. Controlling for average Q, higher marginal Q should be positively correlated with higher expected future profitability. Columns (5) through (7) add the ratio of consensus analyst forecast of firm profitability one, two, and five years out over assets to our baseline specification. One-year earning forecast has a positive effect on investment decision. The effect is small, but statistically significant at the five percent level. A one-standard deviation change in one-year earning forecast is associated with roughly a .5 percent change in that firm's investment to capital ratio. This suggests that this non-financial measure of future profitability has some information, even when we control for Tobin's Q. However, the coefficient on discretionary accruals actually increases from .2010 to .2329. Moreover, the estimate is measured with the same precision, even though the sample is cut almost in half due to data limitations.

Column (6) of Table 2 adds both one- and two-year profitability estimates to our baseline regression. Discretionary accruals continues to be quite significant. The final specification in Table 2 adds one-, two-, and five-year profitability forecasts Interestingly, all three forecasts are significant at the five percent level or better. Surprisingly, the coefficient on $E_{t-1}[EARN_{i,t+1}]/A_{i,t-1}$ is negative. Nevertheless, controlling for these forecasts presumably strips away any potential information in discretionary accruals concerning the disparity in profitability between the firm's past projects and future ones. The soft earnings variable remains economically and statistically significant.

Another objection to our results is that if discretionary accruals are correlated with lagged financial slackness, then our variable may picking up the fact that financially constrained firms have less financial slack to invest. To take care of this concern we augmented our baseline regression with contemporaneous, two-years lag and three-years lags of earnings before extraordinary items plus depreciation over beginning-of-year capital. The results (unreported) are robust to this modification.

Previous literature provides additional tests of our hypothesis based on sub-sample and cross-sectional evidence. We explore these implications in Table 3. Chan, Chan, Jegadeesh, and Lakonishok (2001) as well as D'Avolio, Gildor, and Shleifer (2001) point out that the ability of discretionary accruals to predict negative stock returns is concentrated in the top 20% of firms ranked on accruals. In column (1) of Table 3, we add a dummy, $HIGHDACCR_{i,t}$, to our baseline discretionary accruals specification. The dummy takes the value of one if the firm is in the top 20% of firms based on discretionary accruals and zero otherwise. This dummy is significant at the one percent level of significance. Since we expect much of the relation to be between positive accruals and investment, it is comforting to find that the coefficient on discretionary accruals is reduced by 20 percent.

Teoh, Welch, and Wong (1998) show that firms issuing equity who have the highest discretionary earnings have the lowest abnormal returns. In column (2) of Table 3, we interact our discretionary accruals variable with a dummy, $HIGHEQISSUE_{i,t}$, that takes the value one if the firm has an equity issuance value in the top 25 percent. We find that the variable is marginally significant with an associated t-statistic of 1.74. We explore the relation between equity issuance/repurchase activity and investment more fully in the next section.

D'Avolio, Gildor, and Shleifer (2001) argue that in recent years the marginal investor may have become less sophisticated providing more incentives to distort earnings. In particular, they show that the mean discretionary accruals for the top decile has been increasing over the past twenty years, more than doubling since 1974. Mean discretionary earnings for the top decile was close to 30% in 1999. As a consequence, we re-estimate our baseline specification for the firm-years in the subperiod 1995-2000 in column (3) of Table 3. Consistent with the D'Avolio, Gildor, and Shleifer (2001) hypothesis, the estimated coefficient on discretionary accruals is roughly a third bigger, moving from 0.2010 to 0.2886. Though we are left with only a quarter of the number of observations, the estimate is statistically significant at the one percent level of significance. In column (4), we restrict the sample further, to only those firm-years in the subperiod 1998-2000. Consistent with the hypothesis that manipulating earnings has become more effective, we find that the coefficient on discretionary accruals is now 0.3240, 50 percent larger than in our baseline regression.

If the D'Avolio, Gildor, and Shleifer (2001) hypothesis is correct, one would more expect to see earnings manipulation in firms with less institutional investors. We find that this is the case as those firms in the top quartile in terms of institutional ownership have average discretionary earnings of -0.0068 while those firms in the lower quartile of institutional ownership have average discretionary earnings of -0.0006. A test of difference in means shows that this difference is statistically significant at the one percent level of significance.

Finally, in the last two columns of Table 3 we split the sample in accordance with the cross-sectional implications of our model. In particular, our model suggests that the greater the degree of informational asymmetry, the greater the incentive to overinvest (underinvest) when overpriced (underpriced). We use firm R&D intensity to proxy for firm transparency. Column (5) re-estimates our baseline regression for those firms below the median value of R&D intensity. Column (6) shows the results for the sub-sample of firms with R&D intensity above the median. Consistent with our model, we find economically important variation across the two sub-samples. Firms that engage in a lot of research and development invest more when they have a lot of discretionary accruals.

D Events signaling firm quality and investment

Our second proxy exploits the information in recent share issuances, repurchases, and changes in dividend policy to identify mispriced firms. Myers and Majluf (1984) and Miller and Rock (1985) indicate how these events signal firm quality. More recently, empirical evidence has surfaced indicating that investors react slowly to the information revealed. Loughran and Ritter (1997) show that benchmark-adjusted stock returns continue to do poorly for the next five years following seasoned equity offerings. Similarly, Ikenberry, Lakonishok, and Vermaelen (1995) show that returns are high following share repurchases for the next five years. Following Daniel and Titman (2002), we construct a measure of a firm's equity issuance / repurchase activity, $EQISSUE_{i,t}$, over a five-year period.[8] They construct their measure to also capture the evidence in Michaely, Thaler, and Womack (1995) showing that abnormal returns are high (low) for five years subsequent to dividend initiations (omissions). We define $EQISSUE_{i,t}$ as the percentage ownership in the firm one would have at time t, given a one percent ownership of the firm at time $t-5$, assuming full reinvestment of all cash flows,

[8]We also measured the same variable over a one-year period and produced similar results.

$$EQISSUE_{i,t} = \log(\frac{N_{i,t}ME_{i,t}}{N_{i,t-5}ME_{i,t-5}}) - r_{i,t-5:t},$$

where $N_{i,t}$ is the number of shares outstanding at time t, $ME_{i,t}$ is the market value of equity at time t, and $r_{i,t-5:t}$ is the log stock return from $t-5$ to t. Therefore our measure includes equity issues, employee stock options plans, share repurchase, dividends, and other actions that pay cash out of the firm, or trade ownership for cash or services (e.g., stock options plans).

Our specification is the following:

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha_i + \gamma_t + b_1 EQISSUE_{i,t} + b_2 Q_{i,t-1} + b_3 \frac{CF_{i,t-1}}{K_{i,t-2}} + \varepsilon_{i,t} \qquad (4)$$

Column (1) of Table 4 displays the results of regression (??). Controlling for investment opportunities and financial slack, firms that are net equity issuers over the past five years invest more. The coefficient of investment on the equity issuance activity measure, b_1, measures 0.0193 and is statistically significant at the one percent level of significance. The economic importance of the effect seems on the order of magnitude as before. A typical (one-standard deviation) change in a firm's equity issuance indicator is associated with roughly a two percent change in that firm's investment to capital ratio.

Unlike the discretionary accruals measure, where there is no direct link, one expects issuance activity to be tied to investment. Of course, our regressions acknowledge the direct link by controlling for investment opportunities and financial slack. However, these controls are now crucial. As a consequence, the remaining columns in Table 4 repeat the robustness checks of the last section. In columns (2) through (4) we control for future and past values of Q. Q_t and Q_{t-2} are statistically significant, though with the wrong sign. However, the coefficient on our equity issuance indicator is essentially unchanged. The effect remains economically and statistically significant.

In columns (5) through (7) of Table 4, we add analysts' expectations of future profitability. Recall that these variables are designed to pick up variation in future investment opportunities not picked up by Tobin's Q. Though the coefficient on $EQISSUE_{i,t}$ is smaller, we still find that controlling for investment opportunities, firms that are expected to underperform (overperform) benchmarks have investment that is too high (low).

Table 5 reports the results from sub-sample analysis. Column (1) of Table 5 restricts the sample to those firm-years in the subperiod 1995-2000 while column (2) restricts the sample to those firm-years in 1998-2000. We find that the effect is still strong in these two subperiods. As before, we split the sample in accordance with the cross-sectional implications of our model. Column (5) re-estimates our baseline regression for those firms below the median value of R&D intensity while column (6) re-estimates the regression for firms above the median value of R&D intensity. Firms with less R&D activity have a weaker relation between equity issuance and equity issuance activity. Firms involved in more R&D activity have a stronger one. But, the difference is not statistically significant.

E Price momentum and investment

Our next measure exploits the firm and industry momentum anomalies of Jegadeesh and Titman (1993) and Moskowitz and Grinblatt (1999). Yearly excess returns at either the firm or industry level exhibit positive serial correlation. Also, Jegadeesh and Titman (1993, 2001) document long-term reversal of momentum profits. For example, Jegadeesh and Titman (2001) find that *cumulative* profits reach 12.17 percent after one year and then steadily decline to -0.44 percent after five years. Similar patterns exist in industry returns.

Several conflicting theories have been offered to explain momentum and reversal. According to Daniel, Hirshleifer and Subrahmanyan (1998), investor overconfidence results in overreaction to private information, implying long-run negative autocorrelation. Barberis Shleifer and Vishny (1998) assume that investors are subject to a conservatism bias and representativeness heuristic. Thus, in their model, investors underreact to earnings, causing short-lag positive autocorrelations. However, when they observe trends of rising earnings representativeness causes them to switch to overreaction, causing long-lag negative autocorrelation. In Hong and Stein (1999), there are two types of investors: investors who focus only on fundamentals and ignore the market price and investors who focus only on market price and follow price trends. The first group causes underreaction, the second group induces overreaction.

These three different theories agree that momentum is a mispricing phenomenon, but disagree on whether serial correlation of excess returns is consistent with firms slowly moving towards their fundamental price (underreaction) or firms moving away from their fundamental price (overreaction). The evidence is mixed as to which explanation best describes the data. For this reason, our third measure is the weakest of the three. The interpretation of our result depends on which description is appropriate. Nonetheless, we think it is interesting to investigate the relationship between momentum and investment decisions.

We use lagged firm and industry momentum as our final indicator of firm mispricing. Firm lagged momentum ($MOM_{i,t-1}$) is the cross-sectionally demeaned (using the universe of all CRSP stocks) stock return over the period January$_{t-1}$ to November$_{t-1}$. Industry lagged momentum ($IMOM_{t-1}$) is the cross-sectionally demeaned (using the universe of all CRSP stocks) industry return over the period January$_{t-1}$ to November$_{t-1}$.

We lag momentum for two reasons. The first is so that our Q variable will incorporate any news concerning future returns and/or cash flows contained in the price run-up. More importantly, we use momentum as a characteristic predicting future mispricing. Firms that are winners and losers are the firms that investors typically overreact to. Whether or not the subsequent return is actually abnormal is unobservable. This is in contrast to our other mispricing measures. We identify firms with extreme $DACCR_{i,t}$ and $EQISSUE_{i,t}$ as the firms which are typically currently mispriced. In this case, whether or not these firms actually were mispriced is unobservable.

Our specification is:

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha_i + \gamma_t + b_1 MOM_{i,t-1} + b_2 IMOM_{i,t-1} + b_3 Q_{i,t-1} + b_4 \frac{CF_{i,t-1}}{K_{i,t-2}} + \varepsilon_{i,t} \qquad (5)$$

Column (1) of Table 6 displays the results of regression (??). Controlling for investment opportunities and financial slack, firms experiencing price momentum invest more. The coefficient of investment on firm momentum, b_1, measures 0.0516 with an associated t-statistic of 7.3. A similar response occurs for the industry momentum variable. The coefficient of investment on industry momentum, b_2, is 0.0468. Thus, firms in price momentum industries invest more than the standard model would indicate. This coefficient is statistically significant; the associated t-statistic is 3.9.

A typical (one-standard deviation) change in a firm's price momentum is associated with roughly a three percent change in that firm's investment to capital ratio.[9] One percent movements in investment ratios are associated with typical moves in a firm's industry momentum.

These results are consistent with two alternative explanations. First, if momentum firms are overpriced firms as in Daniel, Hirshleifer and Subrahmanyan (1998) our result is consistent with the story that overpriced firms invest more than otherwise identical firms. Alternatively, if momentum is evidence of underreaction (e.g., Hong, Lim, and Stein, 2000), our result may suggest that firms (at least those that are not cash constrained) invest optimally, ignoring the market's underreaction. Unfortunately, it is hard to distinguish between these two cases and therefore we think this is our weakest result.

As with the previous two variables, there is some concern that momentum is correlated with our benchmark variables. Certainly, price momentum may just reflect information concerning the firm's profitability and/or degree of financial constraints not contained in Q or $\frac{CF}{K}$. Firms with high stock returns may have very profitable growth options that their average Q only partially reflects. These firm should invest more. One could also argue that sensitivity of investment to stock returns may indicate financial constraints being binding.

Our initial response to these alternative interpretations is to point out that we find an effect not only at the firm level but also at the industry level. It seems harder to argue that entire industries are financially constrained or have systematic differences between average and marginal Q.

The rest of Table 6 estimates regressions with our traditional alternative specifications and control variables. Columns (2), (3), and (4) show that the timing of when we measure

[9]These results relate to those of Morck, Shleifer, and Vishny (1990). That paper predicts three-year investment growth using lagged CAPM alphas over a three-year period. These alphas do a good job predicting investment alone. However, in a horse race with future fundamentals, CAPM alphas have little additional explanatory power. High alphas are related to high stock returns, our variable. However, we compare momentum to the level of stock market valuation, Q. Thus the variable we pit against momentum contains expectations of all future firm profitability. Morck, Shleifer, and Vishny's control variables are purely accounting and therefore are realizations of these expectations, and then only one year out.

Q does not matter. In columns (5), (6), and (7) we add the consensus analyst's estimates of future earnings. Both momentum variables remain economically and statistically significant. In fact, the final specification, which includes forecasts one, two, and five years out, has a coefficient on investment on firm momentum that is over fifty percent higher.

In Table 7 we explore some of the cross-sectional findings in the literature concerning momentum. Various studies have shown that momentum is stronger for losers than for winners. Column (1) repeats the regression for firms experiencing negative momentum while column (3) estimates the relation among winner firms. Recall that the coefficient on firm momentum was 0.0282 in our baseline specification. The estimate for firms with negative momentum is twice as large, 0.0564, while the estimate for winning firms is 0.0188. Both estimates are significant at the one percent level of significance.

In order to try to distinguish between the overreaction and the underreaction hypothesis we rely on the finding of Lee and Swaminathan (2000) that overreaction patterns are more pronounced for losers with low turnover. In columns (2) and (4) we interact firm momentum and turnover. In column (2), the coefficient on the interaction term is negative and statistically significant at the ten percent level of significance. This is consistent with the results of Lee and Swaminathan (2000). In column (4) the coefficient on the interaction term is 0.0034 with an associated t-statistic of 1.55. Though not statistically significant, the result is in line with Lee and Swaminathan's result that winners overreact more when turnover is high.

Column (5) of Table 7 reports a striking result. We estimate our baseline momentum specification restricting our sample to only Internet firms. We define Internet stocks as all the firms that were included in the ISDEX Internet Stock Index. We identified 107 firms that belonged to the Index, thus we have only 121 firm-years observations. Our coefficient is an order of magnitude higher for these firms. This estimate is statistically significant at the one percent level. This result is shocking given the limited number of observations. At least for this sample of firms it is hard to claim that momentum is evidence of underreaction. Column (6) of Table 7 restricts the sample to those firm-years in the subperiod 1995-2000 while column (7) restricts the sample to those firm-years in 1998-2000. We find that the effect is stronger in these two subperiods. As before, we split the sample in accordance with cross-sectional implications of our model. Column (8) reestimates our baseline regression for those firms below the median value of R&D intensity while column nine reestimates the regression for firms above the median value of R&D intensity. The results are consistent with our model's conclusions. The momentum effect on investment is stronger for firms that engage in a lot of research and development.

F Combining all three measures into a mispricing metric

Our final measure uses the three variables in a firm-level vector autoregression (VAR) in order to create a mispricing metric. This metric has the advantage that the information in the three variables used in previous sections is used simultaneously. More importantly, the ability of each of our measures to predict stock returns is measured at the price level. This is important as even if all variables predict one-period returns with the same magnitude, those variables which are more persistent have a larger price-level impact. Finally, the VAR lets us control for risks so that mispricing is explicitly dependent on a model of market equilibrium.

Specifically, let $z_{i,t}$ be a vector of firm-specific state variables describing a firm i at time t. The first element of the vector is the firm's market-adjusted annual stock return, $r_{i,t}$. Also in the vector are yearly measures of the firm's systematic risk according to the CAPM, $\beta_{i,t}$, as well as other firm characteristics that predict future risks and returns. An individual firm's state vector is assumed to follow a linear law:

$$z_{i,t} = \Gamma z_{i,t-1} + u_{i,t}$$

The linear nature of the VAR easily generates forecasts of the state, $E_t[z_{i,t+j}] = \Gamma^j z_{i,t}$. Define $e1' \equiv [1\ 0\ ...\ 0]$ and $e2' \equiv [0\ 1\ ...\ 0]$. At a particular point in time, we take the VAR's forecasts for the next j periods of returns, $e1'\Gamma^j z_{i,t}$, and risks, $e2'\Gamma^j z_{i,t}$, and each period run a cross-sectional regression of forecasted returns on forecasted risks, period by period.

$$e1'\Gamma^j z_{i,t} = a + be2'\Gamma^j z_{i,t} + e_{i,t+j}$$

We then compound the residuals from all j regressions into a mispricing metric, $MISPRICING_{i,t} = \prod_{j=1}^{J} (1 + e_{i,t+j})$.

In estimating the VAR coefficient matrix, we follow Vuolteenaho (2002) and use weighted least squares, deflating the annual data for each firm by the number of firms in the corresponding cross-section. We calculate standard error estimates correcting for clustering of the residual at the year level.

We consider the following parsimonious specification of the VAR. The vector contains the stock return, $r_{i,t}$; the market return beta measured over the previous 12 months, $\beta_{i,t}^{short}$; the market return beta, $\beta_{i,t}^{long}$, measured using at least 36 and as many as 60 of the previous months; log book-to-market equity, $BE/ME_{i,t}$; as well as our previous measures $DACCR_{i,t}$ and $EQISSUE_{i,t}$. All variables are market-adjusted, i.e. cross-sectionally demeaned. The appendix describes how we calculate book-to-market equity. Note that we use forecasts of future 12-month return betas as our measure of risk so that return forecasts exactly correspond to risk forecasts. However we also include a more precise three to five year estimate of beta to help us forecast that risk. Finally, we include four lags of the stock return in the vector, $z_{i,t}$, in order to measure the long term effect of our third variable, lagged momentum, on stock returns.[10]

Table 8 reports the result of the VAR. We find that point estimates of the coefficients on the lagged stock return, log book-to-market equity, and discretionary accruals are economically large and have the same sign as previous research. Due to the severe data restrictions required in order to measure discretionary accruals, only the coefficient on discretionary accruals is statistically significant at conventional levels, with a t-statistic of -2.41. The coefficient on book-to-market is close to being marginally statistically significant (t-statistic of 1.64). However the point estimates for book-to-market as well as the lagged stock return are similar to estimates from longer periods where we do not include discretionary accruals. The ability of the equity issuance variable to predict subsequent stock returns is subsumed by the other variables in the VAR.

The coefficients on lagged returns may help answer the question as to whether momentum profits reverse. Though the coefficients on returns three to five years in the past are large and jointly similar to the coefficient on the lagged stock return, in a test not reported, we cannot

[10]We also estimated the VAR excluding four lags of stock returns and all the results reported in Table 9 are essentially the same.

reject the hypothesis that the coefficients are jointly equal to zero. This result suggests that overall the reversal of momentum profits is not significant. One possible explanation for this is as suggested by the corresponding theories, momentum may measure overreaction in some cases and underreaction in others, therefore for the overall sample we do not find that momentum profits reverse in a statistically significant way.

The remaining columns in Table document the predictability of each element in the VAR. Our measure of risk, $\beta_{i,t}^{short}$, is forecastable using both lagged own values as well as lagged values of $\beta_{i,t}^{long}$. Interestingly, firms with relatively high levels of discretionary accruals have relatively lower betas over the subsequent year. As is well-known, firms' book-to-market ratios are persistent. Other strong results include market-adjusted returns being positively related to subsequent market-adjusted discretionary accruals.

The one-period predictability of market-adjusted stock returns in combination with the estimates relating current characteristics to future characteristics generates a mispricing measure for each firm at each point in time. Figure 1 plots the histogram of these estimates. The average mispricing is about 1.64%. The standard deviation is approximately 18.65%. As one might guess, the distribution of the estimates is right-skewed.

Table 9 uses this mispricing metric in our investment regressions. We estimate the basic regression:

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha_i + \gamma_t + b_1 MISPRICING_{i,t} + b_2 Q_{i,t-1} + b_3 \frac{CF_{i,t-1}}{K_{i,t-2}} + \varepsilon_{i,t} \tag{6}$$

Column (1) of Table 2 displays the results of regression (??). Controlling for investment opportunities and financial slack, firms that are overpriced invest more. The coefficient of investment on our mispricing metric, b_1, measures 0.2124 with an associated t-statistic of 7.37. Firms whose current price is high relative to the CAPM invest more than the standard model would indicate. This effect is economically important. A typical (one-standard deviation) change in a typical firm's level of discretionary accruals is associated with roughly a four percent change in that firm's investment to capital ratio.

This finding is robust to the timing of Tobin's Q as well as the use of analysts consensus estimates of future profitability. In columns (2) through (4) of Table 8, we include end-of-period Q as well lags of Q. Neither the point estimate nor the precision of that estimate is affected by these additional controls. In columns (5) through (7) of Table 4, we add analysts' expectations of future profitability. We hope these variables pick up variation in future investment opportunities not picked up by Tobin's Q. Though the coefficient on $MISPRICING_{i,t}$ is smaller, we still find that controlling for investment opportunities, firms that are overpriced (underpriced) have investment that is too high (low).

We also estimated a version of Tables 3, 5, and 7 using our composite mispricing proxy. That table is available upon request. We find that we are unable to reject the hypothesis that the sensitivity of investment to mispricing varies with R&D intensity. The coefficient on mispricing for firms with R&D intensity below the median is 0.2477 while for firms with higher R&D intensity, the coefficient is 0.2042.

The results in Table 9 are robust to varying the characteristics used to predict future returns and risks in the VAR. For example, using a long (1928-2000) panel, Cohen, Polk, and Vuolteenaho (2002) argue that mispricing relative to the CAPM is not an important factor in determining the prices of value and growth stocks if risk is measured using long-horizon covariances of cash-flow fundamentals. Our short panel precludes such an approach. Moreover, one might also be worried that BE/ME is too correlated with Tobin's Q causing collinearity in regressions of investment on Q and mispricing measures derived from BE/ME. Therefore we repeat the analysis in Table 8 manually setting the ability of BE/ME to predict returns equal to zero. Those results are qualitatively similar; mispricing explains investment after controlling for investment opportunities and financial slack.[11]

In summary we find that our mispricing metric explains investment in a manner consistent with our model. This finding is comforting as many alternative explanations as to why our three proxies come in individually do not obviously extend to this composite measure.

[11] Mispricing continues to explain investment even if we set the ability of both momentum and BE/ME to predict returns equal to zero.

IV Conclusions

We present a model of the firm's investment decision in which investment decisions are affected by the market (mis)valuation of the company. In the model managers with private information about the quality of the firm's investment may invest inefficiently on behalf of shareholders. The reason is that investment decision serve as a signal of firm's value and can be used to manipulate stock prices to the shareholders' advantages. If investors' beliefs about the quality of the firm's project are biased, inefficient investments can be predicted with ex-ante variables.

In the empirical part of the paper we show that variables which predict mispricing also predict investment, controlling for investment opportunities and financial slack. In particular we show that a typical change in a stock's mispricing results in roughly a two to four percent change in the firm's investment-capital ratio. This relation is robust to formally measuring mispricing using the output from a firm-level VAR.

Our model predicts that these sensitivities should be greater, the greater the degree of asymmetric information between firms and investors. We find that that is generally the case, as the effect is weaker for firms with low R&D investment intensities. We argue that these findings represent a first attempt at showing that mispricing in the capital markets may have significant consequences for the real economy.

V Appendix I

Sketch of the Proof of Proposition 1:

A manager who sees a bad investment project does not want to deviate. If he deviates and does not invest the (average) shareholder gets a payoff of V_0. If he does not deviate the shareholder gets a payoff of $V_0 + \frac{q[(1-\lambda)V_g+\lambda V_b]}{q+p} + \frac{(V_b)p}{q+p}$. Such a payoff is greater than V_0 if and only if $(\lambda - 1) > \frac{p+q}{q}\frac{(V_b)}{V_g - V_b} = \frac{(q+p)}{q}\frac{1}{(R-1)}$. Note that this result will hold for any out of equilibrium path belief δ due to the assumption that when no investment occurs the variation in the value of the firm is zero, independent of the quality of the project. Analogously, a manager who sees a good investment project does not want to deviate. If he does not deviate the shareholder gets a payoff of $V_0 + \frac{q[(1-\lambda)V_g+\lambda V_b]}{q+p} + \frac{(V_g)p}{q+p} > V_0$ under the above conditions.

Sketch of the Proof of Proposition 2:

A manager who sees a good investment project (the binding case) will not want to deviate. If he deviates and does invest the (average) shareholder gets a payoff of:

$V_0 + \frac{q[(1-\lambda)V_g+\lambda V_b]}{q+p} + \frac{(V_g)p}{q+p} < V_0$ if $\lambda > \frac{(q+p)}{q}\frac{R}{(R-1)}$

Note that this underinvestment equilibrium depends on non Bayesian beliefs in the out-of-equilibrium case.

Sketch of the Proof of Proposition 3:

A manager who sees a good project will not want to deviate. If he deviates, the shareholder gets a payoff of V_0. If the manager does not deviate the shareholder gets a payoff of $V_0 + \frac{q[V_g]+p[V_g]}{q+p}$ that is bigger than V_0, for $V_g > 0$. A manager who sees a bad project will not want to deviate. If he deviates the shareholder gets $V_0 + \frac{q[V_g]+p[V_b]}{q+p} < V_0$, if $p > Rq$.

VI Appendix II

Investment (I_t) is capital expenditure (COMPUSTAT item 128). Capital (K_{t-1}) is net property, plant, and equipment (COMPUSTAT item 8). Q_{t-1} equals the market value of assets divided by the book value of assets (COMPUSTAT item 6). Market value of assets equals the book value of assets plus the market value of common stock less the sum of book value of common stock (COMPUSTAT item 6) and balance sheet deferred taxes (COMPUSTAT item 74) in year t-1. Cash flow (CF_{t-1}) equals the sum of earnings before extraordinary items (COMPUSTAT item 18) and depreciation (COMPUSTAT item 14) over beginning of year capital. Sales (COMPUSTAT item 12) is net sales. One-year expected profitability ($E_{t-1}[ROA_t]$) is the median analyst year t-1 forecast of earnings in year t divided by the book value of assets (COMPUSTAT item 6). Two-year expected profitability ($E_{t-1}[ROA_{t+1}]$) is the median analyst year t-1 forecast of earnings in year t+1 divided by the book value of assets (COMPUSTAT item 6) in year t-1. Five-year expected profitability ($E_{t-1}[ROA_{t+4}]$) is the median analyst year t-1 forecast of earnings in year t+4 divided by the book value of assets (COMPUSTAT item 6) in year t-1. Research and development intensity is research and development expense (COMPUSTAT item 46) over the book value of assets (COMPUSTAT item 6). We ignore firms with negative accounting numbers for book assets, capital, or investment. We drop those firms with extreme values for the accounting ratios we study as those observations probably represent data errors.

We construct discretionary accruals following Chan, Chan, Jegadeesh. Lakonishok (2001). Accruals ($ACCR_t$) equal the change in accounts receivable (COMPUSTAT data item 2) plus the change in inventories (COMPUSTAT data item 3) plus the change in other current assets (COMPUSTAT data item 68) minus the change in accounts payable (COMPUSTAT data item 70) minus the change in other current liabilities (COMPUSTAT data item 72) minus depreciation (COMPUSTAT data item 178). Accruals are scaled by total assets (the average of COMPUSTAT data item 6 at the beginning and end of the fiscal year). The discretionary component of accruals is defined as

$$DACCR_t = ACCR_t - E_t(ACCR_t)$$

$$E_t(ACCR_t) = \frac{\sum_{k=1}^{5} ACCR_{t-k}}{SALES_{t-k}} SALES_t$$

Therefore we model normal accruals as a constant proportion of firm sales.

Following Daniel and Titman (2002), we construct a measure of a firm's equity issuance / repurchase activity, $EQISSUE_{i,t}$, over a five-year period. We define $EQSSUE_{i,t}$ as the percentage ownership in the firm one would have at time t, given a one percent ownership of the firm at time $t-5$, assuming full reinvestment of all cash flows,

$$EQISSUE_{i,t} = \log(\frac{N_{i,t} ME_{i,t}}{N_{i,t-5} ME_{i,t-5}}) - r_{i,t-5:t},$$

where $N_{i,t}$ is the number of shares outstanding at time t, $ME_{i,t}$ is the market value of equity at time t, and $r_{i,t-5:t}$ is the log stock return from $t-5$ to t.

We compute book-to-market equity, $BE/ME_{i,t}$. Book equity is defined as stockholders' equity, plus balance sheet deferred taxes (COMPUSTAT data item 74) and investment tax credit (data item 208) (if available), plus post-retirement benefit liabilities (data item 330) (if available) minus the book value of preferred stock. Depending on availability, we use redemption (data item 56), liquidation (data item 10), or par value (data item 130) (in that order) for the book value of preferred stock. We calculate stockholders' equity used in the above formula as follows. We prefer the stockholders' equity number reported by COMPUSTAT (data item 216). If neither one is available, we measure stockholders' equity as the book value of common equity (data item 60) plus the par value of preferred stock. (Note that the preferred stock is added at this stage because it is later subtracted in the book equity formula.) If common equity is not available, we compute stockholders' equity as the book value of assets (data item 6) minus total liabilities (data item 181), all from COMPUSTAT.

The price-to-book ratio used to form portfolios in May of year t is book common equity for the fiscal year ending in calendar year t-1, divided by market equity at the end of May of year t. We require the firm to have a valid past price-to-book ratio. Moreover, in order to eliminate likely data errors, we discard those firms with price-to-book ratio less than 0.01 and greater than 100. When using COMPUSTAT as our source of accounting information, we require that the firm must be on COMPUSTAT for two years. This requirement alleviates most of the potential survivor bias due to COMPUSTAT backfilling data.

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Table 1:

Summary Statistics

The data comes from both the merged CRSP-COMPUSTAT database and the Zacks database. Investment, $I_{i,t-1}$, is capital expenditure (COMPUSTAT item 128). Capital, $K_{i,t-1}$, is net property, plant, and equipment (COMPUSTAT item 8). We define discretionary accruals, $DACCR_{i,t}$, as the difference between realized accruals and a constant proportion of contemporaneous firm sales, $S_{i,t-1}$ (COMPUSTAT item 12). We calculate the proportion as the ratio of the sum of the past five years of accruals to the sum of the last five years of sales (see Chan et al. (2001)). Accruals are the difference between accounting earnings and cashflow. See Appendix II for details. Our measure of equity issuance activity, $EQISSUE_{i,t}$, captures equity issues, share repurchases, dividends, and other actions that pay cash out of the firm, or trade ownership for cash or services (e.g., stock options plans) over the period $t-5$ to t. Lagged firm momentum, $MOM_{i,t-1}$, is the cross-sectionally demeaned (using the universe of all CRSP stocks) stock return over the period January$_{t-1}$ to November$_{t-1}$. Lagged industry momentum, $IMOM_{i,t-1}$, is the cross-sectionally demeaned (using the universe of all CRSP stocks) industry return over the period January$_{t-1}$ to November$_{t-1}$ using the two-digit SIC classification. Tobin's Q, $Q_{i,t-1}$, is defined as the market value of assets divided by the book value of assets, $A_{i,t-1}$ (COMPUSTAT item 6). A firm's market value of assets equals the book value of assets plus the market value of common stock less the sum of book value of common stock (COMPUSTAT item 60) and balance sheet deferred taxes (COMPUSTAT item 74). Cash flow, $CF_{i,t-1}/K_{i,t-2}$, equals the sum of earnings before extraordinary items (COMPUSTAT item 18) and depreciation (COMPUSTAT item 14) over beginning of year capital which we define as net property, plant, and equipment (COMPUSTAT item 8). One-year expected profitability, $E_{t-1}[EARN_{i,t}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year t divided by the book value of assets in year $t-1$. Two-year expected profitability, $E_{t-1}[EARN_{i,t+1}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year $t+1$ divided by the book value of assets in year $t-1$. Five-year expected profitability, $E_{t-1}[EARN_{i,t-4}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year $t+4$ divided by the book value of assets in year $t-1$. $R\&D_{i,t-1}/A_{i,t-1}$ measures research and development intensity (research and development expense (COMPUSTAT item 46) over the book value of assets). Share turnover, $TURN_{i,t-1}$ is the average, in December $_{t-1}$, of the daily ratio of shares traded to shares outstanding at the end of the day.

	Mean	Std. Dev.	Min	Max	Obs.
$I_t/K_{i,t-1}$	.31543318	.40981705	.000055	9.8948135	53585
$DACCR_{i,t}$	-.0066178	.09982533	-1.373958	1.790586	31643
$EQISSUE_{i,t}$	.34047265	1.2368979	-8.5319862	16.595188	37761
$MOM_{i,t-1}$	.02231656	.8655887	-3.3779354	19.338051	53585
$IMOM_{i,t-1}$	.03217884	.89540824	-3.5319417	4.8756251	53585
$Q_{i,t-1}$	1.5613214	1.5692514	.074246	82.470253	53585
$CF_{i,t-1}/K_{i,t-2}$	.46286134	1.1810156	-9.9966278	9.9881659	53585
$S_{i,t-1}$	1017.1091	3938.6659	10.002	160883	53585
$A_{i,t-1}$	1277799.8	5897335.8	1878	3.281e+08	53585
$E_{t-1}[EARN_{i,t}]/A_{i,t-1}$	.04385347	.13160954	-6.1592259	13.147612	25249
$E_{t-1}[EARN_{i,t+1}]/A_{i,t-1}$	.07059737	.08605749	-3.8495162	2.0628276	24278
$E_{t-1}[EARN_{i,t+4}]/A_{i,t-1}$	1.746586	3.7817765	-2.403513	120.72811	20628
$R\&D_{i,t-1}/A_{i,t-1}$	.04555467	.07023887	0	2.051975	24153
$TURN_{i,t-1}$	1.4973921	2.3476327	0	252.16142	27834

Table 2:

Discretionary accruals and Firm Investment

The dependent variable is the proportion of investment over beginning of year capital. Investment, $I_{i,t}$, is capital expenditure (COMPUSTAT item 128). Capital, $K_{i,t-1}$, is net property, plant, and equipment (COMPUSTAT item 8). We define discretionary accruals, $DACCR_{i,t}$, as the difference between realized accruals and a constant proportion of firm sales, $S_{i,t}$ (COMPUSTAT item 12). We calculate the proportion as the ratio of the sum of the past five years of accruals divided by the sum of the last five years of sales (see Chan et al. (2001)). Accruals are the difference between accounting earnings and cashflow. Tobin's Q, (Q_t, Q_{t-1}, Q_{t-2}, $Q_{i,t-3}$) is defined as the market value of assets divided by the contemporaneous book value of assets, A_i (COMPUSTAT item 6) . A firm's market value of assets equals the book value of assets plus the market value of common stock less the sum of book value of common stock (COMPUSTAT item 60) and balance sheet deferred taxes (COMPUSTAT item 74). Cash flow, $CF_{i,t-1}/K_{i,t-2}$, equals the sum of earnings before extraordinary items (COMPUSTAT item 18) and depreciation (COMPUSTAT item 14) over beginning of year capital which we define as net property, plant, and equipment (COMPUSTAT item 8). One-year expected profitability, $E_{t-1}[EARN_{i,t}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year t divided by the book value of assets in year $t-1$. Two-year expected profitability, $E_{t-1}[EARN_{i,t+1}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year $t+1$ divided by the book value of assets in year $t-1$. Five-year expected profitability, $E_{t-1}[EARN_{i,t+4}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year $t+4$ divided by the book value of assets in year $t-1$. $R\&D_{i,t-1}/A_{i,t-1}$ measures research and development intensity (research and development expense (COMPUSTAT item 46) over the book value of assets). All regressions include firm and year fixed effects. The standard errors reported in parentheses are corrected for clustering of the residual at the year level. Coefficients starred with one, two, and three asterisks are statistically significant at the ten, five, and one percent level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$DACCR_{i,t}$	0.2010***	0.1866***	0.1798***	0.1748***	0.2329***	0.2454***	0.2723***
	(0.0326)	(0.0315)	(0.0324)	(0.0324)	(0.0380)	(0.0364)	(0.0484)
$Q_{i,t-1}$	0.0544***	0.0553***	0.0576***	0.0568***	0.0532***	0.0538***	0.0550***
	(0.0040)	(0.0051)	(0.0054)	(0.0055)	(0.0054)	(0.0032)	(0.0031)
$CF_{i,t-1}/K_{i,t-2}$	0.0743***	0.0774***	0.0731***	0.0724***	0.0508***	0.0511***	0.0571***
	(0.0124)	(0.0137)	(0.0126)	(0.0127)	(0.0092)	(0.0110)	(0.0135)
$Q_{i,t}$		0.0027	0.0016	0.0019			
		(0.0051)	(0.0050)	(0.0053)			
$Q_{i,t-2}$			-0.0097**	-0.0084			
			(0.0039)	(0.0052)			
$Q_{i,t-3}$				-0.0031			
				(0.0055)			
$E_{t-1}[EARN_{i,t}]/A_{i,t-1}$					0.0405**	0.4200**	0.9252***
					(0.0162)	(0.1920)	(0.2836)
$E_{t-1}[EARN_{i,t+1}]/A_{i,t-1}$						-0.4912	-1.1824**
						(0.3002)	(0.5044)
$E_{t-1}[EARN_{i,t+4}]/A_{i,t-1}$							0.0113**
							(0.0052)
Observations	31643	30271	29567	29053	16480	15862	13491
R-squared	0.430	0.436	0.446	0.445	0.538	0.550	0.534

Table 3:

Discretionary accruals and Firm Investment: Cross-Sectional Analysis

The dependent variable is the proportion of investment over beginning of year capital. Investment, $I_{i,t}$, is capital expenditure (COMPUSTAT item 128). Capital ($K_{i,t-1}$) is net property, plant, and equipment (COMPUSTAT item 8). We define discretionary accruals, $DACCR_{i,t}$, as the difference between realized accruals and a constant proportion of firm sales, $S_{i,t}$ (COMPUSTAT item 12). We calculate the proportion as the ratio of the sum of the past five years of accruals divided by the sum of the last five years of sales (see Chan et al. (2001)). Accruals are the difference between accounting earnings and cashflow. Tobin's Q, $Q_{i,t-1}$, is defined as the market value of assets divided by the book value of assets, $A_{i,t-1}$ (COMPUSTAT item 6). A firm's market value of assets equals the book value of assets plus the market value of common stock less the sum of book value of common stock (COMPUSTAT item 60) and balance sheet deferred taxes (COMPUSTAT item 74). Cash flow, $CF_{i,t-1}/K_{i,t-2}$, equals the sum of earnings before extraordinary items (COMPUSTAT item 18) and depreciation (COMPUSTAT item 14) over beginning of year capital which we define as net property, plant, and equipment (COMPUSTAT item 8). High discretionary accruals, $HIGHDACCR_{i,t-1}$, is a dummy equal to one if the firm has discretionary accruals in the top 20th percentile, and zero otherwise. High equity issuance activity, $HIGHEQISSUE_{i,t-1}$, is a dummy equal to one if the firm has equity issuance in the top 25th percentile, and zero otherwise. Columns (1) and (2) show results for the whole sample. Column (3) shows results for the firm-years in the subperiod, 1995-2000. Column (4) shows results for the firm-years in the subperiod, 1998-2000. Column (5) shows results for the firms that have below-median research and development intensity, $R\&D_{i,t-1}/A_{i,t-1}$. $R\&D_{i,t-1}/A_{i,t-1}$ is research and development expense (COMPUSTAT item 46) over $A_{i,t-1}$. Column (6) shows results for those firms that have above-median research and development intensity. All regressions include firm and year fixed effects. The standard errors reported in parentheses are corrected for clustering of the residual at the year level. Coefficients starred with one, two, and three asterisks are statistically significant at the ten, five, and one percent level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
$DACCR_{i,t}$	0.1593***	0.1796***	0.2886***	0.3240***	0.1560***	0.2054***
	(0.0369)	(0.0297)	(0.0572)	(0.1195)	(0.0433)	(0.0377)
$Q_{i,t-1}$	0.0542***	0.0545***	0.0545***	0.0501***	0.0671***	0.0532***
	(0.0040)	(0.0040)	(0.0042)	(0.0040)	(0.0122)	(0.0048)
$CF_{i,t-1}/K_{i,t-2}$	0.0743***	0.0743***	0.0376**	0.0228	0.1247***	0.0671***
	(0.0124)	(0.0124)	(0.0158)	(0.0252)	(0.0342)	(0.0127)
$HIGHDACCR_{i,t}$	0.0168***					
	(0.0057)					
$DACCR_{i,t} * HIGHEQISSUE_{i,t}$		0.0725*				
		(0.0417)				
Observations	31643	31643	8009	4076	7896	23747
R-squared	0.430	0.430	0.506	0.591	0.427	0.452

Table 4:

Equity issuance and Firm Investment

The dependent variable is the proportion of investment over beginning of year capital. Investment ($I_{i,t}$) is capital expenditure (COMPUSTAT item 128). Capital ($K_{i,t-1}$) is net property, plant, and equipment (COMPUSTAT item 8). Our measure of equity issuance activity, $EQISSUE_{i,t}$, captures equity issues, share repurchases, dividends, and other actions that pay cash out of the firm, or trade ownership for cash or services (e.g., stock options plans) over the period $t-5$ to t. Tobin's Q, (Q_t, Q_{t-1}, Q_{t-2}, Q_{t-3}) is defined as the market value of assets divided by the contemporaneous book value of assets, A_t (COMPUSTAT item 6). A firm's market value of assets equals the book value of assets plus the market value of common stock less the sum of book value of common stock (COMPUSTAT item 60) and balance sheet deferred taxes (COMPUSTAT item 74). Cash flow, $CF_{i,t-1}/K_{i,t-2}$, equals the sum of earnings before extraordinary items (COMPUSTAT item 18) and depreciation (COMPUSTAT item 14) over beginning of year capital which we define as net property, plant, and equipment (COMPUSTAT item 8). One-year expected profitability, $E_{t-1}[EARN_{i,t}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year t divided by the book value of assets in year $t-1$. Two-year expected profitability, $E_{t-1}[EARN_{i,t+1}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year $t+1$ divided by the book value of assets in year $t-1$. Five-year expected profitability, $E_{t-1}[EARN_{i,t+4}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year $t+4$ divided by the book value of assets in year $t-1$. All regressions include firm and year fixed effects. The standard errors reported in parentheses are corrected for clustering of the residual at the year level. Coefficients starred with one, two, and three asterisks are statistically significant at the ten, five, and one percent level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$EQISSUE_{i,t}$	0.0193***	0.0206***	0.0199***	0.0200***	0.0139***	0.0143***	0.0132***
	(0.0024)	(0.0026)	(0.0027)	(0.0027)	(0.0031)	(0.0032)	(0.0032)
$Q_{i,t-1}$	0.0437***	0.0511***	0.0573***	0.0581***	0.0479***	0.0435***	0.0438***
	(0.0042)	(0.0062)	(0.0055)	(0.0056)	(0.0058)	(0.0046)	(0.0063)
$CF_{i,t-1}/K_{i,t-2}$	0.0783***	0.0782***	0.0798***	0.0789***	0.0489***	0.0523***	0.0635***
	(0.0119)	(0.0121)	(0.0122)	(0.0120)	(0.0099)	(0.0114)	(0.0146)
$Q_{i,t}$		-0.0109**	-0.0101**	-0.0107**			
		(0.0051)	(0.0048)	(0.0048)			
$Q_{i,t-2}$			-0.0187***	-0.0176***			
			(0.0039)	(0.0048)			
$Q_{i,t-3}$				-0.0011			
				(0.0036)			
$E_{i,t-1}[EARN_{i,t}]/A_{i,t-1}$					0.3190***	0.4009***	0.4871***
					(0.0826)	(0.0827)	(0.0905)
$E_{t-1}[EARN_{i,t+1}]/A_{i,t-1}$						-0.0476	-0.1089
						(0.1590)	(0.2011)
$E_{t-1}[EARN_{i,t+4}]/A_{i,t-1}$							0.0020
							(0.0038)
Observations	37761	36212	35366	34867	17283	16631	14220
R-squared	0.409	0.414	0.419	0.424	0.572	0.579	0.549

Table 5:

Equity issuance and Firm Investment: Cross-sectional Analysis

The dependent variable is the proportion of investment over beginning of year capital. Investment ($I_{i,t}$) is capital expenditure (COMPUSTAT item 128). Capital ($K_{i,t-1}$) is net property, plant, and equipment (COMPUSTAT item 8). Our measure of equity issuance activity, $EQISSUE_{i,t}$, captures equity issues, share repurchases, dividends, and other actions that pay cash out of the firm, or trade ownership for cash or services (e.g., stock options plans) over the period $t-5$ to t. Tobin's Q, $Q_{i,t-1}$, is defined as the market value of assets divided by the book value of assets, $A_{i,t-1}$ (COMPUSTAT item 6). Market value of assets equals the book value of assets plus the market value of common stock less the sum of book value of common stock (COMPUSTAT item 6) and balance sheet deferred taxes (COMPUSTAT item 74). CF_{t-1}/K_{t-2} equals the sum of earnings before extraordinary items (COMPUSTAT item 18) and depreciation (COMPUSTAT item 14) over beginning of year capital which we define as net property, plant, and equipment (COMPUSTAT item 8). Column (1) shows results for the firm-years in the subperiod, 1995-2000. Column (2) shows results for the firm-years in the subperiod, 1998-2000. Column (3) shows results for the firms that have below-median research and development intensity, $R\&D_{i,t-1}/A_{i,t-1}$. $R\&D_{i,t-1}/A_{i,t-1}$ is research and development expense (COMPUSTAT item 46) over $A_{i,t-1}$. Column (4) shows results for those firms that have above-median research and development intensity. All regressions include firm and year fixed effects. The standard errors reported in parentheses are corrected for clustering of the residual at the year level. Coefficients starred with one, two, and three asterisks are statistically significant at the ten, five, and one percent level respectively.

	(1)	(2)	(3)	(4)
Equity issuance$_t$	0.0140***	0.0043***	0.0151***	0.0184***
	(0.0043)	(0.0012)	(0.0032)	(0.0028)
Q_{t-1}	0.0564***	0.0515***	0.0529***	0.0438***
	(0.0064)	(0.0029)	(0.0104)	(0.0049)
CF_{t-1}/K_{t-2}	0.0401***	0.0252	0.1087***	0.0753***
	(0.0138)	(0.0245)	(0.0135)	(0.0126)
Observations	8346	4327	8620	29141
R-squared	0.563	0.668	0.443	0.424

Table 6:

Momentum and Firm Investment

The dependent variable is the proportion of investment over beginning of year capital. Investment ($I_{i,t}$) is capital expenditure (COMPUSTAT item 128). Capital ($K_{i,t-1}$) is net property, plant, and equipment (COMPUSTAT item 8). Firm lagged momentum ($MOM_{i,t-1}$) is the cross-sectionally demeaned (using the universe of all CRSP stocks) stock return over the period January$_{t-1}$ to November$_{t-1}$. Industry lagged momentum ($IMOM_{t-1}$) is the cross-sectionally demeaned (using the universe of all CRSP stocks) industry return over the period January$_{t-1}$ to November$_{t-1}$. Tobin's Q, (Q_t, Q_{t-1}, Q_{t-2}, Q_{t-3}) is defined as the market value of assets divided by the contemporaneous book value of assets, A_t (COMPUSTAT item 6). A firm's market value of assets equals the book value of assets plus the market value of common stock less the sum of book value of common stock (COMPUSTAT item 60) and balance sheet deferred taxes (COMPUSTAT item 74). Cash flow, $CF_{i,t-1}/K_{i,t-2}$, equals the sum of earnings before extraordinary items (COMPUSTAT item 18) and depreciation (COMPUSTAT item 14) over beginning of year capital which we define as net property, plant, and equipment (COMPUSTAT item 8). Sales (COMPUSTAT item 12) is net sales. One-year expected profitability, $E_{t-1}[EARN_{i,t}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year t divided by the book value of assets in year $t-1$. Two-year expected profitability, $E_{t-1}[EARN_{i,t+1}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year $t+1$ divided by the book value of assets in year $t-1$. Five-year expected profitability, $E_{t-1}[EARN_{i,t+4}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year $t+4$ divided by the book value of assets in year $t-1$. All regressions include firm and year fixed effects. The standard errors reported in parentheses are corrected for clustering of the residual at the year level. Coefficients starred with one, two, and three asterisks are statistically significant at the ten, five, and one percent level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$MOM_{i,t-1}$	0.0282***	0.0262***	0.0282***	0.0276***	0.0356***	0.0381***	0.0461***
	(0.0032)	(0.0030)	(0.0034)	(0.0034)	(0.0050)	(0.0052)	(0.0065)
$IMOM_{i,t-1}$	0.0126***	0.0137***	0.0147***	0.0135***	0.0057**	0.0042*	0.0073**
	(0.0025)	(0.0026)	(0.0022)	(0.0023)	(0.0024)	(0.0024)	(0.0030)
$Q_{i,t-1}$	0.0532***	0.0606***	0.0467***	0.0476***	0.0508***	0.0460***	0.0419***
	(0.0068)	(0.0055)	(0.0051)	(0.0054)	(0.0084)	(0.0069)	(0.0063)
$CF_{i,t-1}/K_{i,t-2}$	0.0732***	0.0755***	0.0675***	0.0678***	0.0642***	0.0662***	0.0696***
	(0.0081)	(0.0087)	(0.0097)	(0.0093)	(0.0083)	(0.0089)	(0.0092)
$Q_{i,t}$		0.0060	0.0055	0.0020			
		(0.0056)	(0.0048)	(0.0050)			
$Q_{i,t-2}$			-0.0061	-0.0026			
			(0.0040)	(0.0054)			
$Q_{i,t-3}$				-0.0052			
				(0.0036)			
$E_{t-1}[EARNi,t]/A_{i,t-1}$					0.1071***	0.0805	0.5430**
					(0.0275)	(0.1603)	(0.2216)
$E_{t-1}[EARN_{t+1}]/A_{i,t-1}$						0.2221	-0.4319
						(0.2669)	(0.3733)
$E_{t-1}[EARN_{t+4}]/A_{i,t-1}$							0.0132***
							(0.0035)
Observations	53585	51045	43008	39255	25249	24278	20290
R-squared	0.495	0.495	0.442	0.444	0.603	0.611	0.630

Table 7:

Momentum and Firm Investment: Cross-Sectional Analysis

The dependent variable is the proportion of investment over beginning of year capital. Investment ($I_{i,t}$) is capital expenditure (COMPUSTAT item 128). Capital ($K_{i,t-1}$) is net property, plant, and equipment (COMPUSTAT item 8). Firm lagged momentum ($MOM_{i,t-1}$) is the cross-sectionally demeaned (using the universe of all CRSP stocks) stock return over the period January$_{t-1}$ to November$_{t-1}$. Industry lagged momentum ($IMOM_{i,t-1}$) is the cross-sectionally demeaned (using the universe of all CRSP stocks) industry return over the period January$_{t-1}$ to November$_{t-1}$. Tobin's Q, $Q_{i,t-1}$, is defined as the market value of assets divided by the book value of assets, $A_{i,t-1}$ (COMPUSTAT item 6). A firm's market value of assets equals the book value of assets plus the market value of common stock less the sum of book value of common stock (COMPUSTAT item 60) and balance sheet deferred taxes (COMPUSTAT item 74). Cash flow, $CF_{i,t-1}/K_{i,t-2}$, equals the sum of earnings before extraordinary items (COMPUSTAT item 18) and depreciation (COMPUSTAT item 14) over beginning of year capital which we define as net property, plant, and equipment (COMPUSTAT item 8). Firm share turnover, $TURN_{i,t-1}$, is the average, in December$_{t-1}$, of the daily ratio of shares traded to shares outstanding at the end of the day. Columns (1) and (2) show results for the sample of firms that have negative momentum. Columns (3) and (4) show results for the sub-sample of firms that have positive momentum. Column (5) shows the results only for internet stock firms. Internet stock firms are defined as the firms that have been included in the ISDEX (Internet Stock Index). Column (6) shows results for the firm-years in the subperiod, 1995-2000. Column (7) shows results for the firm-years in the subperiod, 1998-2000. Column (8) shows results for the firms that have below-median research and development intensity, $R\&D_{i,t-1}/A_{i,t-1}$. $R\&D_{i,t-1}/A_{i,t-1}$ is research and development expense (COMPUSTAT item 46) over $A_{i,t-1}$. Column (9) shows results for those firms that have above-median research and development intensity. All regressions include firm and year fixed effects. The standard errors reported in parentheses are corrected for clustering of the residual at the year level. Coefficients starred with one, two, and three asterisks are statistically significant at the ten, five, and one percent level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$MOM_{i,t-1}$	0.0564***	0.0366***	0.0188***	0.0176**	0.2358*	0.0340***	0.0348**	0.0157***	0.0294***
	(0.0084)	(0.0074)	(0.0048)	(0.0086)	(0.1228)	(0.0065)	(0.0147)	(0.0052)	(0.0031)
$IMOM_{i,t-1}$	0.0111***	0.0112***	0.0165***	0.0136***		0.0060	0.0024	0.0050**	0.0134***
	(0.0032)	(0.0029)	(0.0033)	(0.0029)		(0.0051)	(0.0137)	(0.0025)	(0.0030)
$Q_{i,t-1}$	0.0733***	0.0336***	0.0397***	0.0342***	0.0271	0.0489***	0.0364***	0.1156***	0.0481***
	(0.0089)	(0.0046)	(0.0050)	(0.0060)	(0.0173)	(0.0111)	(0.0064)	(0.0165)	(0.0058)
$CF_{i,t-1}/K_{i,t-2}$	0.0660***	0.0880***	0.0863***	0.1144***	0.0536	0.0434***	0.0206	0.0941***	0.0673***
	(0.0093)	(0.0126)	(0.0121)	(0.0241)	(0.0830)	(0.0075)	(0.0169)	(0.0205)	(0.0080)
$MOM_{i,t-1} * TURN_{i,t-1}$		-0.0035*		0.0034					
		(0.0018)		(0.0022)					
Observations	30216	15232	23369	12602	121	14069	7136	12078	41507
R-squared	0.539	0.487	0.646	0.451	0.671	0.610	0.746	0.546	0.514

Table 8:

Firm-level VAR of risk and return

The table reports the parameter estimates for a firm-level VAR. The model variables include the market-adjusted stock return,$r_{i,t}$ (the first element of the state vector z); the market-adjusted 12-month beta, $\beta_{i,t}^{short}$ (the second element), the market-adjusted beta, $\beta_{i,t}^{long}$, estimated using from 36 to 60 months of data, firm book-to-market equity, $BE/ME_{i,t}$; discretionary accruals, $DACCR_{i,t}$; and equity issuance activity, $EQISSUE_{i,t}$. The appendix describes how we measure $BE/ME_{i,t}$. We define $DACCR_{i,t}$ as the difference between realized accruals and a constant proportion of firm sales, $S_{i,t}$ (COMPUSTAT item 12). We calculate the proportion as the ratio of the sum of the past five years of accruals divided by the sum of the last five years of sales (see Chan et al. (2001)). Accruals are the difference between accounting earnings and cashflow. We calculate $EQISSUE_{i,t}$ to capture equity issues, share repurchases, dividends, and other actions that pay cash out of the firm, or trade ownership for cash or services (e.g., stock options plans) over the period $t-5$ to t. The standard errors reported in parentheses are corrected for clustering of the residual at the year level. Coefficients starred with one, two, and three asterisks are statistically significant at the ten, five, and one percent level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	r_t	β_t^{12}	β_t^{36-60}	B/ME_t	$DACCR_t$	$EQISSUE_t$
r_{t-1}	0.0241	-0.2905***	0.0019	0.0872***	-0.0031	-0.1542*
	(0.0243)	(0.0100)	(0.0059)	(0.0283)	(0.0023)	(0.0264)
β_{t-1}^{12}	0.0056	0.0328**	0.0418***	-0.0057	0.0004	0.0051
	(0.0050)	(0.0141)	(0.0065)	(0.0040)	(0.0016)	(0.0117)
β_{t-1}^{36-60}	-0.0119	0.4110***	0.8006***	0.0161	-0.0067**	-0.0715*
	(0.0220)	(0.0447)	(0.0398)	(0.0198)	(0.0025)	(0.0411)
B/ME_{t-1}	0.0365	-0.0347	-0.0213**	0.8746***	-0.0082***	-0.0556
	(0.0223)	(0.0322)	(0.0100)	(0.0217)	(0.0017)	(0.0347)
$DACCR_{t-1}$	-0.1021**	0.0042	-0.0016	-0.0081	0.0202***	0.6140***
	(0.0423)	(0.0637)	(0.0199)	(0.0267)	(0.0293)	(0.0872)
$EQISSUE_{t-1}$	-0.0021	0.0290	-0.0736***	0.1248***	-0.0064	0.5408***
	(0.0081)	(0.0822)	(0.0260)	(0.0084)	(0.0021)	(0.0691)
r_{t-1}^{24-36}	-0.0030	0.0369	0.0127	0.0729***	0.0225***	0.2398***
	(0.0221)	(0.0379)	(0.0153)	(0.0171)	(0.0052)	(0.0404)
r_{t-1}^{36-48}	-0.0166	0.0642	0.0255	0.0547**	0.0002	0.1722***
	(0.0171)	(0.0494)	(0.0167)	(0.0203)	(0.0019)	(0.0152)
r_{t-1}^{48-60}	-0.0160	0.0053	0.0098	0.0286**	-0.0039	0.2392***
	(0.0147)	(0.0240)	(0.0123)	(0.0106)	(0.0025)	(0.0293)
r_{t-1}^{60-72}	-0.0178	0.0571**	0.0025	0.0216*	-0.0100**	-0.2303***
	(0.0153)	(0.0270)	(0.0123)	(0.0118)	(0.0036)	(0.0325)
Observations	45440	45440	45440	45440	45440	45440
R-squared	0.005	0.057	0.749	0.704	0.028	0.552

Table 9:

Mispricing and Firm Investment

The dependent variable is the proportion of investment over beginning of year capital. Investment ($I_{i,t}$) is capital expenditure (COMPUSTAT item 128). Capital ($K_{i,t-1}$) is net property, plant, and equipment (COMPUSTAT item 8). $MISPRICING_{i,t}$ is the mispricing metric derived from the firm-level VAR model of Table 8. Tobin's Q, (Q_t, Q_{t-1}, Q_{t-2}, Q_{t-3}) is defined as the market value of assets divided by the contemporaneous book value of assets, A_t (COMPUSTAT item 6). A firm's market value of assets equals the book value of assets plus the market value of common stock less the sum of book value of common stock (COMPUSTAT item 60) and balance sheet deferred taxes (COMPUSTAT item 74). Cash flow, $CF_{i,t-1}/K_{i,t-2}$, equals the sum of earnings before extraordinary items (COMPUSTAT item 18) and depreciation (COMPUSTAT item 14) over beginning of year capital which we define as net property, plant, and equipment (COMPUSTAT item 8). Sales (COMPUSTAT item 12) is net sales. One-year expected profitability, $E_{t-1}[EARN_{i,t}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year t divided by the book value of assets in year $t-1$. Two-year expected profitability, $E_{t-1}[EARN_{i,t+1}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year $t+1$ divided by the book value of assets in year $t-1$. Five-year expected profitability, $E_{t-1}[EARN_{i,t+4}]/A_{i,t-1}$, is the median analyst year $t-1$ forecast of earnings in year $t+4$ divided by the book value of assets in year $t-1$. All regressions include firm and year fixed effects. The standard errors reported in parentheses are corrected for clustering of the residual at the year level. Coefficients starred with one, two, and three asterisks are statistically significant at the ten, five, and one percent level respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$MISPRICING_{i,t}$	0.2124***	0.2102***	0.2229***	0.2221***	0.1535***	0.1464***	0.1542***
	(0.0288)	(0.0286)	(0.0294)	(0.0296)	(0.0312)	(0.0275)	(0.0278)
$Q_{i,t-1}$	0.0390***	0.0376***	0.0437***	0.0440***	0.0394***	0.0398***	0.0383***
	(0.0048)	(0.0062)	(0.0060)	(0.0059)	(0.0043)	(0.0047)	(0.0075)
$CF_{i,t-1}/K_{i,t-2}$	0.0909***	0.0910***	0.0914***	0.0914***	0.0652***	0.0611***	0.0641***
	(0.0146)	(0.0146)	(0.0146)	(0.0146)	(0.0083)	(0.0080)	(0.0108)
$Q_{i,t}$		0.0026	-0.0009	-0.0004			
		(0.0051)	(0.0058)	(0.0057)			
$Q_{i,t-2}$			-0.0209***	-0.0169**			
			(0.0052)	(0.0068)			
$Q_{i,t-3}$				-0.0084			
				(0.0071)			
$E_{t-1}[EARN_{i,t}]/A_{i,t-1}$					0.3145***	0.4774***	0.4610***
					(0.0955)	(0.1344)	(0.1626)
$E_{t-1}[EARN_{i,t+1}]/A_{i,t-1}$						-0.0984	-0.1310
						(0.1814)	(0.2105)
$E_{t-1}[EARN_{i,t+4}]/A_{i,t-1}$							0.0060
							(0.0062)
Observations	23347	23347	23347	23347	12914	12520	10787
R-squared	0.460	0.460	0.461	0.461	0.587	0.608	0.576

Figure 1: Histogram of the mispricing metric