

# When Does the Market Matter? Stock Prices and the Investment of Equity-Dependent Firms<sup>\*</sup>

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## Abstract

We use a simple model to outline the conditions under which corporate investment will be sensitive to non-fundamental movements in stock prices. The key cross-sectional prediction of the model is that stock prices will have a stronger impact on the investment of firms that are “equity dependent” – firms that need external equity to finance their marginal investments. Using an index of equity dependence based on the work of Kaplan and Zingales (1997), we find strong support for this prediction. In particular, firms that rank in the top quintile of the KZ index have investment that is almost three times as sensitive to stock prices as firms in the bottom quintile. We also verify several other predictions of the model.

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## **I. Introduction**

Corporate investment and the stock market are positively correlated, in both the time series and the cross-section. The traditional explanation for this relationship is that stock prices reflect the marginal product of capital. This is the interpretation given to the relationship between investment and Tobin's  $Q$ , for example, as in Tobin (1969) and von Furstenberg (1977).

Keynes (1936) suggests a very different explanation. He argues that stock prices contain an important element of irrationality. As a result, the effective cost of external equity sometimes diverges from the cost of other forms of capital. This affects the pattern of equity issues and in turn corporate investment. This "equity financing channel" has been developed in work by Bosworth (1975), Fischer and Merton (1984), Morck, Shleifer and Vishny (1990), Blanchard, Rhee and Summers (1993) and Stein (1996).

It has proven difficult to determine the relative merits of these explanations. This is partly because the equity financing channel has not been articulated in a form that can be empirically distinguished from the traditional view. Empirical tests have had to focus on indirect implications of the two views, or else have had to impose structural assumptions on the data. For example, researchers taking the former approach have examined whether the stock market forecasts investment over and above other measures of the marginal product of capital, such as profitability or cash flow. If it does not, they argue, then the stock market is probably connected to investment only insofar as it reflects fundamentals.

This empirical strategy has yielded mixed results. Barro (1990, p. 130) attributes an important independent role to the stock market: "Even in the presence of cash flow variables, such as contemporaneous and lagged values of after-tax corporate profits, the stock market variable retains significant predictive power for investment." In contrast, Morck, Shleifer and

Vishny (1990, p. 199) conclude from their analysis of firm-level data that “the market may not be a complete sideshow, but nor is it very central.” And Blanchard, Rhee and Summers (1993, p. 132) summarize their study of the aggregate data by stating that “market valuation appears to play a limited role, given fundamentals, in the determination of investment decisions.”

Another empirical strategy is to try to measure inefficiency directly as the difference between market prices and a structural model of efficient prices, and then test whether investment is sensitive to this measure of inefficiency. In a study of aggregate Japanese data, Chirinko and Schaller (2001) find evidence for an equity financing channel using this approach. As they point out, however, their conclusions depend on several structural assumptions.

In this paper we take a new approach. We return to the theory to derive several cross-sectional predictions that are unique to a specific equity financing channel. In particular, the model in Stein (1996) implies that those firms that are in need of external equity finance will have investment that is especially sensitive to the non-fundamental component of stock prices. Intuitively, a firm with no debt and a stockpile of cash can insulate its investment decisions from irrational gyrations in its stock price. But an “equity-dependent” firm that needs equity to fund its marginal investments will be less likely to proceed if it has to issue undervalued shares. The theory thus identifies a specific equity financing channel that suggests *when* the market matters in the cross-section and, at the same time, *why* it matters.<sup>1</sup>

We test several implications of this financing channel. To get started, we need a proxy for the concept of equity dependence. This concept requires some financing friction, or combination of frictions, which makes certain firms more reliant on outside equity at the margin. Standard

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<sup>1</sup> A recent working paper by Polk and Sapienza (2002) also explores the link between stock-market inefficiency and corporate investment. However, their model assumes that all firms are financially unconstrained, and so they focus on a different set of empirical implications.

corporate-finance considerations suggest that equity-dependent firms will tend to be young, and to have high leverage, low cash balances and cash flows, high cash flow volatility (and hence low incremental debt capacity) and strong investment opportunities.<sup>2</sup> One off-the-shelf measure which satisfies most of these criteria is an index based on the work of Kaplan and Zingales (1997). This “KZ index” has already been adapted for use in large-sample empirical work by Lamont, Polk and Saa-Requejo (2001), so we can follow their methodology. By taking this approach, as opposed to building our own measure of equity dependence from scratch, we hope to minimize any concerns about data mining.

Next, we rank firms according to this proxy for equity dependence, and test in a variety of ways whether those that are classified as most likely to be equity dependent have the strongest correlation between stock prices (as measured by  $Q$ ) and subsequent investment. We find strong support for this prediction. In our baseline specification, firms that rank in the top quintile of the sample in terms of the KZ index have a sensitivity of investment to  $Q$  that is almost three times as large as firms that rank in the bottom quintile.<sup>3</sup> In fact, in some specifications the investment of equity-dependent firms is more sensitive to  $Q$  than to cash flow. This is noteworthy because it is generally believed that the cash flow effect dominates the  $Q$  effect in investment equations.

While the heightened  $Q$ -sensitivity of equity-dependent firms is consistent with the equity financing channel in our model, it also admits other interpretations. The ambiguity arises because the theory predicts that the investment of equity-dependent firms should be more

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<sup>2</sup> Morck, Shleifer and Vishny (1990) look for a financing channel using firm size as their only proxy for equity dependence. They argue that the “hypothesis predicts that the influence of the stock market should be particularly great for smaller firms, which rely to a greater extent on external financing” (p. 182). However, they find little evidence that the investment of smaller firms is especially sensitive to stock prices, and conclude that there is no support for the hypothesis. As we show, the use of a more fully developed measure of equity dependence leads to quite different conclusions.

<sup>3</sup> The result that investment is more sensitive to  $Q$  for high-KZ firms actually shows up in the small Kaplan and Zingales (1997) sample. However, their focus is on a different question – how investment-cash flow sensitivities vary with financial constraints – and they never discuss or interpret this particular finding.

sensitive to the *non-fundamental* component of stock prices. But  $Q$  contains more than just this non-fundamental component. It also embodies information about future profitability – and hence about the quality of investment opportunities – as well as measurement error arising from accounting discrepancies between book capital and economic replacement costs. And as we describe in detail below (see Section II.D), one can tell stories in which these other components of  $Q$  covary with our measure of equity dependence in such a way as to induce the patterns we find in the investment- $Q$  regressions. For example, if measurement error in  $Q$  is less of a problem for the firms that we classify as equity-dependent, this might explain why we find a greater sensitivity of investment to  $Q$  for these firms.

Ideally, in order to provide a more focused test of the theory that gets around these problems, we would like to isolate the non-fundamental component of stock prices, and verify that the investment of equity-dependent firms responds more sensitively to this component. This is a difficult task, but we try to tackle it by using future realized stock returns – specifically, returns over the three years subsequent to the year in which we measure investment. The idea is that future realized returns are a noisy estimate of the future returns expected by managers, which in turn include their views about over- or undervaluation. As a result, in the same way that the investment- $Q$  sensitivity is predicted to be positive on average and increasing in equity dependence, the investment-future returns sensitivity should be negative on average and increasingly negative in equity dependence. We confirm this prediction.

Finally, we also look briefly at financing patterns. The model implies that equity-dependent firms should have a pronounced correlation between the non-fundamental component of stock prices and the volume of new equity issues. We find support for this hypothesis as well:

firms with high values of the KZ index also have equity issuance that responds positively to  $Q$  and negatively to future returns.

Overall, our results offer support for a specific equity financing channel in corporate investment. They also complement other evidence that the cost of external equity has an important, independent effect on corporate financing and investment decisions. For example, Ritter (1991), Ikenberry, Lakonishok, and Vermaelen (1995), Loughran and Ritter (1995), Speiss and Affleck-Graves (1995), and Baker and Wurgler (2000) find evidence that equity financing patterns depend on the cost of equity, and Baker and Wurgler (2002) use these results to motivate an alternative view of capital structure. Shleifer and Vishny (2001) argue that the cost of equity is a strong determinant of merger activity, explaining the form of financing in mergers as well as merger waves themselves. Whereas the capital structure findings could be viewed as financial phenomena without significant real effects, however, our results suggest a specific channel through which market inefficiency may affect the real economy.

The remainder of the paper is organized as follows. In Section II, we develop several testable hypotheses in the context of a simple model. The model gives some guidance as to how to measure equity dependence in practice, and also provides a framework for thinking about competing explanations. In Section III, we describe the data, and in Section IV, we present the empirical results. Section V concludes.

## **II. Hypothesis development**

### *A. A simple model*

We use a simplified version of the model in Stein (1996) to develop several testable hypotheses about equity dependence and investment. There is a firm that can invest  $K$  at time 0,

which yields a gross return of  $f(K)$  at time 1, where  $f(\cdot)$  is an increasing, concave function. The efficient-market discount rate is  $r$ , so the net present value of this investment is  $\frac{f(K)}{1+r} - K$ . The first-best level of investment  $K^{fb}$  is therefore given by  $\frac{f'(K^{fb})}{1+r} = 1$ .

The firm also has financing considerations. Its equity may be mispriced by a percentage  $\mathbf{d}$  relative to the efficient-market value, either overpriced ( $\mathbf{d} > 0$ ) or underpriced ( $\mathbf{d} < 0$ ), while its debt is fairly priced. The firm can issue equity  $e$  subject to the constraints that  $0 \leq e \leq e^{\max}$ . In other words, it cannot repurchase equity, and there is an upper bound on how much it can issue. Financing and investment are linked by a leverage constraint,  $e + W - K(1 - \bar{D}) \geq 0$ , where  $W$  is the firm's pre-existing wealth (such as cash on hand, or untapped debt capacity) and  $\bar{D}$  is the fractional debt capacity of the new assets. This constraint implies that the firm's debt ratio can fall below  $\bar{D}$  but cannot exceed it.<sup>4</sup>

Putting all this together, the firm's optimization problem is given by:

$$\max_{e, K} \frac{f(K)}{1+r} - K + \mathbf{d}e, \quad (1)$$

subject to

$$e + W - K(1 - \bar{D}) \geq 0 \text{ and} \quad (2)$$

$$0 \leq e \leq e^{\max}. \quad (3)$$

Proposition 1 summarizes the solution to this problem.

**Proposition 1:** Assume that  $e^{\max} > K^{fb}(1 - \bar{D})$ . Then the possible outcomes are as follows:

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<sup>4</sup> These constraints simplify the exposition, but they can be dispensed with in a fuller model. For example, both repurchases and equity issues could be bounded endogenously by assuming that there are price-pressure effects that increase with the size of the repurchase or issue. The simple form of the leverage constraint can also be generalized by having costs of financial distress that increase continuously whenever the debt ratio exceeds  $\bar{D}$ . These generalizations are considered in Stein (1996).

- i) If  $\mathbf{d} > 0$ , then  $K = K^{fb}$  and  $e = e^{\max}$ : An overvalued firm invests at the first-best level and issues as much equity as possible.
- ii) If  $\mathbf{d} < 0$  and  $W - K^{fb}(1 - \bar{D}) \geq 0$ , then  $K = K^{fb}$  and  $e = 0$ : An undervalued firm with sufficient wealth  $W$  invests at the first-best level and avoids issuing equity.
- iii) If  $\mathbf{d} < 0$  and  $W - K^{fb}(1 - \bar{D}) < 0$ , then  $K < K^{fb}$ : An undervalued firm with insufficient wealth underinvests. This case admits two subcases.
  - a) Define  $K^{ec}$  by  $\frac{f'(K^{ec})}{1+r} = 1 - \mathbf{d}(1 - \bar{D})$ . If  $W - K^{ec}(1 - \bar{D}) < 0$ , it follows that  $K = K^{ec}$  and  $e = K^{ec}(1 - \bar{D}) - W > 0$ : The firm issues equity, and both investment and the size of the equity issue are functions of the degree of undervaluation  $\mathbf{d}$  and debt capacity  $\bar{D}$ .
  - b) If  $W - K^{ec}(1 - \bar{D}) \geq 0$ , then  $K = \frac{W}{1-\bar{D}}$  and  $e = 0$ : The firm does not issue equity and invests as much as it can subject to its wealth  $W$  and the leverage constraint.

The proposition, which is illustrated in Figure 1, makes it clear when investment depends on the non-fundamental component of stock prices  $\mathbf{d}$ . This happens only in region (iii.a), where two necessary conditions are satisfied: the stock is undervalued, and available wealth is so low that the firm would have to issue undervalued equity to invest at the first-best level.<sup>5</sup> We therefore define a firm as “equity dependent” if  $W < K^{fb}(1 - \bar{D})$ . The basic message of Proposition 1 is that for equity-dependent firms, market inefficiency can act like a financial constraint, discouraging investment when stock prices are too low.

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<sup>5</sup> The conclusion that investment is sensitive to stock prices only when  $\mathbf{d} < 0$  is a result of the one-sided nature of the leverage constraint. One could also impose the constraint that an equity issue not cause leverage to fall *below* some critical value, in which case investment may vary with stock prices even when  $\mathbf{d} > 0$ . The model of Shleifer and Vishny (2001) implicitly embodies such a feature—they assume that overvalued firms wishing to issue equity cannot simply park the proceeds in T-bills, and must do something concrete, like acquiring another firm, to justify the issue. Hence overvaluation leads to more investment in the form of mergers.

More precisely, for firms in region (iii.a), the sensitivity of investment to  $\mathbf{d}$  is governed by  $(1-\bar{D})$ . So for a given starting value of  $K$ , firms with less debt capacity have investment that reacts more strongly to stock prices. The intuition is simple. When a firm has little wealth relative to its investment needs, it is forced to issue undervalued equity at the margin to keep the leverage constraint satisfied. This discourages investment. And the lower is  $\bar{D}$ , the more equity must be issued for each marginal dollar of investment, hence the stronger is the negative effect on investment.

### *B. Testable hypotheses*

We use Proposition 1 to generate three empirical predictions. The first two are about investment behavior, and the third is about financing. We develop these predictions in the context of the model, and discuss competing interpretations afterward.

**Hypothesis 1:** Define a firm as equity dependent if  $W < K^{fb}(1-\bar{D})$ . Equity-dependent firms display a higher sensitivity of investment to  $Q$  than do non-equity-dependent firms.

In Hypothesis 1,  $Q$  is taken to be an empirical proxy for  $\mathbf{d}$ , the non-fundamental component of the stock price. Hypothesis 1 is therefore a joint hypothesis about the sources of variation in measured  $Q$  and the validity of the equity dependence mechanism. Note also that Hypothesis 1 does not condition on whether firms are over- or undervalued. It averages over the overvaluation region (i), where equity dependence does not matter, and the undervaluation region (iii.a), where it does. (Graphically, the hypothesis averages over both sides of Figure 1.)

This is an appealing feature of our empirical approach, because we do not have to take a stand on whether a given firm is over- or undervalued in absolute terms in order to test the model.<sup>6</sup>

Our second hypothesis uses future stock returns, instead of current  $Q$ , as a proxy for the non-fundamental component  $d$  in stock prices. The intuition is that overpriced stocks have lower expected returns going forward, as mispricing is corrected, while undervalued stocks have higher expected returns. This leads to the following somewhat sharper prediction.

**Hypothesis 2:** Equity-dependent firms display a more negative sensitivity of investment to future stock returns than do non-equity-dependent firms.

If we were to look on average across all types of firms, there are a couple of reasons to expect the sensitivity of investment to future returns to be negative. Such a relationship might reflect either rational variation in the cost of capital, or the sort of mispricing assumed in our model. Thus if we want to generate more specific support for the model, we need to focus on the cross-sectional prediction associated with equity dependence.

The main impediment to testing Hypothesis 2 is that realized returns are likely to be a very noisy proxy for expected returns, and hence for mispricing. For this reason, and because our main goal is to understand the relationship between investment and  $Q$ , we focus much of our attention on Hypothesis 1. As we discuss below, however, Hypothesis 2 is particularly useful in ruling out alternative explanations for our findings with respect to Hypothesis 1.

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<sup>6</sup> In our earlier NBER working paper (Baker, Stein and Wurgler (2002)) we provide evidence consistent with the more precise prediction that investment is most sensitive to stock prices for *undervalued* equity-dependent firms. We use the level of  $Q$  as a proxy for over- or undervaluation, and find that Hypothesis 1 holds more strongly for low- $Q$  than for high- $Q$  firms as predicted. However, this result could also reflect the fact that there is more measurement error in  $Q$  for high- $Q$  firms, a possibility that is hard to refute. Because of this ambiguity, we focus here on predictions that do not require us to identify the absolute level of mispricing.

Note that both hypotheses involve simple comparisons between firms that are equity dependent and those that are not – that is, comparisons *across* the regions in Proposition 1. We can also ask what happens *within* region (iii.a) as firms become “more” equity dependent, i.e. as  $W$  falls further and further below  $K^{fb}(1-\bar{D})$ . It turns out that a globally monotonic relationship between the degree of equity dependence and the sensitivity of investment to stock prices only obtains if we put certain restrictions on the form of the production function.<sup>7</sup> This situation is reminiscent of the discussion by Kaplan and Zingales (1997, 2000) and Fazzari, Hubbard, and Petersen (2000) as to whether the sensitivity of investment to cash flow is monotonic with respect to a different kind of financial constraint. Nevertheless, the theory is testable as long as we can plausibly identify some firms that are not dependent on equity at all, because the theory unambiguously predicts that the sensitivity of investment to stock prices will rise over at least this first part of the range of measured equity dependence. Whether the sensitivity continues to increase over the whole range is an empirical question, however, and not one for which the theory leaves us with strong priors.

Finally, our model also makes predictions about financing behavior, although they are not as crisp as those for investment. The reason for the difference is apparent from Figure 1. As the degree of mispricing  $\mathbf{d}$  goes from very negative levels (extreme undervaluation) to positive ones (overvaluation), both types of firms see their equity issuance  $e$  go from 0 to  $e^{\max}$ . Thus, averaging over the entire range of  $\mathbf{d}$ 's, both types of firms have equity issuance that is equally responsive to

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<sup>7</sup> Define the “degree” of equity dependence as  $\mathbf{F} = K^{fb}(1-\bar{D}) - W$ , and the percentage sensitivity of investment to stock prices as  $S = 1/K \cdot dK/d\mathbf{d}$ . (This measure of the sensitivity matches our empirical implementation, where we scale investment by existing assets.) It is straightforward to show that a sufficient condition for  $ds/d\Phi$  to be positive in region (iii.a) – and hence for the sensitivity  $S$  to become ever greater as  $W$  declines relative to  $K^{fb}(1-\bar{D})$  – is that  $Kf''(K) + f'(K) < 0$ . Among the functions that satisfy this condition are the quadratic, and anything of the form  $f(K) = K/(K+A)$ , where  $A > 2K$ . Note also that in our setup,  $S$  depends on  $\mathbf{F}$  within region (iii.a) only through  $\bar{D}$  and not through  $W$ , since  $dK/dW$  is zero in this region. Nevertheless, the sufficient condition applies even in a modified version of the model where  $dK/dW > 0$  in the region of interest.

mispricing.<sup>8</sup> Consequently, the strongest unconditional statement for financing patterns is the following.

**Hypothesis 3:** Equity-dependent firms have equity issuance that is positively related to  $Q$  and negatively related to future stock returns.

Hypothesis 3 does not have the same cross-sectional content as the first two hypotheses. It is a prediction of the model, but it should not carry too much inferential weight on its own. Rather, it should be viewed as a complement to the evidence that we develop for investment.<sup>9</sup>

### *C. Determining equity dependence in practice – some initial considerations*

Our theory defines an equity-dependent firm as one in which  $W < K^{fb}(1 - \bar{D})$ . This definition indicates that a firm is more likely to be dependent on equity when  $W$  is low (which translates into low profitability, cash balances, or previously untapped debt capacity), when  $K^{fb}$  is high (growth opportunities are good), and when the incremental debt capacity of new assets  $\bar{D}$  is low.<sup>10</sup> Therefore, a sensible empirical measure of equity dependence should probably be: negatively related to operating cash flow; positively related to proxies for growth opportunities; positively related to actual leverage, net of cash on hand; and negatively related to the debt

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<sup>8</sup> Figure 1 shows that a sharper prediction emerges if we condition on undervaluation. Given undervaluation, the equity issuance of equity-dependent firms is especially sensitive to the non-fundamental component of stock prices. Using the level of  $Q$  to proxy for over- and undervaluation, our NBER working paper finds some support for this prediction (see also footnote 6).

<sup>9</sup> In fact, we should not be surprised if Hypothesis 3 holds, because a large literature (cited in the Introduction) has already documented that, on average, equity issuance is positively correlated with  $Q$  and negatively correlated with future returns. The hypothesis simply adds that these patterns should hold for equity-dependent firms in particular.

<sup>10</sup> These first two factors closely parallel the notion of “financial dependence” in Rajan and Zingales (1998).

capacity of assets. Firm age may also be a factor, to the extent that young firms without established reputations may have a harder time raising bond-market finance (Diamond (1991)).

These observations motivate our interest in the work of Kaplan and Zingales (1997), who undertake an in-depth study of the financial constraints faced by a sample of 49 low-dividend manufacturing firms. Using both subjective and objective criteria, they rank these firms on an ordinal scale, from least- to most-obviously financially constrained. Most useful for our purposes, they then estimate an ordered logit regression which relates their qualitative ranking (mapped into a 1-to-5 scale, where 1 indicates no constraint and 5 a certain constraint) to five Compustat variables. This regression attaches positive weight to  $Q$  and leverage, and negative weight to operating cash flow, cash balances, and dividends. The parameters of this regression, reported below, allow one to create a synthetic “KZ index” of financial constraints for a broader sample of firms, as done in Lamont, Polk and Saa-Requejo (2001).

The KZ index has some very attractive features from our perspective. It is an objective, off-the-shelf index that has already gained substantial currency as an indicator of financial constraints. By using it, as opposed to building our own measure from scratch, we hope to avoid any criticism of data mining. Moreover, relative to what is suggested by our theory, the KZ index seems at first glance to load up on each of the five included variables in the “right” way.

The KZ index also has certain disadvantages for our purposes, however. One problem is that the  $Q$  variable in the index can be given conflicting interpretations within the context of our model. The index also omits other variables that may be useful in identifying equity dependence, such as firm age or proxies for debt capacity. We discuss these deficiencies in more detail below, and explore ways of modifying the KZ index so as to bring it closer into line with what is suggested by the model. A general source of tension is that Kaplan and Zingales (1997) set out to

define financial dependence generally, not equity dependence. Though related, these concepts are not exactly the same – one can imagine a high-KZ firm whose investment is sensitive to debt-market conditions, but that would not issue equity at any price. An important part of our empirical work (Hypothesis 3) is therefore to confirm that high-KZ firms actually do raise significantly more equity when stock prices go up.

#### *D. Competing explanations*

As discussed in the Introduction, differences in the sensitivity of investment to  $Q$  can arise for reasons other than those emphasized in the model. Broadly speaking, ambiguities arise because  $Q$  potentially contains three sources of variation: (i) mispricing; (ii) information about the profitability of investment; and (iii) measurement error. Our theory is about the first of these components, so the other two can create problems for our inferences. Here we discuss these problems in more detail, and describe how they might be addressed in our auxiliary tests.

##### *1. Problems stemming from $Q$ including information about the profitability of investment*

It is possible that equity-dependent firms could have a greater sensitivity of investment to  $Q$  even in an efficient market where all variation in  $Q$  comes from variation in the profitability of investment. Perhaps most notably, the investment of equity-dependent firms may be constrained by adverse-selection problems in the market for new issues (Myers and Majluf (1984)). Several authors have suggested that these problems are more severe when firms have weak investment prospects (Lucas and McDonald (1990), Choe, Masulis and Nanda (1993), Bayless and Chaplinsky (1996)). If so, equity-dependent firms could have investment that is particularly

sensitive to  $Q$  simply because a lower value of  $Q$  is indicative of more adverse selection in the new-issues market.

This explanation can be usefully addressed with our tests of Hypothesis 2, which focus on the link between investment and future stock returns. Given that the adverse-selection models are set in an efficient market, they have no implications at all for future returns. They certainly do not share our prediction that the sensitivity of investment to future returns will be stronger for equity-dependent firms.<sup>11</sup>

Another competing explanation is that different types of firms have different production technologies, which imply different sensitivities of investment to future profitability even in an efficient market.<sup>12</sup> For example, if investment is for some reason naturally concave in  $Q$  and equity-dependent firms tend to have low  $Q$  values, then we would also observe equity-dependent firms having a higher sensitivity of investment to  $Q$ . A straightforward way to address this possibility is to control directly for nonlinearities in the investment– $Q$  sensitivity, by including  $Q^2$  in the investment equation. We can then ask whether our equity dependence measure still has a residual connection to this sensitivity. Our tests of Hypothesis 2 are also helpful in discriminating against production-function explanations, since like the adverse-selection stories, they have no implications for future returns.

## *2. Problems stemming from measurement error in $Q$*

The effects predicted in Hypothesis 1 might also show up if measurement error in  $Q$  were more pronounced for firms that are less equity dependent. However, it is important to note that

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<sup>11</sup> In a similar vein, the tests involving future returns can help to separate our theory from one in which the market is in fact efficient, but managers believe that it is not, and mistakenly associate high stock prices with overvaluation. See Jenter (2001) for a discussion of the overlap between these two stories.

<sup>12</sup> We thank Nick Barberis for suggesting this possibility.

such a pattern in measurement error is precisely the *reverse* of that which has for many years been discussed in the literature on liquidity constraints. For example, in his discussion of Fazzari, Hubbard, and Petersen (1988), Poterba (1988) points out that their results “could be explained on this view because  $Q$  is measured with more error for smaller firms, which tend to be lower-dividend firms” (p. 202). Erickson and Whited (2000) and Alti (2001) further develop this point; the latter builds a formal model to show why measurement error in  $Q$  is likely to be greater for young, faster-growing, low-dividend firms. Clearly, if these arguments are correct, our approach stands on safe ground. The KZ index scores low-dividend, high-growth firms as more likely to be equity dependent. If these attributes are associated with more measurement error in  $Q$ , our tests of Hypothesis 1 will be biased toward being excessively conservative.

Nevertheless, it is certainly possible to concoct measurement-error stories that go in the opposite direction. We address such stories in two ways. Our first approach is to “unpack” the KZ index. The definition of equity dependence leads to specific predictions for how *each* of the components of the KZ index should affect the sensitivity of investment to stock prices. If these predictions hold up in the data, advocates of the measurement-error explanation would then need to explain why measurement error in  $Q$  should be positively correlated with certain of the KZ components and negatively correlated with certain others. Our further tests that look at how the sensitivity of investment to stock prices varies with firm age and debt capacity can be thought of in a similar spirit.

The tests of Hypothesis 2 also address this critique. Measurement error in  $Q$  is typically thought to arise from an inability to accurately measure the replacement cost of capital. In our context, the specific concern is that non-equity-dependent firms do more intangible investment, which leads to more measurement error and hence a bias in the sensitivity toward zero.

Replacing  $Q$  with future returns in the investment equations eliminates this source of measurement error. Realized returns are still a noisy proxy for the non-fundamental component of stock prices, but there is much less reason to believe that the measurement error in this case (i.e., the unforecastable component of returns) is related to firm characteristics in such a way as to confound the test.

### III. Data

We study a large, unbalanced panel of Compustat firms that covers 1980 through 1999. The panel excludes financial firms (i.e., firms with a one-digit SIC of six), and firm-years with a book value under \$10 million, but otherwise it includes all observations with data on investment, financing, equity dependence, and other investment determinants, as described below. The full sample includes 52,101 observations, for an average of 2,605 observations per year.

#### A. Investment

We consider four measures of investment. Our baseline measure is  $CAPX_{it}/A_{it-1}$ , the ratio of capital expenditures in year  $t$  (Compustat Annual Item 128) to start-of-year book assets (Item 6).<sup>13</sup> In addition, we look at  $(CAPX_{it}+RD_{it})/A_{it-1}$ , which includes research and development expenses (Item 46), and at  $(CAPX_{it}+RD_{it}+SGA_{it})/A_{it-1}$ , which further includes selling, general and administrative expenses (Item 189). Finally, we also examine the percentage change in book assets over the year,  $DA_{it}/A_{it-1}$ . To reduce the influence of outliers, we Winsorize each of these

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<sup>13</sup> We scale our measures of investment and cash flow by book assets. This contrasts with some of the literature (e.g. Fazzari, Hubbard, and Petersen (1988) and Kaplan and Zingales (1997)), where the denominator is net plant, property, and equipment (PP&E). Our approach matches our sample, which includes smaller and non-manufacturing firms with modest fixed assets, and our alternative measures of investment, which include intangible assets. Nevertheless, we show in our robustness tests that scaling by PP&E leads to very similar results.

variables at the 1<sup>st</sup> and 99<sup>th</sup> percentile – i.e., we set all observations beyond these tolerances to the 1<sup>st</sup> and 99<sup>th</sup> percentile values respectively.<sup>14</sup> Panel A of Table 1 presents summary statistics for these variables.

### *B. Financing*

We consider two measures of external financing activity. For equity issuance we use  $e_{it}/A_{it-1}$ , the ratio of external equity issues to start-of-year book assets. External equity issues are constructed as the change in book equity minus the change in retained earnings ( $\Delta\text{Item 60} + \Delta\text{Item 74} - \Delta\text{Item 36}$ ). Total external finance is measured as  $(e_{it} + d_{it})/A_{it-1}$ , which includes both equity and debt issues. Debt issues are constructed as the change in assets minus the change in book equity ( $\Delta\text{Item 6} - \Delta\text{Item 60} - \Delta\text{Item 74}$ ). These variables are also Winsorized at the 1<sup>st</sup> and 99<sup>th</sup> percentile.

Panel B of Table 1 presents summary statistics for the financing variables. The mean values are sensitive to major financing events such as acquisitions and divestitures, despite the Winsorization and the restriction on minimum book assets. The medians look more familiar, and are stable across the 1980s and 1990s (not reported).

### *C. Equity dependence*

Following Lamont, Polk and Saa-Requejo (2001), we construct the five-variable KZ index for each firm-year as the following linear combination:

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<sup>14</sup> We have conducted a variety of tests to determine whether our particular treatment of outliers makes any difference. As it turns out, all that matters is that we do something to tamp down the most extreme realizations of  $Q$ , which in the raw data attains a maximum value of 52.5. An alternative to Winsorizing is to replace the book value of equity in  $Q$  with 0.9 times the book value plus 0.1 times the market value, thereby bounding the transformed value of  $Q$  below 10. This procedure gives virtually identical results to those we report. We thank Tuomo Vuolteenaho for suggesting this procedure.

$$KZ_{it} \text{ (five variable)} = -1.002 \frac{CF_{it}}{A_{it-1}} - 39.368 \frac{DIV_{it}}{A_{it-1}} - 1.315 \frac{C_{it}}{A_{it-1}} + 3.139 LEV_{it} + 0.283 Q_{it} \quad (4)$$

where  $CF_{it}/A_{it-1}$  is cash flow (Item 14+Item 18) over lagged assets;  $DIV_{it}/A_{it-1}$  is cash dividends (Item 21+Item 19) over assets;  $C_{it}/A_{it-1}$  is cash balances (Item 1) over assets;  $LEV_{it}$  is leverage ((Item 9+Item 34)/(Item 9+Item 34+Item 216)); and  $Q$  is the market value of equity (price times shares outstanding from CRSP) plus assets minus the book value of equity (Item 60+Item 74) all over assets. We Winsorize the ingredients of the index before constructing it.

One disadvantage of this index is that the model's concept of equity dependence requires a proxy for investment opportunities  $K^{fb}$  that is distinct from mispricing  $d$ . Of the five variables in the index, both low dividends and high values of  $Q$  can be thought of as proxies for strong investment prospects. However,  $Q$  will also contain information about mispricing  $d$ . This dual role for  $Q$  is problematic, since the model has the opposite predictions for the effects of  $K^{fb}$  and  $d$ . In light of this ambiguity, our baseline specifications use a modified four-variable version of the KZ index that omits  $Q$ . We stress that this is for conceptual cleanness rather than because it has any real effect on the results; as we show in a robustness check, leaving  $Q$  in the index does not alter our basic results. We denote the four-variable version of the index simply by  $KZ_{it}$ :

$$KZ_{it} = -1.002 \frac{CF_{it}}{A_{it-1}} - 39.368 \frac{DIV_{it}}{A_{it-1}} - 1.315 \frac{C_{it}}{A_{it-1}} + 3.139 LEV_{it} \quad (5)$$

Henceforth, when we refer to the "KZ index," we mean this version, unless stated otherwise.

Several other aspects of our use of the index deserve further discussion. First, we do not view the KZ index as a precise measure of equity dependence for our sample of firms, nor the coefficients in equation (5) as exactly the "right" weights for this sample. Rather, we think of Kaplan and Zingales (1997) as having nominated several variables that plausibly ought to be indicative of equity dependence, and having shown that each of these variables enters with the

expected sign. Our use of the index is simply an effort to restrict ourselves to these previously-nominated variables, so as to avoid data mining. The precise weights are not really the issue. As we show in a robustness test, very similar results obtain if we reset the weights so that each of the four variables explains one-fourth of the variation in the index.

Second, Kaplan and Zingales (1997) focus on a small sample of low-dividend manufacturing firms. Our sample is much broader, so one might worry about the appropriateness of applying the KZ index to it. However, in our robustness checks, we show that we get very similar results when the index is applied either to a subsample similar to that originally studied by Kaplan and Zingales – i.e., low-dividend manufacturing firms – or to its exact complement.<sup>15</sup>

Third, when we modify the KZ index by dropping  $Q$ , we do not adjust the coefficients on the other four variables. We have re-estimated the four-variable version on the original KZ sample using the data provided in the appendix of Kaplan and Zingales (1997), and found that the coefficients on the other four variables are virtually identical whether or not  $Q$  is included in the regression. In other words,  $Q$  is approximately orthogonal to the linear combination of the other four variables implied by the index, so as a practical matter there is no need to adjust those coefficients when excluding  $Q$ .

Fourth, the index does not include every characteristic that seems likely to be associated with equity dependence. In auxiliary tests, we therefore supplement the index with two other variables.  $AGE_{it}$  is the number of years since the firm's IPO, defined as the current year minus the first year Compustat reports a non-missing market value of equity. As discussed earlier, this variable may serve as a proxy for reputation and access to lending markets.  $IndustryS(CF/A)_i$  is

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<sup>15</sup> Relatedly, our baseline approach also differs from that of Kaplan and Zingales (1997) in that we scale the components of the KZ index by assets rather than by net plant, property, and equipment (Item 8). Again, this is because our sample includes small and non-manufacturing firms. Although scaling by assets produces fewer outliers in the raw KZ index, the results are similar with either denominator, as we show in our robustness tests.

the industry average standard deviation of cash flows, a proxy for industry debt capacity. In combination with the raw level of leverage in equation (5), this variable helps us to get closer to the notion of debt capacity suggested by the model, which is the firm's current leverage *relative* to its debt capacity. We calculate the standard deviation of cash flows across the subset of firm-year observations for each industry using the industry definitions in Fama and French (1997).

Panel A of Table 2 shows summary statistics for the KZ index, its four ingredients, and the other two equity-dependence proxies. By multiplying the coefficients in equation (5) by the standard deviation of the components, one can see that the index is especially sensitive to variation in dividends and leverage.

#### *D. Other investment determinants*

Following Fazzari, Hubbard, and Petersen (1988) and others, our baseline investment equation includes year fixed effects, firm fixed effects, start-of-year  $Q$ , and contemporaneous cash flow.  $Q$  and cash flow are as defined above. Our tests of Hypothesis 2 also require future stock returns. We use the raw three-year cumulative return from CRSP, beginning at the end of the period in which investment is measured. The choice of three years is based on evidence which suggests that equity-issuance related mispricing tends to unwind over roughly this horizon (e.g. Loughran and Ritter (1995) and Baker and Wurgler (2000)).

## **IV. Empirical results**

### *A. Hypothesis 1: Investment and stock prices*

We begin with a simple test of Hypothesis 1, which predicts that the investment of equity-dependent firms is more sensitive to stock prices than that of non-equity-dependent firms.

We assign each firm to a quintile according to its median value of  $KZ_{it}$  over the full sample period.<sup>16</sup> For each KZ quintile, we then estimate the following investment equation:

$$\frac{CAPX_{it}}{A_{it-1}} = a_i + a_t + bQ_{it-1} + c \frac{CF_{it}}{A_{it-1}} + u_{it} . \quad (6)$$

Hypothesis 1 predicts that the coefficient  $b$  will generally increase as KZ increases.

Table 3 shows that there is indeed a strong relationship between KZ and the effect of stock prices on investment. The coefficient  $b$  rises from 0.012 in the first quintile to 0.033 in the fifth quintile. Thus, the firms that are most likely to be equity dependent according to the KZ index have a sensitivity of investment to stock prices that is almost three times as large as firms that are unlikely to be equity dependent.

This pattern in the  $b$  coefficients is our main result, but as an aside it is also interesting to look at the pattern of  $c$  coefficients in Table 3. Consistent with the small-sample results of Kaplan and Zingales (1997), we find no discernible pattern in this coefficient across the KZ quintiles. It is almost the same in quintile 1 (0.110) as in quintile 5 (0.145), and bounces around non-monotonically in between. This particular result, however, is sensitive to the nature of the specification. If we keep everything else the same and lag the cash-flow term one year (so that we are using  $CF_{it-1}/A_{it-2}$  instead of  $CF_{it}/A_{it-1}$ ) the cash-flow coefficient  $c$  now shows a pronounced increasing pattern, going from 0.037 in quintile 1 to 0.134 in quintile 5 (not reported). The pattern of  $b$  coefficients, on the other hand, is essentially unaffected by this variation: it now goes from 0.014 to 0.034 across the five quintiles (not reported).<sup>17</sup>

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<sup>16</sup> Our results are not sensitive to the technique used to classify firm-year observations. In our robustness checks below, we experiment with two alternatives. In the first, we allow a firm's KZ quintile to vary from year to year, so, for example, if its leverage increases, it may move to a higher quintile. In the second, we assign firms to quintiles based on their median values of the index over five-year sub-periods, rather than over the full sample period. Both of these alternatives lead to very similar results.

<sup>17</sup> We use the specification with a contemporaneous cash-flow term as our baseline for two reasons. First, this seems to be the convention in the literature. Second, we are interested in having the cash-flow term be as good a control as

To get a better understanding of economic magnitudes, note from Table 2 that the standard deviation of  $Q$  in our sample is 0.93. Thus in the highest KZ quintile, the impact of a one-standard-deviation shock to  $Q$  is to alter the ratio of capital expenditures to assets by 0.031 ( $0.033 \times 0.93 = 0.031$ ). When compared to either the median or the standard deviation of this investment measure (0.060 and 0.079, respectively), this effect is clearly substantial. As another benchmark, note that the standard deviation of the cash-flow-to-assets ratio is 0.12, so that in the highest KZ quintile, a one-standard-deviation shock to cash flow moves the investment ratio by 0.017 ( $0.145 \times 0.12 = 0.017$ ). Thus among the firms most likely to be equity dependent, stock prices have a substantially larger effect on investment than does cash flow. This stands in contrast to the general belief that the effect of cash flow dominates that of  $Q$  in these sorts of investment equations.

Turning to statistical, as opposed to economic significance, there are a couple of ways to evaluate the precision of our results. First, and most simply, we can do a  $t$ -test of the difference between our quintile-1 and quintile-5  $b$  coefficients. When we estimate these five regressions simultaneously (with residuals clustered at the firm level in an effort to deal with potential serial correlation and with heteroskedasticity-robust standard errors), the  $t$ -statistic for this difference is a significant 4.80.

An alternative approach, in the spirit of Fama and MacBeth (1973), can be used if one is very concerned about serial correlation at the firm level and does not trust the cluster adjustment to deliver proper standard errors. This approach is illustrated in Figure 2. Using the same methodology as before, we now divide firms into twenty KZ-index groups, instead of five. For

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possible for fundamentals, not in making structural inferences with respect to it. This suggests that we should use the most recent cash-flow information available. In contrast, if the goal were to test whether cash flow has a causal impact on investment controlling for investment prospects, this approach might be less palatable, precisely because of contemporaneous cash flow's informativeness about future profitability.

each group, we estimate the  $b$  coefficient of investment on  $Q$ . We then regress these twenty  $b$  estimates against their respective ordinal KZ-index rankings. In other words, we treat each  $b$  coefficient simply as a data point, without making any assumptions about the precision with which it is estimated. This twenty-data-point regression yields a point estimate of 0.0014 and a  $t$ -statistic of 8.44. Intuitively, this methodology infers that the  $b$  coefficients are precisely estimated by virtue of the fact that most of them cluster close to the fitted regression line in Figure 2. And one can show that the point estimate obtained with this approach is roughly consistent in magnitude with the pattern of coefficients in the quintile regressions.

### *B. Robustness of Hypothesis 1 results*

In Tables 4 and 5, we explore the robustness of our basic result. We alter various aspects of the specification such as: the variables included in the KZ index; the scaling of these index components; the horizons over which firms are classified by the index; the other variables in the investment equations; the composition of the sample; and the definition of investment.

In Row 1 of Table 4, we reproduce our baseline specification for reference: recall that the coefficient  $b$  rises from 0.012 to 0.033 as we move from the bottom to the top quintile of the KZ index. In Row 2, we revert to the original five-variable version of the index used in Lamont, Polk and Saa-Requejo (2001), which includes  $Q$ . In this case, the  $b$  coefficient goes from 0.011 in quintile 1 to 0.027 in quintile 5, which differs little from the baseline result.

In Row 3, we go back to the four-variable version of the index, but classify firms based on their 5-year median value of KZ, rather than their median value over the entire sample period. In Row 4, we push this time-varying classification further, and re-classify firms every year.

Specifically, we assign a firm to a KZ quintile in any given year  $t$  based on its value of the index in year  $t-2$ . These changes in the classification horizon do not affect the results.

In Row 5, we scale the elements of the KZ index by property, plant and equipment (PP&E), as opposed to by assets.<sup>18</sup> This strengthens the results somewhat, with  $b$  now almost quadrupling from the first quintile to the fifth quintile. In Row 6, we add the lagged value of the capital-expenditure ratio to the right-hand-side of the regressions. This brings down the  $b$  coefficients a bit, but does not change their relative proportions. In Row 7, we delete the cash-flow term from the regression entirely, so that  $Q$  is the only explanatory variable for investment. Again, the results are very similar to those in the base case.

In Row 8, we restrict ourselves to a subsample similar to the low-dividend manufacturing sample used by Kaplan and Zingales (1997) to fit the index weights. More precisely, we focus on manufacturing firms in SIC codes 2000 to 3999, and further require that these firms have a ratio of dividends to net income of less than 10 percent (the dividend criterion Kaplan and Zingales apply to approximate a subsample studied in Fazzari, Hubbard, and Peterson (1988)); this screen reduces the number of observations from 52,101 to 26,725. We also follow Kaplan and Zingales more literally by using PP&E scaling in the components of the KZ index.<sup>19</sup> Row 8 shows that the  $b$  coefficient in this subsample again just about triples from the bottom to the top quintile. Row 9 further shows that the complementary subsample – i.e., firms which are not low-dividend manufacturers – also generates similar results. Taken together, these results suggest that our previous findings are not an artifact of having applied the KZ index outside of its original setting.

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<sup>18</sup> In Row 5, capital expenditures and cash flow are still scaled by assets. When we scale the variables in the investment equation by PP&E as well,  $b$  rises from 0.063 to 0.113 from the first to the fifth quintile. The difference of 0.050 has a t-statistic of 4.05.

<sup>19</sup> In Row 8, capital expenditures and cash flow are still scaled by assets. When we scale the variables in the investment equation by PP&E as well,  $b$  rises from 0.054 to 0.090 from the first to the fifth quintile. The difference of 0.037 has a t-statistic of 2.90.

Finally, in Row 10, we show that the results are not overly sensitive to the exact weights that the KZ index gives to its four components. We reset the weights so that each component explains an equal amount of the variation in the index. This again gives similar results.

In Table 5, we consider how our basic results carry over to the three other measures of investment. To do this in a compact fashion, we pool the observations and run a series of interactive specifications of the form:

$$\frac{I_{it}}{A_{it-1}} = a_i + a_t + bQ_{it-1} + cQ_{it-1} \cdot KZ_i + d \frac{CF_{it}}{A_{it-1}} + u_{it} \quad (7)$$

where  $I_{it}$  denotes one of the four measures of investment, and  $KZ_i$  is the sample-median value of the KZ index for firm  $i$ .<sup>20</sup> The coefficient of interest in this case is  $c$ . As predicted,  $c$  is positive for each of the four investment measures, with strong statistical significance in each case.

Equation (7) also provides a convenient specification within which to examine one of the competing explanations for our results discussed earlier. That is, different types of firms may have different production technologies, which imply different sensitivities of investment to  $Q$  in the absence of mispricing. More specifically, investment may be naturally concave in  $Q$ , and so if equity dependent firms tend to have lower  $Q$  values, they would be expected to have higher sensitivities. A simple way to examine this explanation is to add a  $Q^2$  term to the specification and examine whether  $c$  changes. In unreported results, we find that, while the coefficient on  $Q^2$  does turn out to be significantly negative, the  $c$  coefficient is barely affected. This is true for each measure of investment considered in Table 5.<sup>21</sup>

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<sup>20</sup> Including the interaction between cash flow and  $KZ$  in equation (7) does not affect the results. The interaction term is statistically insignificant in three out of four regressions in Table 5, and  $c$  is virtually unchanged in all four cases. In the second row,  $c$  drops from 0.012 to 0.011. In the fourth row,  $c$  drops from 0.058 to 0.056. In the first and third rows,  $c$  is unchanged.

<sup>21</sup> The first  $c$  coefficient in Table 5 drops from 0.011 to 0.08; the second from 0.013 to 0.010; the third from 0.021 to 0.018; and, the fourth from 0.058 to 0.053. All four remain statistically significant at the one percent level.

### C. Decomposing KZ and the effect of other equity-dependence indicators

The KZ index results may appear to be something of a black box. We know the sign that each variable takes in the index, and we have established the overall effect of the index on the sensitivity of investment to stock prices. Here we examine explicitly how each component of the index individually affects this sensitivity. We also examine the effect of other variables, not in the KZ index, that may help to identify equity dependence. As argued above, demonstrating that the sensitivity responds in the expected direction to each of a number of variables forces an advocate of competing explanations – based on, for example, measurement error in  $Q$ , or differences in production technologies across firms – to tell a somewhat more convoluted story.

To perform the KZ index decomposition, it is again convenient to pool all observations, and run the following interactive specification:

$$\begin{aligned} \frac{I_{it}}{A_{it-1}} = & a_i + a_t + bQ_{it-1} + Q_{it-1} \cdot \left[ c_1 \frac{CF}{A} + c_2 \frac{DIV}{A} + c_3 \frac{C}{A} + c_4 LEV \right] \\ & + \left[ d_1 \frac{CF}{A} + d_2 \frac{DIV}{A} + d_3 \frac{C}{A} + d_4 LEV \right] + e \frac{CF_{it}}{A_{it-1}} + u_{it} \end{aligned} \quad (8)$$

where the un-subscripted versions of the variables  $CF/A$ ,  $DIV/A$ ,  $C/A$ , and  $LEV$  refer to sample-median values for firm  $i$ . We run this regression for each of four measures of investment. The definition of equity dependence makes predictions for the signs of the interactions:  $c_1$  should be negative, as should  $c_2$  and  $c_3$ . In contrast,  $c_4$  should be positive.

Panel A of Table 6 shows that the predictions for  $c_1$ ,  $c_2$ ,  $c_3$  and  $c_4$  are largely borne out. The sharpest results are for  $c_4$ , the interaction on the leverage term. Across all four definitions of investment,  $c_4$  is always significantly positive, indicating a strong tendency for levered firms to have investment that is more sensitive to stock prices. The results for  $c_1$ ,  $c_2$  and  $c_3$  are somewhat

weaker, but generally consistent with the theory – they take on the predicted sign in eight of twelve cases altogether, and in seven of the eight cases where they are statistically significant.

In Panel B we consider two other proxies for equity dependence that are not included in the KZ index: firm age and industry cash flow volatility. We re-estimate (8) augmented with these two variables and their interactions with  $Q$ , denoting the interaction coefficients as  $c_5$  and  $c_6$ , respectively. We predict that  $c_5$  will be negative, on the premise that younger firms are more likely to be dependent on equity, and  $c_6$  will be positive, since higher cash flow volatility implies lower debt capacity, which again contributes to equity dependence. The results in Panel B strongly support these predictions. Both  $c_5$  and  $c_6$  have the expected sign for all four measures of investment, and are significant in all but one case.

Overall, these results paint a detailed picture of the type of firm that is likely to have a high sensitivity of investment to stock prices: a young, non-dividend-paying firm, with low cash flow and cash balances, and with high leverage *relative* to the debt capacity of its assets. This picture fits the theoretical definition of equity dependence rather well. And while it does not definitively rule out competing explanations for our results, it does suggest that such explanations would have to be quite intricate and multi-dimensional.

#### *D. Hypothesis 2: Investment and future stock returns*

We now turn to Hypothesis 2. The basic strategy for testing this hypothesis is to replace  $Q$  in the investment equations with future stock returns. More precisely, we now run regressions of the following form:

$$\frac{CAPX_{it}}{A_{it-1}} = a_t + bR_{it,t+3} + c \frac{CF_{it}}{A_{it-1}} + u_{it}, \quad (9)$$

where  $R_{it,t+3}$  is the return on firm  $i$ 's stock over the 3-year period from the end of year  $t$  to the end of year  $t+3$ . As discussed above, one might expect  $b$  to be negative on average whether variation in  $R_{it,t+3}$  reflects either mispricing or differences in the rational cost of capital. The unique prediction of our theory is again a cross-sectional prediction –  $b$  should be *more negative* for equity-dependent firms. Note that such a prediction does not follow from any of the alternative explanations of our Hypothesis-1 results, such as differences in measurement error in  $Q$  across firms, differences in production technologies, or adverse selection that varies with  $Q$ .

Equation (9) drops the firm fixed effect that we included in our previous  $Q$  specifications. The results to follow are actually stronger if we keep the fixed effect in, but using a fixed effect that is effectively fitted over the firm's entire sample period makes the interpretation of the future-returns term problematic.<sup>22</sup> By leaving out the fixed effect, we have all the variables set up in such a way that if we were to put future returns on the left-hand side instead of the right, we would be in a position to conduct a legitimate no-look-ahead return-forecasting exercise. Indeed, the full-sample results that we have are isomorphic to such a forecasting exercise, implying that, controlling for cashflow, higher investment forecasts lower returns.<sup>23</sup> If one wants to preserve the spirit of a fixed effect, but avoid the "look-ahead" problems that it entails, another approach is to measure the investment and cashflow terms relative to their contemporaneous industry averages. Demeaning in this way leads to estimates similar to those reported here.

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<sup>22</sup> For example, if returns are negative in the past, a fixed effect will make subsequent returns look high even if they are in fact zero.

<sup>23</sup> In a recent paper, Titman, Wei and Xie (2001) do this kind of forecasting exercise explicitly, demonstrating that one can earn high benchmark-adjusted returns by buying the stocks of low-investment firms and shorting the stocks of high-investment firms. They are interested in a different set of issues than we are, however, and so they do not explore the cross-sectional predictions that we focus on. See also Polk and Sapienza (2002).

Table 7 presents the results for investment and future returns. (The requirement of returns data reduces the number of observations from 52,101 to 41,819.) The table shows that the basic prediction of Hypothesis 2 is supported. The coefficients on future returns are negative and significant in each KZ quintile, and they go from  $-0.004$  in the first quintile to  $-0.007$  in the fifth quintile. The  $t$ -statistic on the difference of these estimates is  $-2.40$ .

As before, another simple and robust way to assess the statistical significance of the coefficient pattern across KZ categories is with the type of scatter plot that we introduced in Figure 2. We repeat this exercise for future returns in Figure 3. A regression of the twenty individual  $b$  coefficients against their ordinal KZ-index rankings yields a slope of  $-0.0002$ , with a  $t$ -statistic of  $-3.23$ . In spite of this significant  $t$ -statistic, however, a visual comparison of Figures 2 and 3 suggests that our estimates of  $b$  are markedly less precise in the future-returns regressions than they were in the  $Q$ -based regressions. This is not surprising, since future realized returns are bound to be a very noisy proxy for mispricing.

In unreported regressions, we have also replicated the robustness analysis of Tables 4 and 5, as well as the KZ-index decomposition of Table 6, with future returns inserted everywhere in place of  $Q$ . The results generally hold up to different measures of investment, and to variations in scaling techniques and other details. The most noteworthy wrinkle is that because of the greater noise inherent in working with future returns, we no longer have the power to do the KZ-index decomposition in a meaningful way – when we interact future returns with each of the index components separately, the individual interaction coefficients are often statistically insignificant.

Finally, we have tried using both  $Q$  and future returns *together* in the same regression (along with cashflow) to explain investment. The patterns across KZ categories are similar to those we obtain when we analyze the roles of  $Q$  and future returns separately. In particular, the

coefficients on  $Q$  continue to be positive and increasing in the KZ index, while the coefficients on future returns continue to be negative and decreasing. This is consistent with the view that both  $Q$  and future realized returns contain independent noisy information about future expected returns, and hence about mispricing.

*E. Hypothesis 3: Financing, stock prices and stock returns*

Our last hypothesis is that the equity issuance of equity-dependent firms is positively related to  $Q$  and negatively related to future returns. Verifying this hypothesis would lend further support to model's premise that financing considerations are at the heart of the link between investment and stock prices. It would also further justify our assumption that the KZ index is a useful indicator of equity dependence – i.e., it would establish that high-KZ firms do in fact issue meaningfully more equity when their stock prices are high. We test Hypothesis 3 with the same regression framework used for the previous hypotheses, simply changing the dependent variable from investment to financing.

Panel A of Table 8 looks at the relationship between financing and  $Q$ . In the first row, the financing variable is equity issues over assets,  $e_{it}/A_{it-1}$ . The sensitivity of equity issuance to  $Q$  is strongly significant across all KZ quintiles, and rises from 0.021 in the first quintile to 0.064 in the fifth quintile. Thus firms classified as most likely to be equity-dependent have equity issuance that is strongly tied to their stock prices, as predicted in Hypothesis 3.<sup>24</sup>

The model does not imply that equity-dependent firms finance 100 percent of their marginal investment with equity issues, of course. According to Proposition 1, in the relevant

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<sup>24</sup> As discussed earlier, the theory makes a clear-cut prediction for the relative strength of the effect across different KZ classes only if one conditions on undervaluation. See the NBER working paper version for empirical tests along these lines.

region of the parameter space (iii.a) the leverage constraint is binding, so at the margin new equity and debt are raised in proportions  $(1 - \bar{D})$  and  $\bar{D}$  respectively. This suggests that equity-dependent firms should also be raising a significant amount of debt on the margin.

We examine this prediction using a total external finance variable that includes both equity and debt issues,  $(e_{it} + d_{it})/A_{it-1}$ . The results are in the second row of Panel A. They show that for firms in KZ quintile 5, the sensitivity of total finance to  $Q$  is 0.136, whereas for equity issues alone it is 0.064. In other words, for high-KZ firms, a marginal increase in the stock price leads to roughly equal increases in equity and debt finance. This seems consistent with the model's prediction that equity-dependent firms issue equity and debt in lock step. Moreover, the quantitative response of equity issues to stock prices is substantial relative to the response of total finance, consistent with the spirit of the equity financing channel.

Panel B changes the proxy for mispricing from  $Q$  to future returns. The conclusions are much the same as in Panel A. Equity issuance is significantly negatively related to future returns for high-KZ firms, and the response of equity issues to future returns in this group again accounts for roughly half of the response of total external finance to future returns.

Finally, because of the difficulty of measuring equity and debt issues from Compustat data, we have examined whether the results in Table 8 are robust to alternative definitions of financing variables. Those used in Table 8 are backed out from balance sheet data. In unreported regressions, we find very similar results using equity and debt issues taken from the cash flow statement.<sup>25</sup>

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<sup>25</sup> Specifically, we re-measure net equity issues as Compustat Item 108 minus Item 115, and debt issues as the change in long-term debt (Item 111 minus Item 114). With these definitions, the sensitivity of equity issuance to  $Q$  goes from 0.017 in the first KZ quintile to 0.042 in the fifth quintile, and sensitivity of total external finance to  $Q$  from 0.026 in the first quintile to 0.107 in the fifth quintile.

## V. Conclusion

A great deal of research has been devoted to understanding why investment is correlated with stock prices. The traditional view, embodied in the  $Q$  theory of investment, emphasizes the role of stock prices as indicators of investment opportunities. An alternative view posits the existence of an equity financing channel in which non-fundamental variations in the cost of external equity have an independent effect on investment. Empirical attempts to determine the relative merits of these two views have not been very successful, however. In part, this is because the equity financing channel is usually not articulated in a form that yields distinct empirical predictions.

In this paper, we adapt Stein's (1996) model to develop a specific, testable version of the equity financing channel. The key is the *cross-sectional prediction* that equity-dependent firms will have investment that is especially sensitive to the non-fundamental component of their stock prices. This is because undervaluation increases the effective cost of external equity, and therefore deters investment by equity-dependent firms.

We test the model using the index developed by Kaplan and Zingales (1997) to identify equity-dependent firms. The main empirical finding is that firms that rank in the top quintile of the KZ index have investment that is almost three times as sensitive to  $Q$  as firms in the bottom quintile. This finding is consistent with one of the basic predictions of the model. But differences in  $Q$  coefficients might also stem from differences in measurement error in  $Q$  across firms, or differences in production technologies.

Two further sets of results tend to support our theory over these alternative explanations. First, we "unpack" the KZ index results, and verify that in most cases the individual components of the index affect the sensitivity of investment to  $Q$  in the direction predicted by the model. Two

other proxies for equity dependence, firm age and industry cash flow volatility, also enter with the predicted sign. The detailed picture of the determinants of the investment- $Q$  sensitivity that emerges from this exercise increases the burden on competing stories.

Second, just as we find a stronger (positive) sensitivity of investment to  $Q$  among equity-dependent firms, we also find that such firms have a stronger (negative) sensitivity of investment to future returns. To the extent that future returns are a cleaner proxy than  $Q$  for mispricing, this helps to hone in on the specific mechanism in our model. Moreover, this pattern is especially difficult to reconcile with alternative explanations. For example, it is not predicted by a rational asymmetric-information theory in which new issues by equity-dependent firms are constrained by an adverse-selection problem that gets worse when  $Q$  is low.

Finally, we also verify that equity issues by high-KZ firms exhibit considerable sensitivity to both stock prices and future returns, consistent with the role played by financing in the model. Overall, our results complement recent research on how the cost of external equity – particularly the component that is non-fundamental, or perceived as such by managers – drives patterns in equity issues, capital structure, and merger activity. But they may be of greater economic significance than findings pertaining purely to financing patterns, because they suggest a channel by which stock market inefficiency can have an impact on the real economy.

We close with a final caveat regarding interpretation. If one takes our model literally, it might be tempting to conclude that the investment behavior of equity-dependent firms must necessarily be less efficient than that of non-equity-dependent firms. After all, according to the model, non-fundamental movements in stock prices introduce volatility into the investment of the equity-dependent firms, thereby moving them away from the first best. But we caution readers against jumping to this sort of welfare conclusion, because it is quite sensitive to the

perhaps unrealistic assumption that, absent financial constraints, managers always act in the interest of their stockholders.

Consider the following embellishment of the model. Everything is as before, except that unconstrained managers are subject to an agency problem that leads them to prefer excessively smooth investment in the face of changes in fundamentals. If one layers on top of this agency problem our equity financing channel, the same basic *positive* implications emerge: all else equal, the investment of equity-dependent firms will respond more to stock prices than that of non-equity-dependent firms. But the *normative* implications of the model will be very different. Since the non-equity-dependent firms are now underreacting to stock prices, the investment of the equity-dependent firms may actually be closer to efficient on average.<sup>26</sup> In other words, starting from a second-best situation, the distortion inherent in the equity financing channel may help to alleviate the distortion coming from managers' tendency to smooth investment.

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<sup>26</sup> Indeed, researchers commonly associate a greater sensitivity of investment to stock prices with a *higher* degree of efficiency. See, e.g., Scharfstein (1998) and Rajan, Servaes and Zingales (2000) for examples in the context of internal capital markets.

## References

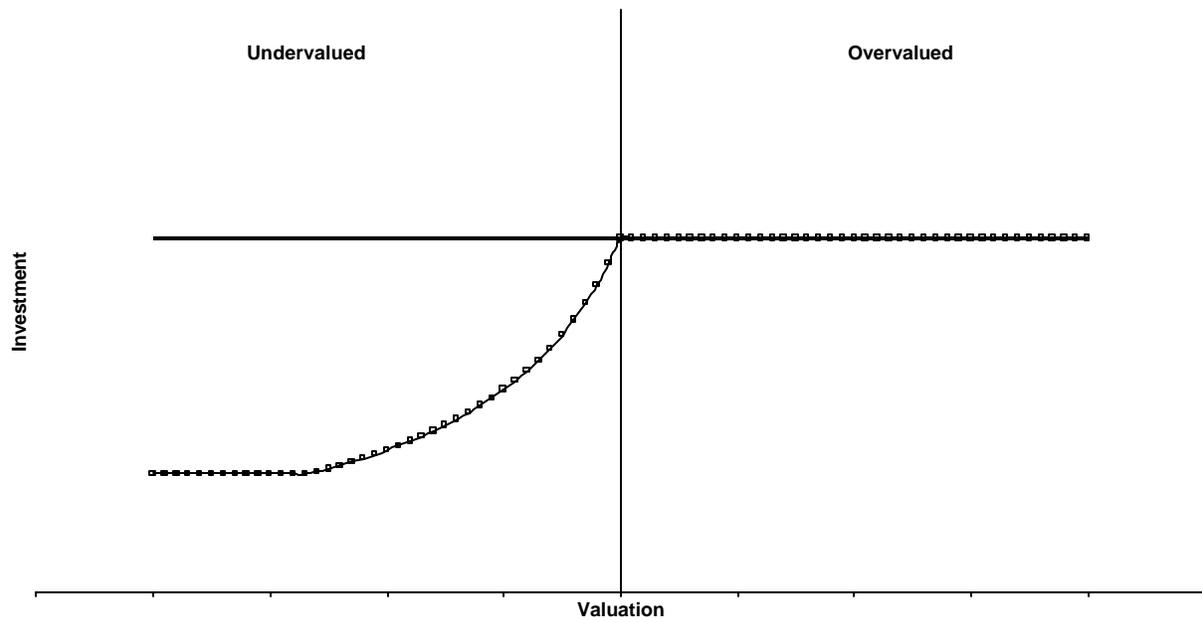
- Alti, Aydogan, 2001, "How sensitive is investment to cash flow when financing is frictionless?," Carnegie-Mellon University working paper.
- Baker, Malcolm and Jeffrey Wurgler, 2000, "The equity share in new issues and aggregate stock returns," *Journal of Finance* 55, 2219-2257.
- Baker, Malcolm, Jeremy Stein, and Jeffrey Wurgler, 2002, "When does the market matter? Stock prices and the investment of equity-dependent firms," NBER working paper.
- Baker, Malcolm and Jeffrey Wurgler, 2002, "Market timing and capital structure," *Journal of Finance* (forthcoming).
- Barro, Robert J., 1990, "The stock market and investment," *Review of Financial Studies* 3, 115-132.
- Bayless, Mark, and Susan Chaplinsky, 1996, "Is there a window of opportunity for seasoned equity issuance?" *Journal of Finance* 51, 253-278.
- Blanchard, Olivier, Chanyong Rhee, and Lawrence Summers, 1990, "The stock market, profit, and investment," *Quarterly Journal of Economics* 108, 115-136.
- Bosworth, Barry, 1975, "The stock market and the economy," *Brookings Papers on Economic Activity* 2:1975, 257-290.
- Chirinko, Robert S., and Huntley Schaller, 2001, "Business fixed investment and 'bubbles': The Japanese case," *American Economic Review* 91, 663-680.
- Choe, Hyuk, Ronald W. Masulis, and Vikram Nanda, 1993, "Common stock offerings across the business cycle: Theory and evidence," *Journal of Empirical Finance* 1, 3-31.
- Diamond, Douglas W., 1991, "Monitoring and reputation: The choice between bank loans and directly placed debt," *Journal of Political Economy* 99, 689-721.
- Erickson, Timothy, and Toni M. Whited, 2000, "Measurement error and the relationship between investment and  $q$ ," *Journal of Political Economy* 108, 1027-1057.
- Fama, Eugene F., and Kenneth R. French, 1997, "Industry costs of equity," *Journal of Financial Economics* 43, 153-193.
- Fama, Eugene F., and James D. MacBeth, 1973, "Risk, return and equilibrium: Empirical tests," *Journal of Political Economy* 81, 607-636.
- Fazzari, Steven M., R. Glenn Hubbard, and Bruce C. Petersen, 1988, "Financing constraints and corporate investment," *Brookings Papers on Economic Activity* 1:1988, 141-195.

- Fazzari, Steven M., R. Glenn Hubbard, and Bruce C. Petersen, 2000, "Investment-cash flow sensitivities are useful: A comment on Kaplan and Zingales," *Quarterly Journal of Economics* 115, 707-712.
- Fischer, Stanley, and Robert C. Merton, 1984, "Macroeconomics and finance: The role of the stock market," *Carnegie-Rochester Conference Series on Public Policy* 21, 57-108.
- Ikenberry, David, Josef Lakonishok, and Theo Vermaelen, 1995, "Market underreaction to open market share repurchases," *Journal of Financial Economics* 39, 181-208.
- Jenter, Dirk, 2001, "Market Timing and Managerial Portfolio Decisions," Harvard University working paper.
- Kaplan, Steven N., and Luigi Zingales, 1997, "Do investment-cash flow sensitivities provide useful measures of financing constraints?," *Quarterly Journal of Economics* 112, 169-215.
- Kaplan, Steven N., and Luigi Zingales, 2000, "Investment-cash flow sensitivities are not valid measures of financing constraints," *Quarterly Journal of Economics* 115, 695-705.
- Keynes, John Maynard, 1936, *The General Theory of Employment, Interest, and Money*, London: Macmillan.
- Lamont, Owen, Christopher Polk, and Jesus Saa-Requejo, 2001, "Financial constraints and stock returns," *Review of Financial Studies* 14, 529-554.
- Loughran, Tim, and Jay Ritter, 1995, "The new issues puzzle," *Journal of Finance* 50, 23-51.
- Lucas, Deborah, and Robert McDonald, 1990, "Equity issues and stock price dynamics," *Journal of Finance* 45, 1019-1043.
- Morck, Randall, Robert Vishny, and Andrei Shleifer, 1990, "The stock market and investment: Is the market a sideshow?," *Brookings Papers on Economic Activity* 2:1990, 157-215.
- Myers, Stewart C., and Nicholas S. Majluf, 1984, "Corporate financing and investment decisions when firms have information that investors do not have," *Journal of Financial Economics* 13, 187-221.
- Polk, Christopher, and Paola Sapienza, 2002, "The real effects of investor sentiment," Northwestern University working paper.
- Poterba, James, 1988, "Comments on Fazzari, Hubbard, and Petersen," *Brookings Papers on Economic Activity* 1:1988, 200-204.
- Rajan, Raghuram G., Henri Servaes, and Luigi Zingales, 2000, "The cost of diversity: The diversification discount and inefficient investment," *Journal of Finance* 55, 35-80.
- Rajan, Raghuram G., and Luigi Zingales, 1998, "Financial dependence and growth," *American Economic Review* 88, 559-586.

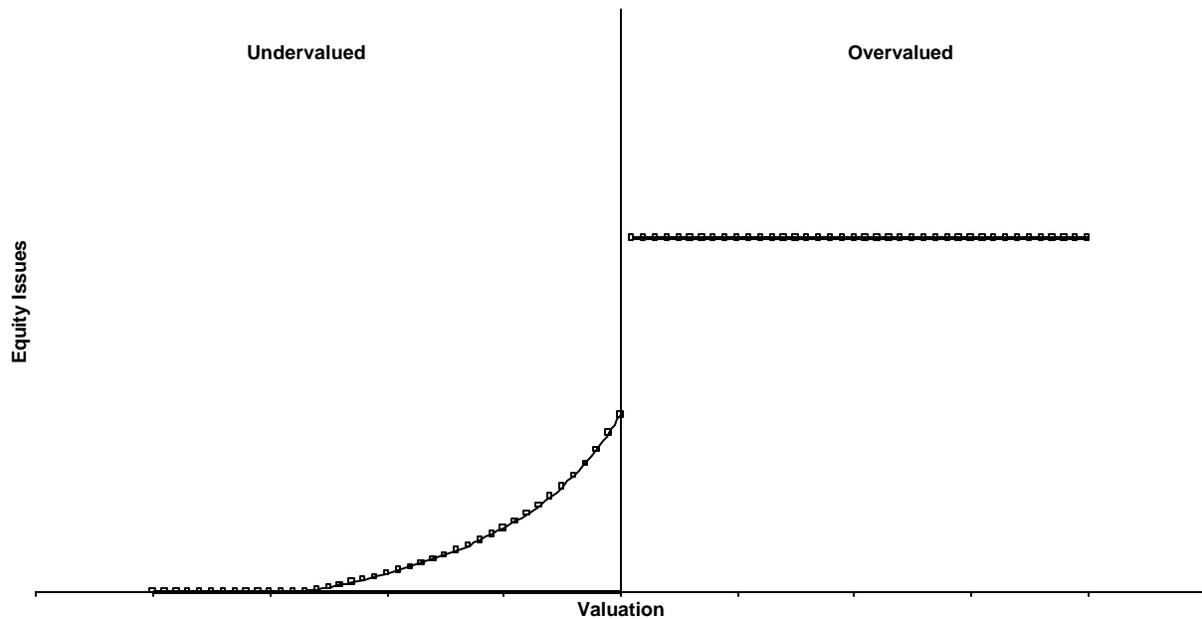
- Ritter, Jay, 1991, "The long-run performance of initial public offerings," *Journal of Finance* 42, 365-394.
- Scharfstein, David S., 1998, "The dark side of internal capital markets II: Evidence from diversified conglomerates," NBER working paper 6352.
- Shleifer, Andrei, and Robert Vishny, 2001, "Stock market driven acquisitions," Harvard University working paper.
- Speiss, D. Katherine, and John Affleck-Graves, 1995, "Underperformance in long-run stock returns following seasoned equity offerings," *Journal of Financial Economics* 38, 243-267.
- Stein, Jeremy C., 1996, "Rational capital budgeting in an irrational world," *Journal of Business* 69, 429-455.
- Titman, Sheridan, K.C. John Wei, and Feixue Xie, 2001, "Capital investments and stock returns," University of Texas working paper.
- Tobin, James, 1969, "A general equilibrium approach to monetary theory," *Journal of Money, Credit, and Banking* 1, 15-29.
- Von Furstenberg, George M., 1977, "Corporate investment: Does market valuation matter in the aggregate?," *Brookings Papers on Economic Activity* 2:1977, 347-397.

**Figure 1. Graphical illustration of Proposition 1.** The horizontal axis measures the degree of stock-price misvaluation  $d$ . The vertical axis shows investment  $K$  (in Panel A) and equity financing  $e$  (in Panel B). The square markers show the policy of an equity-dependent firm. The solid line is the policy of a non-equity-dependent firm.

A. Mispricing and Investment



B. Mispricing and Equity Financing

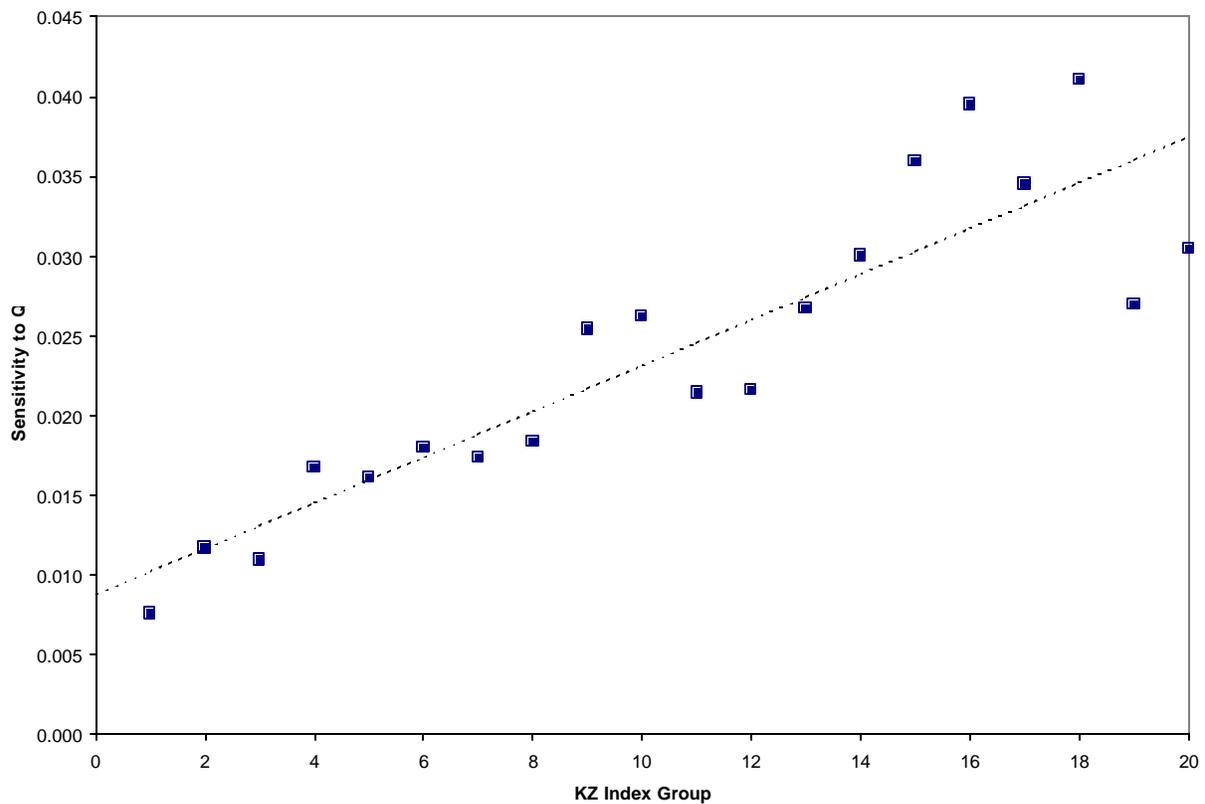


**Figure 2. Equity dependence and the link between investment and stock prices.** Plot of the sensitivity of investment to  $Q$  by equity dependence group. We sort firms into twenty groups according to the firm median Kaplan and Zingales (1997) index of financial constraints (excluding  $Q$  from the index) over the period from 1980 to 1999, performing separate regressions for each group. Year and firm fixed effects are included.

$$\frac{CAPX_{it}}{A_{it-1}} = a_i + a_t + bQ_{it-1} + c\frac{CF_{it}}{A_{it-1}} + u_{it}$$

We plot estimates of  $b$ . Investment is defined as capital expenditures over assets.  $Q$  is defined as the market value of equity plus assets minus the book value of equity over assets. Cash flow is defined as operating cash flow over assets. We report the slope estimate and the  $t$ -statistic from an OLS regression of the  $b$  estimates on KZ index group.

$Q$  coefficients (slope = 0.0014 [8.44])

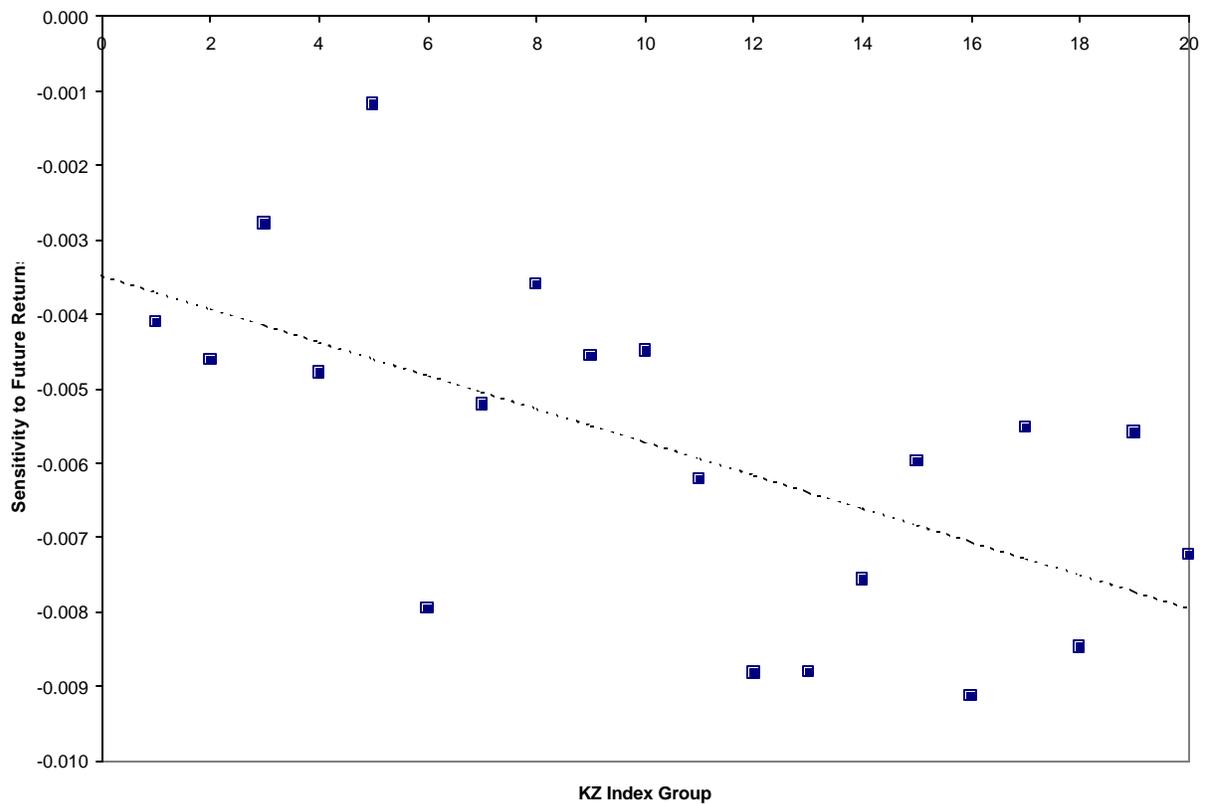


**Figure 3. Equity dependence and the link between investment and future returns.** Plot of the sensitivity of investment to future stock returns by equity dependence group. We sort firms into twenty groups according to the firm median Kaplan and Zingales (1997) index of financial constraints (excluding  $Q$  from the index) over the period from 1980 to 1999, performing separate regressions for each group. Year fixed effects are included.

$$\frac{CAPX_{it}}{A_{it-1}} = a_t + bR_{it,t+3} + c\frac{CF_{it}}{A_{it-1}} + u_{it}$$

We plot estimates of  $b$ . Investment is defined as capital expenditures over assets.  $R_{it,t+3}$  is the cumulative stock return in years  $t+1$ ,  $t+2$  and  $t+3$  from CRSP. Cash flow is defined as operating cash flow over assets. We report the slope estimate and the  $t$ -statistic from an OLS regression of the  $b$  estimates on KZ index group.

R coefficients (slope = -0.0002 [-3.23])



**Table 1. Summary statistics for investment and financing variables.** In Panel A, investment is alternately defined as capital expenditures (Item 128) over assets (Item 6); capital expenditures plus research and development expenses (Item 46) over assets; capital expenditures plus research and development expenses plus selling, general, and administrative expenses (Item 189) over assets; and growth in assets. In Panel B, financing is alternately defined as equity issues ( $\Delta$ Item 60+ $\Delta$ Item 74- $\Delta$ Item 36) (i.e. the change in book equity minus the change in retained earnings) over assets, and equity issues plus debt issues ( $\Delta$ Item 6- $\Delta$ Item 60- $\Delta$ Item 74) over assets. All variables are Winsorized at the 1<sup>st</sup> and 99<sup>th</sup> percentiles.

	<i>Full Sample</i>						<i>Subsample Means</i>	
	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>Median</b>	<b>Min</b>	<b>Max</b>	<b>1980-89</b>	<b>1990-99</b>
Panel A: Investment								
$CAPX_t/A_{t-1} \%$	52,101	8.23	7.85	6.00	0.18	45.22	8.81	7.79
$+RD_t/A_{t-1}$	52,101	11.41	10.46	8.45	0.24	58.43	10.96	11.76
$+RD_t+SGA_t/A_{t-1}$	52,101	40.09	28.93	34.21	1.65	144.04	39.23	40.76
$\Delta A_t/A_{t-1} \%$	52,101	11.10	28.03	6.41	-43.76	153.73	10.30	11.73
Panel B: Financing								
$e_t/A_{t-1} \%$	52,101	4.38	14.48	0.64	-15.90	92.28	3.00	5.44
$+d_t/A_{t-1}$	52,101	10.51	27.32	4.03	-33.70	161.59	8.48	12.08

**Table 2. Summary statistics for equity dependence and other investment determinants.** Equity dependence is defined using the Kaplan and Zingales (1997) index of financial constraints (excluding  $Q$  from the index). This modified version of the index has four components: cash flow (Item 14+Item 18) over assets; cash dividends (Item 21+Item 19) over assets; cash balances (Item 1) over assets; and leverage ((Item 9+Item 34)/(Item 9+Item 34+Item 216)). We also consider two additional measures of equity dependence, firm age and the industry standard deviation of cash flow over assets between 1980 and 1999. Industry definitions follow Fama and French (1997). Age is equal to the current year minus the IPO year, which is defined as the first year Compustat reports a non-missing market value of equity.  $Q$  is defined as the market value of equity (price times shares outstanding from CRSP) plus assets minus the book value of equity (Item 60+Item 74) over assets.  $R_{it,t+3}$  is the cumulative stock return in years  $t+1$ ,  $t+2$  and  $t+3$  from CRSP. All variables are Winsorized at the 1<sup>st</sup> and 99<sup>th</sup> percentiles except for firm age and the industry standard deviation of cash flow.

	<i>Full Sample</i>						<i>Subsample Means</i>	
	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>Median</b>	<b>Min</b>	<b>Max</b>	<b>1980-89</b>	<b>1990-99</b>
Panel A: Equity Dependence Variables ( $t-2$ )								
<i>KZ Index</i>	52,101	-0.04	2.60	0.28	-18.43	3.68	-0.12	0.03
<i>CF<sub>t-2</sub>/A<sub>t-3</sub> %</i>	52,101	12.57	28.75	8.97	-39.81	225.92	13.31	11.99
<i>DIV<sub>t-2</sub>/A<sub>t-3</sub> %</i>	52,101	1.98	4.67	0.60	0.00	37.65	2.34	1.71
<i>C<sub>t-2</sub>/A<sub>t-3</sub> %</i>	52,101	14.95	30.13	5.01	0.01	223.79	12.80	16.61
<i>LEV<sub>t-2</sub> %</i>	52,101	35.33	25.62	34.29	0.00	124.13	35.76	35.00
<i>AGE<sub>t-2</sub></i>	52,101	10.72	6.08	9.00	1.00	31.00	8.86	12.17
<i>Industry s(CF/A)</i>	52,101	144.49	223.89	64.89	11.34	914.11	142.44	146.08
Panel B: Other Investment Determinants								
<i>Q<sub>t-1</sub></i>	52,101	1.47	0.93	1.17	0.53	6.15	1.28	1.62
<i>R<sub>it,t+3</sub> %</i>	41,819	58.37	111.70	36.96	-92.32	565.24	54.79	62.63
<i>CF<sub>t</sub>/A<sub>t-1</sub> %</i>	52,101	8.20	11.68	9.19	-42.43	36.52	9.25	7.39

**Table 3. Equity dependence and the link between investment and stock prices.** Regressions of investment on  $Q$  and cash flow by equity dependence quintile. We sort firms into five quintiles according to the firm median Kaplan and Zingales (1997) index of financial constraints (excluding  $Q$  from the index), performing separate regressions for each group. Year and firm fixed effects are included.

$$\frac{CAPX_{it}}{A_{it-1}} = a_i + a_t + bQ_{it-1} + c\frac{CF_{it}}{A_{it-1}} + u_{it}$$

We report estimates of  $b$ . Investment is defined as capital expenditures over assets.  $Q$  is defined as the market value of equity plus assets minus the book value of equity over assets. Cash flow is defined as operating cash flow over assets.  $T$ -statistics use heteroskedasticity-robust standard errors, clustered by firm, with all five regressions in a panel estimated simultaneously.

KZ index	N	$Q_{t-1}$		$CF_t/A_{t-1}$		$R^2$
		<b>b</b>	[t-stat]	<b>c</b>	[t-stat]	
Quintile 1	10,427	0.012	[8.82]	0.110	[7.54]	0.62
2	10,415	0.018	[11.61]	0.124	[9.45]	0.61
3	10,421	0.024	[10.18]	0.117	[8.46]	0.58
4	10,418	0.032	[10.74]	0.137	[10.60]	0.62
5	10,420	0.033	[7.70]	0.145	[10.61]	0.62

**Table 4. Equity dependence and the link between investment and stock prices: Robustness.** Regressions of investment on  $Q$  and cash flow by equity dependence quintile. We sort firms into five quintiles according to various modifications of the Kaplan and Zingales (1997) index of financial constraints, performing separate regressions for each group. Year and firm fixed effects are included.

$$\frac{CAPX_{it}}{A_{it-1}} = a_i + a_t + bQ_{it-1} + c\frac{CF_{it}}{A_{it-1}} + u_{it}$$

We report estimates of  $b$ . Investment is defined as capital expenditures over assets.  $Q$  is defined as the market value of equity plus assets minus the book value of equity over assets. Cash flow is defined as operating cash flow over assets. The first row is our baseline specification, which classifies firms according to their median four-variable KZ index (excluding  $Q$ ). The second row uses the firm median five-variable KZ index (including  $Q$ ). The third row uses a five-year median KZ index (excluding  $Q$ ). The fourth row uses an annual KZ index measured at time  $t-2$  (excluding  $Q$ ). The fifth row scales the KZ-index components by fixed assets instead of total assets. The sixth row includes lagged investment as an independent variable. The seventh row excludes cash flow. The eighth row restricts the sample to manufacturing firms (SIC codes 2000 through 3999) with a ratio of dividends to net income of less than 10 percent, and also scales the KZ-index components by fixed assets. The ninth row studies the complement sample to that studied in the eighth row, again scaling by fixed assets. The tenth row resets the KZ-index weights so that each variable explains the same portion of the index variation.  $T$ -statistics use heteroskedasticity-robust standard errors, clustered by firm, with all five regressions in a row estimated simultaneously.

	<i>Bottom Quintile</i>		2		3		4		<i>Top Quintile</i>		<i>Top – Bottom</i>	
	<b>b</b>	<b>[t-stat]</b>	<b>b</b>	<b>[t-stat]</b>	<b>b</b>	<b>[t-stat]</b>	<b>b</b>	<b>[t-stat]</b>	<b>b</b>	<b>[t-stat]</b>	<b>Db</b>	<b>[t-stat]</b>
1. KZ (base case)	0.012	[8.79]	0.018	[11.51]	0.024	[10.10]	0.032	[10.74]	0.033	[7.86]	0.021	[4.80]
2. KZ (five-variable index)	0.011	[7.13]	0.019	[11.32]	0.020	[10.02]	0.028	[11.50]	0.027	[8.98]	0.016	[4.74]
3. KZ (five-year median)	0.011	[7.83]	0.019	[10.96]	0.024	[10.81]	0.030	[10.54]	0.034	[7.33]	0.023	[4.72]
4. KZ (annual)	0.010	[6.13]	0.019	[9.68]	0.024	[8.21]	0.033	[9.08]	0.035	[7.93]	0.026	[5.40]
5. KZ (PP&E scaling)	0.010	[8.21]	0.015	[10.37]	0.025	[12.01]	0.032	[10.62]	0.039	[10.02]	0.030	[7.28]
6. Lagged $CAPX/A$ included	0.009	[7.83]	0.012	[8.66]	0.019	[8.93]	0.025	[9.25]	0.028	[7.66]	0.019	[4.96]
7. $CF/A$ excluded	0.016	[12.43]	0.022	[13.57]	0.028	[11.59]	0.037	[10.92]	0.038	[7.89]	0.022	[4.47]
8. Low-div. mfg., PP&E scaling	0.008	[6.68]	0.013	[6.82]	0.015	[6.81]	0.025	[7.39]	0.024	[5.90]	0.016	[3.69]
9. Complement sample to #8	0.018	[6.85]	0.024	[7.64]	0.028	[6.53]	0.042	[9.25]	0.047	[6.97]	0.030	[4.12]
10. KZ (reset to equal weights)	0.014	[11.18]	0.020	[11.12]	0.027	[10.15]	0.035	[9.87]	0.031	[6.66]	0.017	[3.60]

**Table 5. Equity dependence and the link between investment and stock prices: Interactive specifications.** Regressions of investment on  $Q$ ,  $Q$  interacted with equity dependence, and cash flow. Year and firm fixed effects are included.

$$\frac{I_{it}}{A_{it-1}} = a_i + a_t + bQ_{it-1} + cQ_{it-1} \cdot KZ_i + d \frac{CF_{it}}{A_{it-1}} + u_{it}$$

Investment is alternately defined as capital expenditures over assets; capital expenditures plus research and development expenses over assets; capital expenditures plus research and development expenses plus selling, general, and administrative expenses over assets; and growth in assets.  $Q$  is defined as the market value of equity plus assets minus the book value of equity over assets. The measure of equity dependence is the firm median Kaplan and Zingales (1997) index of financial constraints (excluding  $Q$  from the index), standardized to have unit variance. Cash flow is defined as operating cash flow over assets.  $T$ -statistics use heteroskedasticity-robust standard errors, clustered by firm.

	N	$Q$		$Q \cdot KZ$		$CF_t/A_{t-1}$		$R^2$
		b	[t-stat]	c	[t-stat]	d	[t-stat]	
<i>CAPX/A</i>	52,101	0.021	[22.04]	0.011	[6.87]	0.129	[20.96]	0.61
+ <i>RD/A</i>	52,101	0.028	[21.63]	0.013	[6.71]	0.109	[12.89]	0.69
+ <i>RD+SGA/A</i>	52,101	0.049	[18.01]	0.021	[4.19]	0.258	[14.64]	0.84
$\Delta A/A$	52,101	0.080	[20.43]	0.058	[10.16]	1.117	[38.00]	0.41

**Table 6. Equity dependence decomposition.** Regressions of investment on  $Q$ ,  $Q$  interacted with the components of equity dependence, the components of equity dependence themselves, and cash flow. Year and firm fixed effects are included.

$$\frac{I_{it}}{A_{it-1}} = a_i + a_t + bQ_{it-1} + Q_{it-1} \cdot \left[ c_1 \frac{CF}{A_i} + c_2 \frac{DIV}{A_i} + c_3 \frac{C}{A_i} + c_4 LEV_i + c_5 \log(AGE_{i,t-1}) + c_6 \mathbf{s} \left( \frac{CF}{A} \right) \right] + \left[ d_1 \frac{CF}{A_i} + d_2 \frac{DIV}{A_i} + d_3 \frac{C}{A_i} + d_4 LEV_i + d_5 \log(AGE_{i,t-1}) + d_6 \mathbf{s} \left( \frac{CF}{A} \right) \right] + e \frac{CF_{it}}{A_{it}} + u_{it}$$

We report **c**. Investment is alternately defined as capital expenditures over assets; capital expenditures plus research and development expenses over assets; capital expenditures plus research and development expenses plus selling, general, and administrative expenses over assets; and growth in assets.  $Q$  is defined as the market value of equity plus assets minus the book value of equity over assets. Panel A decomposes the effect of the Kaplan and Zingales (1997) index (excluding  $Q$ ) into its four components: firm median operating cash flow over assets; firm median dividends over assets; firm median cash balance over assets; and firm median leverage. Panel B adds two additional measures of equity dependence, firm age and the industry standard deviation of cash flow over assets between 1980 and 1999. All components of equity dependence are standardized to have unit variance. The first row indicates the sign the variable takes in the Kaplan and Zingales (1997) index. The second row indicates the predicted sign for **c**.  $T$ -statistics use heteroskedasticity-robust standard errors, clustered by firm.

	$CF_{t-2}/A_{t-3}$		$DIV_{t-2}/A_{t-3}$		$C_{t-2}/A_{t-2}$		$LEV_{t-2}$		$\log(AGE_{t-2})$		$Industry \mathbf{s} (CF/A)$	
	<b>c<sub>1</sub></b>	<b>[t-stat]</b>	<b>c<sub>2</sub></b>	<b>[t-stat]</b>	<b>c<sub>3</sub></b>	<b>[t-stat]</b>	<b>c<sub>4</sub></b>	<b>[t-stat]</b>	<b>c<sub>5</sub></b>	<b>[t-stat]</b>	<b>c<sub>6</sub></b>	<b>[t-stat]</b>
<i>KZ Index</i>	-		-		-		+					
<i>Prediction</i>	-		-		-		+		-		+	
Panel A: KZ Index Variables												
<i>CAPX/A</i>	0.006	[3.68]	-0.006	[-4.07]	-0.006	[-5.66]	0.007	[4.79]				
<i>+RD/A</i>	-0.000	[-0.03]	-0.006	[-3.36]	-0.004	[-2.47]	0.008	[4.14]				
<i>+RD+SGA/A</i>	-0.020	[-3.69]	0.003	[0.59]	0.002	[0.68]	0.022	[5.92]				
<i>ΔA/A</i>	-0.025	[-2.92]	-0.030	[-6.17]	0.002	[0.34]	0.027	[4.93]				
Panel B: Additional Measures of Equity Dependence												
<i>CAPX/A</i>	0.006	[4.16]	-0.004	[-3.31]	-0.006	[-6.26]	0.005	[3.43]	-0.004	[-5.67]	0.007	[4.93]
<i>+RD/A</i>	0.000	[0.17]	-0.005	[-2.73]	-0.004	[-2.85]	0.006	[3.08]	-0.004	[-3.98]	0.007	[4.14]
<i>+RD+SGA/A</i>	-0.019	[-3.47]	0.006	[1.22]	0.000	[0.10]	0.022	[5.34]	-0.008	[-3.65]	0.004	[1.67]
<i>ΔA/A</i>	-0.024	[-2.84]	-0.026	[-5.35]	0.000	[0.00]	0.025	[4.23]	-0.011	[-4.02]	0.010	[2.77]

**Table 7. Equity dependence and the link between investment and future returns.** Regressions of investment on future and cash flow by equity dependence quintile. We sort firms into five quintiles according to the firm median Kaplan and Zingales (1997) index of financial constraints (excluding  $Q$  from the index), performing separate regressions for each group. Year fixed effects are included.

$$\frac{CAPX_{it}}{A_{it-1}} = a_t + bR_{it,t+3} + c\frac{CF_{it}}{A_{it-1}} + u_{it}$$

We report estimates of  $b$  and  $c$ . Investment is defined as capital expenditures over assets.  $R_{it,t+3}$  is the cumulative stock return in years  $t+1$ ,  $t+2$  and  $t+3$  from CRSP. Cash flow is defined as operating cash flow over assets.  $T$ -statistics use heteroskedasticity-robust standard errors, clustered by firm, with all five regressions in a panel estimated simultaneously.

KZ index	N	$R_{it,t+3}$		$CF_t/A_{t-1}$		$R^2$
		<b>b</b>	[t-stat]	<b>c</b>	[t-stat]	
Quintile 1	8,307	-0.004	[-4.41]	0.228	[13.53]	0.14
2	8,292	-0.004	[-4.08]	0.215	[13.03]	0.07
3	8,449	-0.006	[-6.16]	0.250	[12.11]	0.07
4	8,407	-0.008	[-8.80]	0.311	[15.22]	0.08
5	8,364	-0.007	[-8.05]	0.290	[15.56]	0.08

**Table 8. Equity dependence and the link between external finance, stock prices and returns.** Regressions of external finance on  $Q$  and cash flow, by equity dependence quintile (Panel A), and regressions of external finance on future returns and cash flow, by equity dependence quintile (Panel B). We sort firms into five quintiles according to the firm median Kaplan and Zingales (1997) index of financial constraints (excluding  $Q$ ), performing separate regressions for each group.

$$Financing_{it} = a_i + a_t + bQ_{it-1} + c \frac{CF_{it}}{A_{it-1}} + u_{it} \quad Financing_{it} = a_t + bR_{it,t+3} + c \frac{CF_{it}}{A_{it-1}} + u_{it}$$

We report estimates of  $b$ . External financing is alternately defined as equity issues over assets and as equity plus debt issues over assets.  $Q$  is defined as the market value of equity plus assets minus the book value of equity over assets.  $R_{it,t+3}$  is the cumulative stock return in years  $t+1$ ,  $t+2$  and  $t+3$  from CRSP. Cash flow is defined as operating cash flow over assets. Year fixed effects are included in both panels. Firm fixed effects are included in Panel A only.  $T$ -statistics use heteroskedasticity-robust standard errors, clustered by firm, with all five regressions in a row estimated simultaneously.

	<i>Bottom Quintile</i>		2		3		4		<i>Top Quintile</i>		<i>Top – Bottom</i>	
	<b>b</b>	<b>[t-stat]</b>	<b>b</b>	<b>[t-stat]</b>	<b>b</b>	<b>[t-stat]</b>	<b>b</b>	<b>[t-stat]</b>	<b>b</b>	<b>[t-stat]</b>	<b>Db</b>	<b>[t-stat]</b>
Panel A: Financing and $Q$												
External Equity – All Firms	0.021	[5.22]	0.051	[10.31]	0.040	[7.22]	0.056	[8.17]	0.064	[7.58]	0.043	[4.59]
External Equity Plus Debt – All	0.036	[5.57]	0.077	[9.63]	0.087	[9.60]	0.104	[9.00]	0.136	[8.45]	0.100	[5.75]
Panel B: Financing and Future Returns												
External Equity – All Firms	-0.007	[-3.92]	-0.013	[-6.12]	-0.012	[-5.82]	-0.012	[-9.53]	-0.008	[-8.45]	-0.001	[-0.71]
External Equity Plus Debt – All	-0.008	[-2.67]	-0.019	[-6.18]	-0.020	[-5.93]	-0.026	[-10.44]	-0.020	[-7.60]	-0.012	[-2.94]