Capital Market Imperfections and the Sensitivity of Investment to Stock Prices

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Abstract

Prior studies argue that investment by undervalued firms that require external equity is particularly sensitive to stock prices in irrational capital markets. We present a model in which investment can appear to be more sensitive to stock prices when capital markets are rational, but subject to imperfections such as debt overhang, information asymmetries, and financial distress costs. Our empirical tests support the rational (but imperfect) capital markets view. Specifically, investment–stock price sensitivity is related to firm leverage, financial slack, and probability of financial distress, but is not related to proxies for firm undervaluation. Because, in our model, stock prices reflect the net present values (NPVs) of investment opportunities, our results are consistent with rational capital markets improving the allocation of capital by channeling more funds to firms with positive NPV projects.

I.   Introduction

Economists and investors are now and historically have been fascinated with the question of whether the stock market is rational. However, as Morck, Shleifer, and Vishny (MSV) (1990) note, fascinating as it may be, the debate over market rationality is not consequential if stock prices do not affect real economic activity. In consideration of this question, MSV (1990) articulate four theories to explain the interaction between stock prices and corporate investment expenditures. The first of these does not allow market irrationality to influence corporate investment, while the other three do. MSV (1990) conduct a series of empirical analyses and conclude that their evidence is consistent only with the first theory: that stock prices, whether rational or irrational, do not influence corporate investment decisions. Their empirical results build upon prior work by Bosworth (1975) and are supported by subsequent work of Blanchard, Rhee, and Summers (1993) and Bond and Cummins (2000), among others.

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Baker, Stein, and Wurgler (BSW) (2003) present a formidable theoretical and empirical challenge to the view that stock prices do not influence corporate investment activity. Their challenge rests upon the presumption that noise traders and other uninformed investors cause stock prices to deviate from their fundamental values. In particular, they present a model that results in certain types of firms bypassing positive net present value (NPV) projects when their stock prices are irrationally low. Such firms do not have sufficient internal resources or borrowing capacity to undertake all positive NPV projects and thus are dependent upon equity financing to undertake additional projects. When their stock prices are irrationally low, such "equity-dependent" firms are cut off from capital markets and profitable projects are foregone. They present evidence consistent with their model. Their evidence raises the stakes in the debate over whether the stock market is rational because it suggests that irrational prices do influence the allocation of capital.

The purpose of this study is to reconsider the relation between stock prices and corporate capital expenditures. Broadly considered, we contribute to the debate over whether stock prices influence real economic activity. More narrowly considered, we directly tackle the challenge offered by BSW (2003). In particular, we present a model in which the stock market is rational but, nevertheless, gives rise to empirical predictions similar to those in the BSW (2003) model. This model directly incorporates certain market imperfections, and these imperfections, rather than irrationally low stock prices, influence the flow of capital across firms. The types of market imperfections that we consider include the costs of underinvestment resulting from debt overhang (Myers (1977)), the costs of information asymmetries between managers and outside investors (Myers and Majluf (1984)), and the costs of financial distress (Altman (1969)). We then present cross-sectional empirical tests that distinguish between the two models and find strong support for our model.

Both models predict a positive relation between investment and stock prices. Moreover, this relation is systematically stronger for certain types of firms. In the BSW (2003) model, the relation between investment and stock prices runs from stock prices to investment, and this relation is especially pronounced for undervalued and equity-dependent firms. In our model, the relation between investment and stock prices runs in the opposite direction, from investment to stock prices. In particular, stock prices reflect growth opportunities such that an improvement in the quality of growth opportunities leads to an increase in stock price. In our model, the relation between investment and stock prices is especially strong for firms that are more subject to debt overhang, information asymmetry, and financial distress costs (rather than under- or overvaluation).

In our empirical tests, we first examine whether firms that we classify as "undervalued" make investment decisions fundamentally differently from firms classified as "overvalued." Specifically, we examine undervalued and overvalued firms and find no systematic differences in the sensitivity of their investment to stock prices. This evidence is inconsistent with the BSW (2003) argument, as it predicts a significantly stronger sensitivity of investment to stock prices for undervalued firms.

Second, we analyze whether investment is sensitive to stock-price-based measures of growth opportunities (such as Q) and to non-stock-price-based measures of growth opportunities (such as growth of assets and sales). We find that investment is sensitive to both stock-price-based and non-stock-price-based measures of growth opportunities, and that the sensitivity varies systematically with firm characteristics that proxy for debt overhang, information asymmetry, and financial distress costs. This evidence is consistent with our model.

Our model is related to a number of recent papers that analyze the relation between firm investment, current stock prices, and future returns. The models of Berk, Green, and Naik (1999), Carlson, Fisher, and Giammarino (2004), and others present theories of how changes in firms' growth opportunities affect current and future stock return dynamics. In Berk et al. (1999), projects are heterogeneous in risk. The arrival of a low-risk project is attractive to a firm and has the effect of simultaneously increasing capital investment, increasing firm valuation, and lowering future expected returns. Conversely, if a firm bypasses a low-risk project, there is a simultaneous drop in current firm valuation and an increase in future expected returns. Because book-to-market and size are important state variables summarizing, respectively, the firm's risk relative to its asset base and the relative importance of assets in place, expected returns vary systematically with book-to-market and firm size. Carlson et al. (2004) develop a similar theory but argue that book-to-market is related to the firm's operating leverage, which affects the riskiness of the firm's future cash flows and, therefore, future returns.

These models are similar to ours in that they allow firm investment to affect current stock prices in an environment in which capital markets are rational. The relation between investment, valuation, and expected returns arises because changes in growth opportunities alter the firm's decisions of which projects to undertake. This, in turn, affects current firm valuation and future returns. These models are, therefore, able to explain both the positive relation between investment and stock prices and the negative relation between current investment and future returns. Moreover, because book-to-market and size are proxies for systematic risk factors, these models are capable of generating systematic cross-sectional differences in the sensitivities of investment to expected future returns. Thus, the negative relation between investment and future returns that varies systematically with firm characteristics is consistent with rational capital markets. This result is important because previous papers have found evidence of systematic differences in sensitivities of firms' investment to future returns and have interpreted this evidence as consistent with the hypothesis that stock market irrationalities impact firms' real investment decisions (BSW (2003), Polk and Sapienza (2009)). The theoretical arguments in Berk et al. (1999) and Carlson et al. (2004) give pause to this interpretation, however. Coupled with arguments developed in this paper, the evidence suggests that market irrationality does not have an impact on real corporate investment. On the contrary, firms appear to make their investment decisions consistent with well-functioning (but imperfect) capital markets.

The rest of the paper is organized as follows: In Section II, we begin by documenting cross-sectional differences in investment–stock price sensitivities across firms classified by BSW (2003) as equity- and non-equity-dependent. BSW

(2003) use the Kaplan and Zingales (KZ) (1997) index as their measure of equity dependence and document that higher KZ index firms appear more sensitive in their investment to stock prices than lower KZ index firms.[1] We confirm this result in Section II but challenge BSW's presumption that higher KZ index firms are necessarily more equity-dependent. To do so, we present several theoretical arguments as to why higher KZ index firms should actually be more dependent on debt than equity to finance marginal investment.

In Section III, we develop a model that explains why higher KZ index firms can appear (falsely) to have a systematically higher sensitivity of investment to stock prices even though they are not more equity-dependent. We show that firms with significant debt overhang, information asymmetries, and exposure to costly financial distress can appear to be especially sensitive in their investment to stock prices even if changes in stock prices *do not cause* changes in investment. In our model, stock prices *adjust* to changes in the firm's investment opportunity set, which gives rise to a positive relation between investment and stock prices. We illustrate our model with numerical examples.

In Section IV, we empirically evaluate BSW (2003) and our hypotheses. Using lagged market-to-book and lagged equity issuance as proxies for mispricing, we find that firms that are more likely to be undervalued do not appear to be more sensitive in their investment to stock prices. Indeed, both under- and overvalued firms classified on the basis of market-to-book and equity issuance make remarkably similar investment decisions. Because there is no room for irrational firm mispricing to affect firm investment decisions in our model, these results are consistent with our hypothesis.

Finally, we find that investment of higher KZ index firms responds more strongly not only to stock prices but also to other growth opportunity measures, such as their asset growth ratios, sales growth ratios, and earnings forecast ratios. These results are also consistent with our hypothesis. Section V offers our commentary and conclusions.

II.   Analysis of the KZ Index

We begin our analysis by documenting the cross-sectional relation between the KZ index and the sensitivity of investment to stock prices. We use a sample of all firms on Compustat for the period January 1970–December 2003, excluding financial services firms (firms with a one-digit SIC code of 6), utility firms (firms with a two-digit SIC code of 49), firms with a book value of assets of less than $10 million, and firms with no data on investment, cash flow, leverage, and earnings. Our final sample includes 91,957 firm-year observations, representing 10,732 unique firms.

We compute the KZ index as in BSW (2003):

$$(1) \quad KZ_{it} = -1.002 \frac{CF_{it}}{A_{it-1}} - 39.368 \frac{DIV_{it}}{A_{it-1}} - 1.316 \frac{C_{it}}{A_{it-1}} + 3.139 \frac{D_{it}}{A_{it-1}},$$

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[1] We emphasize the *apparent* sensitivity of investment to stock prices because, as shown below, investment may appear sensitive to stock prices even if it is independent of stock prices.

where KZ_{it} is the value of the KZ index, CF_{it}/A_{it-1} is the ratio of cash flows to assets, DIV_{it}/A_{it-1} is the ratio of dividends to assets, C_{it}/A_{it-1} is the ratio of cash balances to assets, and D_{it}/A_{it-1} is leverage. All variables are defined in Appendix A.

The KZ index derives from the work of Kaplan and Zingales (1997), who conduct a detailed examination of financial constraints faced by a sample of 49 low-dividend-paying firms. Using quantitative accounting data and qualitative data from corporate annual reports, the authors classify all firms in their sample from least obviously to most obviously financially constrained. Among other things, they estimate an ordered logit regression, relating their classification to a number of firm characteristics. This ordered logit regression forms the basis for the KZ index, which was first used in its current form on a much broader sample of firms in Lamont, Polk, and Saa-Requejo (2001). As in BSW (2003), we omit Q from the index; however, our conclusions are not sensitive to whether Q is included.

For every year of data, we sort firms into quintiles based on the value of their KZ indexes. Firms with the lowest value on the KZ index are placed into quintile one, firms with the highest value on the KZ index are placed into quintile five and so forth. We then estimate the following investment equation separately for each KZ index quintile of firms:

$$(2) \qquad \frac{CAPX_{it}}{A_{it-1}} = \beta_i + \beta_t + \beta_1 Q_{it-1} + \beta_2 \frac{CF_{it}}{A_{it-1}} + \varepsilon_{it},$$

where β_i and β_t are firm and year fixed effects, $CAPX_{it}/A_{it-1}$ is the ratio of capital expenditures to assets, and Q_{it-1} is our proxy for stock prices. Consistent with BSW (2003), Q is the market value of equity plus assets minus the book value of equity, all over assets. The other variables are as defined above.

The results from estimating equation (2) are reported in Table 1. Consistent with BSW (2003), there is a strong positive relation between the KZ index and the coefficient β_1, which BSW (2003) label the sensitivity of investment to stock prices. The coefficient β_1 increases monotonically across the KZ index quintiles from 0.0099 in quintile one to 0.0476 in quintile five. The difference between quintile one and quintile five coefficients is statistically significant at the 1% level. Higher KZ index firms appear to be more sensitive in their investment to stock prices than lower KZ index firms.

BSW (2003) interpret their findings as consistent with the hypothesis that equity-dependent firms are more sensitive in their investment to stock prices than non-equity-dependent firms.[2] However, this interpretation is based on the assumption that the KZ index accurately captures firms' equity dependence.

By construction, higher KZ index firms have less cash and cash flow (i.e., less financial slack), pay lower dividends, and have higher leverage. Therefore, by construction, higher KZ index firms are more likely to face significant debt overhang problems (Myers (1977)), more likely to face information asymmetry problems when raising external capital (Myers and Majluf (1984)), and more likely

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[2] BSW (2003) argue that the measurement error in Q or different adjustment costs cannot explain the relation between the KZ index and the investment–stock price sensitivity.

TABLE 1

The Sensitivity of Investment to Stock Prices across KZ Index Portfolios of Firms

Firms' investment is regressed on Q and the ratio of cash flows to assets:

$$\frac{CAPX_{it}}{A_{it-1}} = \dot{\beta}_i + \beta_t + \beta_1 Q_{it-1} + \beta_2 \frac{CF_{it}}{A_{it-1}} + \varepsilon_{it},$$

where $CAPX_{it}/A_{it-1}$ is the ratio of capital expenditures to book assets; Q_{it-1} is the market value of equity plus assets minus the book value of equity, all divided by book assets; and CF_{it}/A_{it-1} is the ratio of cash flows to book assets. The regressions are estimated separately for each KZ index portfolio of firms with firm and year fixed effects included. The t-statistics (in parentheses) are heteroskedasticity-robust and are corrected for clustering of the residual at the firm level.

Portfolio Ranking	N	Q_{t-1}	CF_t/A_{t-1}	R^2
Lowest KZ index firms	18,407	0.0099 (7.10)	0.0835 (5.34)	0.835
Quintile 2	18,435	0.0166 (8.92)	0.1559 (7.83)	0.858
Quintile 3	18,382	0.0240 (9.17)	0.1778 (8.53)	0.842
Quintile 4	18,355	0.0369 (10.71)	0.1856 (7.88)	0.823
Highest KZ index firms	18,378	0.0476 (10.72)	0.1168 (5.57)	0.755

to encounter costly financial distress. It is not necessarily the case, however, that low financial slack and high leverage firms are more equity-dependent. For example, under the pecking order theory of Myers and Majluf (1984), firms with little or no financial slack prefer debt to equity capital and finance marginal projects with debt issues because the adverse selection costs associated with debt issues are lower than those associated with equity issues. This logic suggests that higher KZ index firms, which by construction have less cash and cash flow, should be more dependent on debt than equity to finance marginal investment.

A number of empirical papers find support for the pecking order theory in studies of incremental financing decisions (Shyam-Sunder and Myers (1999), Fama and French (2002), Hadlock and James (2002), and others) as well as in studies of the determinants of capital structure (Long and Malitz (1985), Titman and Wessels (1988), Rajan and Zingales (1995), and Fama and French (2002), and others). The evidence in these papers implies that, contrary to the conclusion in BSW (2003), low financial slack (and therefore high KZ index) firms may not be more equity-dependent but may actually prefer debt to equity financing when raising external capital.

It is also not necessarily true that high leverage (and therefore high KZ index) firms are equity-dependent. Despite high leverage, these firms may prefer to finance marginal investment with additional debt. Consider the investment incentive problem created by debt overhang in Myers (1977). The incentive problem arises because shareholders are unwilling to finance a project that transfers wealth from shareholders to debtholders. If the project is financed with debt instead of equity, old debtholders' claims on the firm's assets are eroded unless old debtholders protect themselves with the "me-first" rules. This erosion in debtholders' claims reduces the debtholders' capital gain from the new project, which, in turn, increases the incentive for shareholders to undertake the project (Myers (1977)).

The empirical evidence consistent with this hypothesis comes from recent survey evidence. Graham and Harvey (2001) survey 392 chief financial officers (CFOs) about cost of capital, capital budgeting, and capital structure decisions. While CFOs of high and low leverage firms value financial flexibility equally, the CFOs of already high leverage firms find it less important to restrict additional borrowing than CFOs of low leverage firms. Consistent with this survey evidence, KZ (1997) find that firms classified as least likely to be financially constrained have lower leverage and issue less debt and more equity than firms classified as more likely to be financially constrained. This implies that there is a positive relation between firm leverage and marginal debt financing. It is possible, therefore, that high leverage (and therefore high KZ index) firms are less equity-dependent and prefer debt over equity financing when making incremental financing decisions.

It is difficult to formally test whether the KZ index is an accurate proxy for equity dependence. Such a test would require knowing a firm's investment level in the first-best scenario, which is unobservable. If an econometrician knew the first-best investment level, she could calculate "investment deficit" (i.e., the difference between the first-best level of investment and actual investment) and analyze whether this deficit is more likely to be financed by equity issues for higher KZ index firms.

We take a different approach. We ask whether the empirically documented relation between the KZ index and the investment–stock price sensitivity is necessarily consistent with the irrational capital market view, whereby equity-dependent firms exploit equity mispricing by issuing external equity to finance marginal investment. Alternatively, can the same relation exist in rational capital markets? In the next section, we present a model in which the observed empirical relation between the KZ index and investment–stock price sensitivity occurs in rational capital markets. In the model, managers act in the best interest of shareholders and undertake all projects that increase shareholder wealth. In an important outcome of the model, marginal projects turn out to be financed with debt rather than equity. This is consistent with our arguments above, that higher KZ index firms may prefer debt to equity when financing new projects. The underlying requirement is that the KZ index proxies for debt overhang, information asymmetries, and exposure to costly financial distress. Given that the observed empirical relation between the KZ index and investment–stock price sensitivity can occur when capital markets are rational or irrational, it is important to distinguish between the two explanations. We undertake that task in Section IV.

III.   A Model of Capital Market Imperfections

Much of the literature exploring the role of the stock market as a determinant of corporate investment begins with the observation that stock prices are well-known to be positively correlated with corporate capital expenditures. Both BSW (2003) and we use this observation as a starting point for the analysis. BSW (2003) suggest that at least some of the relation between investment and stock prices runs from stock prices to investment. They argue that, in irrational capital

markets, a stock price increase may lower the cost of equity capital, thus improving the quality of growth opportunities available to firms and increasing their investment.

· In contrast, we argue that the relation between investment and stock prices runs from investment to stock prices. We assume that capital markets are rational and efficient, in that stock prices reflect the quality of investment opportunities available to firms and will respond to information about changes in that opportunity set (McConnell and Muscarella (1985)). Thus, as the quality of investment opportunities improves, stock prices increase to reflect the positive NPV associated with the investment opportunities. Subsequently, firms increase their investment, giving rise to a positive correlation between investment and stock prices.

We focus on the role of capital market imperfections in affecting firms' investment decisions. In our analysis, market imperfections reduce the expected cash flows from marginal projects, thereby reducing the marginal projects' NPV and depressing the firm's investment expenditures relative to the situation in which the capital market is perfect. Therefore, projects may exist that have a positive NPV in perfect capital markets, but that are not undertaken because market imperfections make them unattractive. We focus on three market imperfections: the cost of underinvestment that arises when a firm has debt in its capital structure; the cost of information asymmetries between managers and outside investors; and the cost of financial distress. We showed in the previous section that higher KZ index firms exhibit an increased sensitivity of investment to stock prices and argued that these firms are more likely to suffer from debt overhang and information asymmetry problems. Because of high leverage, these firms are also more likely to encounter costly financial distress. It is thus plausible that these market imperfections will affect these firms' financing decisions as well as their investment decisions. Furthermore, as shown below, such imperfections will affect investment decisions in such a way that investments will appear to exhibit increased sensitivity to stock prices (even though they do not).

We suggest that the arrival of a positive NPV opportunity can reduce the costs of market imperfections for the projects in the firms' existing investment opportunity set, thereby making some of these projects more attractive. For example, the arrival of a positive NPV opportunity can reduce debt overhang and consequent underinvestment, or it may reduce the information asymmetry between managers and outside investors. In these situations, the firm will respond by undertaking the new project along with some previously rejected projects. Simultaneously, the firm's stock price will increase by the sum of NPVs from all projects undertaken, which gives the appearance that investment is sensitive to stock prices. Moreover, so long as the investment–stock price sensitivity of previously rejected projects is higher than that of the new project, the firm that accepts both projects will exhibit a higher perceived sensitivity of investment to stock prices than a firm that accepts only the new project.

In the discussion that follows, we present our arguments as to how debt overhang, information asymmetries, and costly financial distress can give rise to the appearance that investment is sensitive to stock prices. To illustrate the argument, in the next section, we present two specific numerical examples of the way in which debt overhang and information asymmetries can give rise to this

appearance. In Appendix B, we provide a numerical example of the way in which costly financial distress can give rise to this appearance.

An important element of this analysis is that we do not argue that firms are financially constrained. In particular, the traditional definition of a financially constrained firm is one for which the cost of capital or required return on investment is higher for projects funded with external capital than for projects funded with internal capital. In our examples, the required return is the risk-free rate regardless of whether the project is funded with internal or external capital. It is the cash flows of the project that determine its NPV, and all projects that increase shareholder wealth are accepted.

A.   The Cost of Debt Overhang

Myers (1977) argues that firms with risky debt outstanding will forego investment in a positive NPV opportunity if a large enough portion of the value from the project goes to the firm's creditors. Assume that a firm has one project that would have been rejected even though it has a positive NPV because of the so-called debt overhang. Now suppose a new investment opportunity arrives that increases shareholders' expected cash flow from undertaking both projects and that the increase in expected cash flow is greater if both projects are financed with debt. In that case, the firm will respond by undertaking the new as well as the previously rejected opportunity and will finance both projects with debt.

Table 2 provides a numerical example. Consider a firm with $50 of risky debt outstanding that must be repaid in one period. Debt is risky because there is one state in which the cash flow of the firm is insufficient to cover the debt payment. This situation is depicted in Panel A. In state 4, the firm's cash flow is $25, and bondholders receive only $25. Without loss of generality, assume that investors are risk neutral, and that the risk-free rate of interest is zero, which implies a zero cost of capital.

Suppose the firm has one positive NPV project (project A) in its investment opportunity set.[3] Cash flow from the project, the required investment, and bondholders' and shareholders' expected cash flows are presented in Panel B of Table 2. First, suppose that the project is financed with debt. In that case, as shown in the last column of Table 2, the expected cash flow to bondholders is $62.00 if the project is taken and $43.75 if the project is rejected. The increase in bondholders' cash flow is only $18.25, which is insufficient to cover the $21.00 investment required to undertake the project. Therefore, it is not in the bondholders' interest to finance the project.

A similar situation occurs if project A is financed with equity. From the last column of Table 2, expected shareholders' cash flow is $40.25 if the project is taken and $20.00 if the project is rejected. If the project is taken, the increase in shareholders' cash flow is $20.25, which again is insufficient to cover the $21.00 cost of the project. The result is that project A is rejected, even though it has a positive NPV. This is the underinvestment problem described in Myers (1977).

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[3]The project's NPV is $1.75 ((expected cash flow − required investment) = ($22.75 − $21.00) = $1.75).

TABLE 2

The Effects of Debt Overhang on Capital Investment: A Numerical Example

The calculations in Table 2 are as follows:

Total gain to bondholders if project is debt-financed = (expected bondholders' claim with the project) — (expected bond-holders' claim without the project).

Net gain (loss) to bondholders if project is debt-financed = (total gain to bondholders if project is debt-financed) — (investment).

Total gain to shareholders if project is debt- or equity-financed = (expected shareholders' claim with the project) — (expected shareholders' claim without the project).

Net gain to shareholders if project is equity-financed = (total gain to shareholders if project is equity-financed) — (investment).

Item	States of the World				Expected Cash Flows
	1	2	3	4	
Panel A. Initial Situation					
Firm cash flow	$60.00	$100.00	$70.00	$25.00	$63.75
Bondholders' cash flow	$50.00	$50.00	$50.00	$25.00	$43.75
Shareholders' cash flow	$10.00	$50.00	$20.00	$0.00	$20.00
Panel B. Firm Considers Investment in Project A Only					
Project A cash flow	$27.00	$27.00	$27.00	$10.00	$22.75
Total cash flow	$87.00	$127.00	$97.00	$35.00	$86.50
Project is Debt-Financed					
Bondholders' cash flow	$71.00	$71.00	$71.00	$35.00	$62.00
Shareholders' cash flow	$16.00	$56.00	$26.00	$0.00	$24.50
Project is Equity-Financed					
Bondholders' cash flow	$50.00	$50.00	$50.00	$35.00	$46.25
Shareholders' cash flow	$37.00	$77.00	$47.00	$0.00	$40.25
Investment					$21.00
Total gain to bondholders if project is debt-financed					$18.25
Net gain (loss) to bondholders if project is debt-financed					($2.75)
Total gain to shareholders if project is debt-financed					$4.50
Total gain to shareholders if project is equity-financed					$20.25
Net gain (loss) to shareholders if project is equity-financed					($0.75)
Panel C. Firm Considers Investment in Project B Only					
Project B cash flow	−$20.00	$2.00	$10.00	$22.00	$3.50
Total cash flow	$40.00	$102.00	$80.00	$47.00	$67.25
Project is Debt-Financed					
Bondholders' cash flow	$40.00	$52.00	$52.00	$47.00	$47.75
Shareholders' cash flow	$0.00	$50.00	$28.00	$0.00	$19.50
Project is Equity-Financed					
Bondholders' cash flow	$40.00	$50.00	$50.00	$47.00	$46.75
Shareholders' cash flow	$0.00	$52.00	$30.00	$0.00	$20.50
Investment					$2.00
Total gain to bondholders if project is debt-financed					$4.00
Net gain (loss) to bondholders if project is debt-financed					$2.00
Total gain (loss) to shareholders if project is debt-financed					($0.50)
Total gain to shareholders if project is equity-financed					$0.50
Net gain (loss) to shareholders if project is equity-financed					($1.50)
Panel D. Firm Considers Investment in Projects A and B					
Projects' A & B cash flow	$7.00	$29.00	$37.00	$32.00	$26.25
Total cash flow	$67.00	$129.00	$107.00	$57.00	$90.00
Project is Debt-Financed					
Bondholders' claim	$67.00	$73.00	$73.00	$57.00	$67.50
Shareholders' claim	$0.00	$56.00	$34.00	$0.00	$22.50
Project is Equity-Financed					
Bondholders' claim	$50.00	$50.00	$50.00	$50.00	$50.00
Shareholders' claim	$17.00	$79.00	$57.00	$7.00	$40.00
Investment					$23.00
Total gain to bondholders if project is debt-financed					$23.75
Net gain (loss) to bondholders if project is debt-financed					$0.75
Total gain to shareholders if project is debt-financed					$2.50
Total gain to shareholders if project is equity-financed					$20.00
Net gain (loss) to shareholders if project is equity-financed					($3.00)

Now suppose a new project (project B) arrives, which also has a positive NPV.[4] The relevant information for project B is presented in Panel C of Table 2. Repeating the analysis of Panel B, bondholders lose $0.50 from undertaking the project if it is debt-financed.[5] Similarly, shareholders lose $1.50 from undertaking the project if it is equity-financed. Thus, by itself, project B is also not undertaken despite its positive NPV.

However, when the two projects are considered together, it is advantageous for both bondholders and shareholders to undertake the projects and finance them with debt.[6] This situation is depicted in Panel D of Table 2. The bondholders' expected gain is $0.75 if both projects are undertaken and financed with debt, while the shareholders' expected gain is $2.50. The expected gain in shareholder value is greater if the projects are financed with debt rather than equity. In the case of equity financing, shareholders lose $3.00 by accepting both projects. Thus, the arrival of project B increases the attractiveness of project A, and the firm responds by undertaking both projects. The firm's total investment increases from $0.00 to $23.00 with the arrival of project B. Assuming that capital markets are efficient, the firm's stock price simultaneously increases by $3.25, the sum of the NPVs of projects A and B. Moreover, because shareholders gain more if projects are debt-financed, the firm finances its marginal investment with debt.

In this example, if we were to merely observe investments and stock prices, it would appear that investment is sensitive to stock prices. The perceived sensitivity of investment to stock prices is 7.08 ($23.00/$3.25) (i.e., it appears that for every dollar increase in the stock price, investment increases by $7.08).[7] However, in this example, investment is independent of stock prices. Investment and stock prices move together not because stock prices influence investment, but because stock prices reflect the quality and mix of the firm's investment opportunities.

If the firm did not suffer from debt overhang (which gives rise to underinvestment), the firm would have undertaken project A even without project B in its opportunity set.[8] Hence, the arrival of project B would have increased the firm's investment by only $2.00 (from $21.00 to $23.00) and would have simultaneously increased the stock price by $1.50, project B's NPV. The resulting perceived sensitivity of investment to stock prices would have been only 1.33 ($2.00/$1.50). This numerical example illustrates that investment by firms subject to debt overhang (which causes underinvestment) will appear more sensitive to changes in

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[4] The project's NPV is $1.50 ((expected cash flow − required investment) = ($3.50 − $2.00) = $1.50).

[5] Note that it is in the interest of shareholders to undertake project B and finance it with debt. In this situation, their net expected gain is $2.00. However, bondholders will never commit the capital to this project.

[6] The NPV of both projects is $3.25, which is simply the sum of the two projects' NPV.

[7] If the announcement of the project increases stock price and the capital expenditure occurs later, it would appear that a change in stock price leads to a change in investment.

[8] For example, if the firm had risk-free debt with a face value of only $25, it is easy to show that it would have been optimal for shareholders to invest in project A even without project B in the investment opportunity set. With the face value of debt of $25, the present value of shareholders' gain from undertaking project A is $24.55, which represents a $4.55 premium over the required investment. Therefore, project A may be undertaken by itself.

stock prices (investment sensitivity = 7.08) than will the investment of firms with no debt overhang (investment sensitivity = 1.33).

The key insight from this example is that for firms with significant debt over-hang, there exists a wealth transfer (either from bondholders to shareholders when the new project is financed with debt or from shareholders to bondholders when the new project is financed with equity) when each project is treated individually so that, by itself, each project hurts the party that finances the project. In other words, if bondholders finance the project, the shareholders capture the full NPV of the project plus some of the bondholder value. The reverse situation occurs when shareholders finance the project. The end result is that the firm bypasses investment in both positive NPV projects.[9]

When the projects are considered in combination, bondholders and share-holders share the NPV of both projects when they are debt-financed. The result is that it is in the interest of both parties to undertake both projects and finance them with debt. The firm responds by undertaking both projects and increasing its total investment from $0.00 to $23.00. Simultaneously, the stock prices increases by $3.25, the combined NPV of the two projects.

In this example, capital markets are rational, so that stock prices accurately capture changes in the investment opportunity set. The positive correlation be-tween investment and stock prices arises *not* because changes in stock prices *cause* changes in investment but because stock prices *reflect* the quality and mix of the firm's investment opportunities.

B.   The Cost of Information Asymmetries

The second market imperfection that we consider is costly information asym-metries between managers and outside investors. Myers and Majluf (1984) argue that firms will forego investments in positive NPV opportunities if undertaking these opportunities benefits their new financiers at the expense of existing share-holders. Their logic goes as follows: i) outside investors do not know the true value of assets in place nor the NPV of the new project at the time when external financing is required to undertake the new project, and firm value is based on the expected values of assets in place and the new project NPV; ii) managers know the true values of assets in place and the new project's NPV and act in the interest of existing shareholders; and iii) if undertaking the project results in an increase in the wealth of investors financing the project that is greater than the project's NPV, value will be transferred from existing shareholders to new investors, and the project will not be undertaken. Therefore, some projects that have a positive NPV will be foregone because they benefit outside investors at the expense of existing shareholders.

If, however, another project arrives that increases the NPV of all projects un-dertaken by more than the value transfer from existing shareholders to the project financiers, the firm will respond by undertaking the new project and other positive

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[9]Note that this problem only exists if the firm cannot issue risk-free debt. If the firm could issue risk-free debt, no wealth transfer from shareholders to bondholders would occur, and the firm would undertake all positive NPV projects.

NPV projects that otherwise would have been foregone. Moreover, because the value transfer from existing shareholders is always less with debt financing than with equity financing (Myers and Majluf (1984)), firms will finance their marginal investment with debt.

Table 3 provides a numerical example. Suppose there is a firm with assets in place and a positive NPV opportunity (project A), as depicted in Panel A. There are four equally likely states at time two, and the expected values of assets in place and the investment opportunity at time zero are $118.75 and $15.00, respectively. Further, suppose that the firm has risky debt outstanding with a face value of $50.00. The firm's debt is risky because in state 3, the firm is unable to repay the full amount of debt. The debt's expected value is $43.75.

TABLE 3

The Effects of Information Asymmetries on Capital Investment: A Numerical Example

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Given that default never takes place in the example, the calculations in Table 3 are as follows:

Firm value at time 1 conditional on state = (Assets in place) + (Project NPV) + (Investment)

Old shares' market value at time 0 before state is known = (Expected value of assets in place) + (Expected value of project NPV)

With Debt Financing

Market value of debt at time 0 before state is known (D) = (Expected value of existing debt) + (Investment)

Intrinsic value of shares at time 1 = (Assets in place) + (Project NPV) − (Face value of debt)

Intrinsic value of debt at time 1 (D_1) = (Face value of existing debt) + (Investment)

Change in market value of debt = $D_1 - D$

The project is undertaken if (Change in market value of debt) < (Project NPV) (Myers and Majluf (1984))

With Equity Financing

Market value of new equity at time 0 before state is known (E) = Investment

Intrinsic value of old shares at time 1 = (Market value of old shares at time 0)/((Market value of old shares at time 0) + (Market value of new shares at time 0)) × (Firm value at time 1 conditional on state)

Intrinsic value of new shares at time 1 (E_1) = (Market value of new shares at time 0)/((Market value of old shares at time 0) + (Market value of new shares at time 0)) × (Firm value at time 1 conditional on state)

Change in market value of new shares = $E_1 - E$

The project is undertaken if (Change in market value of new equity) < (Project NPV) (Myers and Majluf (1984)).

Item	Time 1 States of the World				Expected CF
	1	2	3	4	
Initial Situation					
Assets in place (a)	$150.00	$100.00	$25.00	$200.00	$118.75
Face value of existing debt	$50.00	$50.00	$50.00	$50.00	
Expected value of existing debt conditional on state	$50.00	$50.00	$25.00	$50.00	$43.75
Panel A. Firm Considers Investment in Project A Only					
Project A NPV (b)	$10.00	$5.00	$30.00	$15.00	$15.00
Investment (*I*)	$30.00	$30.00	$30.00	$30.00	
Firm value at time 1 conditional on state	$190.00	$135.00	$85.00	$245.00	
Old shares' market value at time 0 before state is known	$90.00	$90.00	$90.00	$90.00	
Project is Debt-Financed					
Market value of debt at time 0 before state is known (*D*)	$73.75	$73.75	$73.75	$73.75	
Intrinsic value of shares at time 1	$110.00	$55.00	$5.00	$165.00	$83.75
Intrinsic value of debt at time 1 (D_1)	$80.00	$80.00	$80.00	$80.00	
Change in market value of debt	$6.25	$6.25	$6.25	$6.25	
Project undertaken	yes	no	yes	yes	
Value loss from failure to undertake project	−$1.25				
Project is Equity-Financed					
Market value of new equity at time 0 before state is known (*E*)	$30.00	$30.00	$30.00	$30.00	
Intrinsic value of old shares at time 1	$110.77	$67.25	$27.69	$154.29	$90.00
Intrinsic value of new shares at time 1 (E_1)	$36.92	$22.42	$9.23	$51.43	$30.00
Change in market value of new shares	$6.92	−$7.58	−$20.77	$21.43	
Project undertaken	yes	yes	yes	no	
Value loss from failure to undertake project	−$3.75				

TABLE 3 (continued)

The Effects of Information Asymmetries on Capital Investment: A Numerical Example

Item	Time 2 States of the World				Expected CF
	1	2	3	4	
Panel B. Firm Considers Investment in Project B Only					
Project B NPV (b)	$5.00	$5.00	$30.00	$0.00	$10.00
Investment (*I*)	$10.00	$10.00	$10.00	$10.00	
Firm value at time 1 conditional on state	$165.00	$115.00	$65.00	$210.00	
Old shares' market value at time 0 before state is known	$85.00	$85.00	$85.00	$85.00	
Project is Debt-Financed					
Market value of debt at time 0 before state is known (*D*)	$53.75	$53.75	$53.75	$53.75	
Intrinsic value of shares at time 1	$105.00	$55.00	$5.00	$155.00	$78.75
Intrinsic value of debt at time 1 (D_1)	$60.00	$60.00	$60.00	$60.00	$60.00
Change in market value of debt	$6.25	$6.25	$6.25	$6.25	
Project undertaken	no	no	yes	no	
Value loss from failure to undertake project	−$2.50				
Project is Equity-Financed					
Market value of new equity at time 0 before state is known (*E*)	$10.00	$10.00	$10.00	$10.00	
Intrinsic value of old shares at time 1	$110.14	$62.25	$14.37	$153.24	$85.00
Intrinsic value of new shares at time 1 (E_1)	$12.96	$7.32	$1.69	$18.03	$10.00
Change in market value of new shares	$2.96	−$2.68	−$8.31	$8.03	
Project undertaken	yes	yes	yes	no	
Value loss from failure to undertake project	−$1.25				
Panel C. Firm Considers Investment in Projects A and B					
Projects A and B NPV (b)	$15.00	$10.00	$60.00	$15.00	$25.00
Investment (*I*)	$40.00	$40.00	$40.00	$40.00	
Firm value at time 1 conditional on state	$205.00	$150.00	$125.00	$255.00	
Old shares' market value at time 0 before state is known	$100.00	$100.00	$100.00	$100.00	
Projects are Debt-Financed					
Market value of debt at time 0 before state is known (*D*)	$83.75	$83.75	$83.75	$83.75	
Intrinsic value of shares at time 1	$115.00	$60.00	$35.00	$165.00	$93.75
Intrinsic value of debt at time 1 (D_1)	$90.00	$90.00	$90.00	$90.00	$90.00
Change in market value of debt	$6.25	$6.25	$6.25	$6.25	
Projects undertaken	yes	yes	yes	yes	
Value loss from failure to undertake projects	$0.00				
Projects are Equity-Financed					
Market value of new equity at time 0 before state is known (*E*)	$40.00	$40.00	$40.00	$40.00	
Intrinsic value of old shares at time 1	$115.89	$74.77	$56.07	$153.27	$100.00
Intrinsic value of new shares at time 1 (E_1)	$46.36	$29.91	$22.43	$61.31	$40.00
Change in market value of new shares	$6.36	−$10.09	−$17.57	$21.31	
Projects undertaken	yes	yes	yes	no	
Value loss from failure to undertake projects	−$3.75				

The remaining rows of Panel A of Table 3 parallel the analysis of Myers and Majluf (1984). First, note that with project A in the firm's investment opportunity set, the existing debt becomes risk-free because the project's NPV in state 3 is sufficient to cover the portion of the debt obligation not covered by the assets in place. Hence, if project A is financed with debt, bondholders gain $6.25, which is exactly equal to the original bondholders' discount because the existing debt is now risk-free. Moreover, in state 2, the NPV of project A is less than the bondholders' gain, and it is not in the interest of current shareholders to undertake the project. The expected loss of value from failing to undertake the project is $1.25, which represents the expected NPV lost in state 2.

Similarly, if project A is equity-financed, in state 4, new shareholders gain more than the project's NPV. In state 4, the project's NPV is $15.00, while new shareholders gain $21.43, which represents a wealth transfer of $6.43 from existing to new shareholders. Thus, it is not in the interest of existing shareholders to undertake the new project and finance it with equity. Project A is not undertaken in state 4, and the firm's total investment is $0.00.

Now suppose a new project (project B) arrives that has a positive expected NPV of $10.00. The project's cash flows and the value gains (and losses) to bond-holders and shareholders from undertaking the projects are presented in Panel B of Table 3. Again, there is always at least one state in which undertaking project B by itself is not in the interest of current shareholders, irrespective of whether the project is financed with debt or equity. In that state, project B is not undertaken, and the firm's total investment is $0.00.[10]

Now suppose the projects are considered together. In that case, it is advanta-geous to current shareholders to undertake both projects in all states and finance them with debt. That situation is depicted in Panel C of Table 3. The NPV from both projects is always greater than the increase in bondholders' value, so that in all states, a positive portion of the projects' NPVs accumulates to existing shareholders. As a result, it is in the interest of current shareholders to under-take projects A and B in all states, and there is no ex ante loss of value from failing to undertake positive NPV projects. A firm acting in the shareholders' interest will undertake both projects and increase its investment from $0.00 to $40.00 when it is not advantageous to undertake either project separately. At the same time, the firm's stock price will increase by $25.00, the combined expected NPV of the two projects. Again, investment and stock prices move together be-cause stock prices reflect the quality and mix of the firm's investment opportuni-ties. This comovement gives the appearance that investment is sensitive to stock prices. The apparent sensitivity of investment to stock prices in this scenario is 1.60 ($40.00/$25.00).

Of course, if the firm had enough financial slack to finance projects A and B, the underinvestment problem would have been avoided. Project A would al-ways be attractive, and there would be no state in which the firm would forego investment in project A even without project B in the opportunity set. To put it differently, if the firm has slack in all states, the firm's investment increases from $30.00 to $40.00 with the arrival of project B, because project A is always under-taken. The arrival of project B also causes the stock price to increase by its NPV of $10.00, which produces the perceived sensitivity of investment to stock prices of only 1.00 ($10.00/$10.00) in comparison with the observed sensitivity of 1.60.

Investment of firms that are subject to costly information asymmetries be-tween managers and outside investors (in other words, firms with insufficient slack to finance all projects internally) appears more sensitive ex ante to changes in stock prices (investment sensitivity = 1.53) than investment of firms for which the costs of information asymmetries are insignificant (investment sensitivity = 0.89). This perceived sensitivity does not stem from stock prices' influencing capital investment. Rather, it results from stock prices' reflecting changes in the investment opportunity set faced by the firm.

C. The Cost of Financial Distress

The third market imperfection that we consider is costly financial distress. A levered firm with highly correlated cash flows across projects may encounter

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[10]For purposes of our discussion, it is important that project B is not undertaken in state 4.

costly financial distress if, in some states of the world, cash flow is insufficient to service its debt payments. The expected cost of financial distress can be reduced if a new investment opportunity arrives that has cash flows that are less than perfectly correlated with cash flows from the existing projects. In turn, the reduction in the possibility of costly financial distress can allow the firm to undertake positive NPV projects that otherwise would not have been undertaken because their cash flows were positively correlated with cash flows from the projects already undertaken.

Appendix B provides a numerical example. In it we show that investment of firms with greater exposure to costly financial distress can appear more sensitive to stock prices than investment of other firms. In this example, the sensitivity is 0.52 for firms with significant expected costs of financial distress and 0.50 for firms for which these costs are insignificant. However, similar to our previous examples, this perceived sensitivity does not arise because stock prices influence investment. Stock prices in this example reflect changes in the investment opportunity set faced by firms.

D. Summation

To summarize, our arguments and numerical examples show that a positive relation between investment and stock prices is expected in rational capital markets because stock prices reflect the quality of investment opportunities available to firms. Moreover, the examples demonstrate that investment can appear to be increasingly sensitive to stock prices in the presence of market imperfections such as the cost of debt overhang, the cost of information asymmetry, and the cost of financial distress for firms for which the effects of these imperfections are most severe. The analysis also documents that the financing of marginal projects is more likely to come from debt rather than equity issues.

Our model follows an extensive body of literature that studies the relation between market imperfections and capital investment.[11] These studies argue that market imperfections increase the shadow cost of capital and make external financing costly for firms with insufficient internal funds to finance all positive NPV projects (financially constrained firms). Costly external financing, in turn, distorts investment of financially constrained firms relative to the case when financing is frictionless. Our model differs from these studies in two important ways. First, we assume that all firms are financially unconstrained, in that the cost of external capital for these firms equals the cost of internal capital. Second, we relax the common assumption in the literature that market imperfections are constant with respect to changes in the investment opportunity set. We do assume that market imperfections make external financing unattractive and distort investment. However, we go one step further and demonstrate how changes in the investment opportunity set can reduce the effects of market imperfections and stimulate capital investment. It is this "accelerator" mechanism in our model that gives rise

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[11] Fazzari, Hubbard, and Petersen (1988), Whited (1992), Calomiris and Hubbard (1995), Gilchrist and Himmelberg (1995), and Hennessy (2004) are some representative papers. See Hubbard (1998) for an extensive review.

to the perceived increased sensitivity of investment to stock prices for firms with more severe effects of capital market imperfections.

IV.   Empirical Analysis

In this section, we empirically evaluate the two explanations for the apparent sensitivity of investment to stock prices shown in Table 1. The unique prediction of the BSW (2003) hypothesis is that undervalued and equity-dependent firms are especially sensitive in their investment decisions to stock prices (BSW (2003), pp. 975–976). In contrast, our hypothesis predicts that firms with significant debt overhang, information asymmetries, and exposure to costly financial distress are especially sensitive in their investment decisions to changes in the investment opportunity set. Stock prices merely reflect changes in the investment opportunity set.

A.   Structure of the Tests

To distinguish between the two explanations, we conduct two sets of tests. In the first, we use different firm characteristics to identify undervalued and overvalued firms and examine whether i) investment of undervalued firms is more sensitive to stock prices than investment of overvalued firms, and whether ii) the cross-sectional differences in the investment–stock price sensitivity across low and high KZ index firms is more significant for undervalued than overvalued firms. In the second set of tests, we examine whether investment responds to measures of growth opportunities other than stock prices and whether this response is stronger for firms classified as more likely to face debt overhang and information asymmetry problems or financial distress. A potential criticism of the first set of tests is that the same firm characteristics that are likely to proxy for undervaluation may also proxy for information asymmetries, debt overhang, and exposure to costly financial distress. The second set of tests circumvents this issue by examining whether investment responds to the fundamental component or the irrational component in stock prices. Because the measures of growth opportunities that we use are not based on stock prices, any relation between investment and these measures is unlikely to be attributable to any irrational component in stock prices.

B.   Firm Undervaluation and Capital Expenditures

We use two different firm characteristics to proxy for equity misvaluation. Each proxy is motivated by prior studies. Our first proxy is the lagged firm market-to-book ratio, as defined in Appendix A. Everything else being equal, higher market-to-book firms are more likely to be overvalued. Consistent with this notion and the belief that mispricing corrects in the long run, market-to-book is inversely related to future returns in the cross-section in Fama and French (1992) and in the time series in Kothari and Shanken (1997). Extreme values of market-to-book have also been connected to extreme investor expectations in Lakonishok, Shleifer, and Vishny (1994), La Porta (1996), and La Porta, Lakonishok, Shleifer, and Vishny (1997). Motivated by these studies, BSW (2003) and Jenter (2005),

among others, use market-to-book as a mispricing proxy. They report evidence that firm mispricing affects managerial decisions.

Our second proxy for equity misvaluation is the lagged five-year net equity issuance, computed as in Daniel and Titman (2006):

$$(3) \qquad \text{EQUITY\_ISSUE}_{it} \;=\; \log\left(\frac{\text{MVE}_{it-1}}{\text{MVE}_{it-5}}\right) - r_{it-1},$$

where $\text{MVE}_{it-1}(\text{MVE}_{it-5})$ is the price per share times the number of shares outstanding as of the end of the calendar year $t-1$ $(t-5)$, and r_{it-1} is the log stock return from $t-5$ to $t-1$.

Several papers report that firms issue equity when market valuations appear high and repurchase equity when market valuations appear low. Loughran and Ritter (1995) find low abnormal long-run stock returns following initial public offerings (IPOs) and secondary equity offerings (SEOs). Ikenberry, Lakonishok, and Vermaelen (1995) document high abnormal long-run returns following equity repurchases.[12] Baker and Wurgler (2002) explicitly formulate a market timing theory of capital structure, whereby firms attempt to time equity markets by issuing equity when it is overvalued and repurchasing equity when it is undervalued.

For every year of data, we sequentially sort firms by lagged market-to-book and by lagged equity issuance. Firms with below (above) median value of market-to-book or equity issues are defined as undervalued (overvalued). Within each category, we further sort firms into quintiles based on the value of their KZ indexes. Firms with the lowest value of the KZ index are placed into quintile one, firms with the highest value of the KZ index are placed into quintile five, and so forth. Finally, we estimate equation (2) separately for each of these 10 categories of firms (2 misvaluation regions × 5 KZ index quintiles).

Under the BSW (2003) hypothesis, the sensitivity of investment to stock prices is predicted to be higher for low market-to-book and low equity issuance firms (i.e., undervalued firms) than for high market-to-book and high equity issuance firms (i.e., overvalued firms). Moreover, as we move from low KZ index firms to high KZ index firms, the sensitivity of investment to stock prices is predicted to increase more dramatically for undervalued than for overvalued firms. This is because overvalued firms invest at the first-best level irrespective of their equity dependence status, either because some (non-equity-dependent) firms have sufficient capital to invest at the optimum, or because other (equity-dependent) firms can issue "cheap" equity to invest at the optimum. Therefore, investment decisions of overvalued firms are independent of stock prices.

Under our hypothesis, stock prices reflect fundamentals. Because there is no room for mispricing, our model predicts no systematic differences in the sensitivity of investment to stock prices across low market-to-book and high market-to-book firms and across low equity issuance and high equity issuance firms. Moreover, since high market-to-book firms are characterized by higher growth

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[12]Other papers documenting that firms issue equity during periods of high valuations are Marsh (1982), Asquith and Mullins (1986), Korajczyk, Lucas, and McDonald (1991), Jung, Kim, and Stulz (1996), Loughran, Ritter, and Rydqvist (1994), Pagano, Panetta, and Zingales (1998), and Hovakimian, Opler, and Titman (2001).

in our model, these firms are expected to especially benefit from the arrival of
new growth opportunities. Thus, the sensitivity of investment to stock prices is
predicted to increase more dramatically for high market-to-book firms than for
low market-to-book firms.

The results are presented in Table 4. Panel A presents the results for under-
valued and overvalued firms based on lagged market-to-book. Panel B presents
the results for undervalued and overvalued firms based on lagged equity issuance.

TABLE 4

The Sensitivity of Investment to Stock Prices across KZ Index Portfolios of Firms for Undervalued and Overvalued Firms

Firms' investment is regressed on Q and the ratio of cash flows to assets:

$$\frac{CAPX_{it}}{A_{it-1}} = \beta_i + \beta_t + \beta_1 Q_{it-1} + \beta_2 \frac{CF_{it}}{A_{it-1}} + \epsilon_{it},$$

where $CAPX_{it}/A_{it-1}$ is the ratio of capital expenditures to book assets; Q_{it-1} is the market value of equity plus assets minus the book value of equity, all divided by book assets; and CF_{it}/A_{it-1} is the ratio of cash flows to book assets. Firms are first separated into low and high market-to-book (MTB) firms (Panel A) and into low and high equity issuance firms (Panel B). Within each subgroup, firms are further sorted into quintiles based on their KZ index values. Regressions are estimated separately for each subgroup of firms, with firm and year fixed effects included. The t-statistics are heteroskedasticity-robust and are corrected for clustering of the residual at the firm level.

Panel A. Firms Sorted by Lagged Market-to-Book

| | | Low MTB Firms | | | | | | High MTB Firms | | | | |
| | | Q_{t-1} | | CF_t/A_{t-1} | | | | Q_{t-1} | | CF_t/A_{t-1} | | |
Portfolio Ranking	N	β_1	t-Stat	β_2	t-Stat	R^2	N	β_1	t-Stat	β_2	t-Stat	R^2
Low KZ index firms	9,201	0.0254	2.33	0.1024	4.06	0.834	9,188	0.0090	4.61	0.0796	3.57	0.837
Quintile 2	9,226	0.0278	3.02	0.1834	6.01	0.845	9,218	0.0114	5.01	0.1562	5.48	0.884
Quintile 3	9,200	0.0444	3.32	0.1627	5.21	0.842	9,190	0.0251	4.79	0.1615	4.67	0.877
Quintile 4	9,190	0.0396	2.37	0.1691	4.67	0.796	9,173	0.0264	6.22	0.2001	5.56	0.865
High KZ index firms	9,204	0.0438	1.87	0.1468	4.53	0.758	9,167	0.0393	6.89	0.0773	2.51	0.797

Panel B. Firms Sorted by Lagged Equity Issues

| | | Low Equity Issuance Firms | | | | | | High Equity Issuance Firms | | | | |
| | | Q_{t-1} | | CF_t/A_{t-1} | | | | Q_{t-1} | | CF_t/A_{t-1} | | |
Portfolio Ranking	N	β_1	t-Stat	β_2	t-Stat	R^2	N	β_1	t-Stat	β_2	t-Stat	R^2
Low KZ index firms	5,662	0.0053	2.10	0.1581	4.45	0.867	5,644	0.0106	3.41	0.0930	3.11	0.866
Quintile 2	5,676	0.0116	3.22	0.1972	4.93	0.896	5,669	0.0180	3.61	0.1698	4.10	0.878
Quintile 3	5,649	0.0269	4.87	0.2253	4.98	0.880	5,641	0.0311	4.85	0.1514	3.82	0.868
Quintile 4	5,648	0.0227	2.98	0.2082	4.05	0.867	5,644	0.0401	4.41	0.1585	3.53	0.836
High KZ index firms	5,627	0.0447	4.30	0.1424	3.55	0.804	5,638	0.0435	3.40	0.1158	3.13	0.772

The evidence in both panels indicates that undervalued firms do not behave
significantly differently from overvalued firms. In Panel A of Table 4, the coef-
ficient β_1 is higher for low market-to-book firms than for high market-to-book
firms, which suggests that undervalued firms, on average, are more sensitive in
their investment to stock prices. However, none of the differences in β_1 coeffi-
cients across low and high market-to-book subsamples are statistically significant
(t-statistics for the difference in β_1 coefficients across low and high market-to-
book subsamples range from 0.19 for the highest KZ index firms to 1.73 for firms
in the KZ index quintile 2).

Similarly, the evidence in Panel B of Table 4 indicates that low equity is-
suance firms behave little differently from high equity issuance firms. The evi-
dence indicates that low equity issuance firms are generally *less* sensitive in their

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investment to stock prices. Except for firms in the highest KZ index quintile, low equity issuance firms have lower investment–stock price sensitivity than high equity issuance firms, although the differences in coefficients are again not statistically significant (t-statistics for the difference in parameter estimates range from -1.47 for firms in the KZ index quintile 4 to 0.07 for firms in the KZ index quintile 5).

Overall, the results indicate that undervalued firms are little different from overvalued firms in their investment decisions: Both types of firms exhibit a similar sensitivity of investment to stock prices. These results are inconsistent with the BSW (2003) hypothesis. Because there is no room for irrational firm misvaluation to affect firm investment decisions in our model, these results are consistent with our hypothesis.

It is possible that our failure to find meaningful differences in investment–stock price sensitivity across undervalued and overvalued firms stems from imperfect partitioning of firms. To the extent that there are differences in firm investment behavior across undervalued and overvalued firms, those differences should be especially evident in comparing firms in the extremes. In unreported robustness checks, we replicate the analyses of Table 4 by partitioning firms into quartiles based on lagged market-to-book and lagged equity issuance and defining undervalued (overvalued) firms as those firms in the lowest (highest) market-to-book and equity issuance quartiles. The results are very similar to the results in Table 4. Firms in the lowest market-to-book quartile are marginally more sensitive in their investment to stock prices than firms in the highest market-to-book quartile. Similarly, firms in the lowest equity issuance quartiles are less sensitive in their investment to stock prices than firms in the highest accrual and equity issuance quartiles. However, none of the differences in investment–stock price sensitivity are statistically significant.[13]

Turning to the relation between the KZ index and the investment–stock price sensitivity, the results in Table 4 indicate that higher KZ index firms are consistently more sensitive in their investment to stock prices than lower KZ index firms. The β_1 coefficient increases monotonically from low KZ index firms to high KZ index firms. This result holds for low and high market-to-book firms in Panel A and for low equity issuance and high equity issuance firms in Panel B. The differences in β_1 coefficients between low KZ index firms and high KZ index firms are statistically significant at the 5% level or higher.

The evidence in Panel A of Table 4 also indicates that the increase in the β_1 coefficient from low KZ index firms to high KZ index firms is much stronger for high market-to-book firms than for low market-to-book firms. The increase in the β_1 coefficient is 337% ($[0.0393 - 0.0090]/0.0090 = 3.3667$) for high market-to-book firms and 72% ($[0.0438 - 0.0254]/0.0254 = 0.7244$) for low market-to-book firms. This evidence is consistent with our hypothesis, as high growth and therefore high market-to-book firms benefit especially from the arrival of new growth opportunities.

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[13]Our results are also insensitive to the way we sort firms into various subsamples. We replicate our analyses with independent sorts based on mispricing proxies and the KZ index and find similar results.

Overall, we find that the relation between the KZ index and the sensitivity of firms' investment to stock prices is generally similar across low and high market-to-book firms and across low and high equity issuance firms. These results are inconsistent with the BSW (2003) hypothesis but are consistent with our hypothesis, as firms with more significant debt overhang, information asymmetry, and expected financial distress costs (i.e., higher KZ index firms) will especially benefit from the arrival of new investment opportunities. As firms undertake these new investment opportunities, stock prices adjust, giving rise to the appearance that investment is sensitive to stock prices.

One potential criticism of the above methodology is that in rejecting the BSW (2003) hypothesis, it provides only circumstantial evidence in support of our hypothesis. For example, we show above that firms classified as undervalued do not make investment decisions fundamentally differently than firms classified as overvalued. While inconsistent with the BSW (2003) hypothesis, this evidence does not directly imply that capital market imperfections affect firm investment decisions. To directly test our hypothesis, we must establish a link between changes in the investment opportunity set and the resulting change in firm investment. Moreover, we need to demonstrate that a given change in the investment opportunity set has a more significant impact on the change in firm investment for firms suffering from capital market imperfections. This is the test we turn to next.

C.   Non-Stock-Price-Based Measures of Growth Opportunities and Capital Expenditures

To directly analyze whether investment responds to irrational variations in stock prices or rational changes in the investment opportunity set, we adopt the following procedure. We augment the investment equation (2) to include other measures of growth opportunities in addition to Q, while controlling for the availability of internal funds with cash flows:

$$(4) \qquad \frac{CAPX_{it}}{A_{it-1}} \;=\; \beta_i + \beta_t + \beta_1 Q_{it-1} + \beta_2 GROWTH_{it} + \beta_3 \frac{CF_{it}}{A_{it-1}} + \varepsilon_{it},$$

where $GROWTH_{it}$ is a measure of growth opportunities and the rest of the variables are as defined above. We sequentially use the ratio of asset growth to assets (Fama and French (2002)), the ratio of sales growth to sales (MSV (1990)), and the ratio of analyst median earnings forecast to assets (Polk and Sapienza (2009)) as measures of growth opportunities.[14] Because these measures are not directly connected to stock prices, any sensitivity of investment to asset growth, sales growth, and earnings forecasts cannot be due to irrational variations in stock prices. We estimate equation (4) separately for each KZ index quintile of firms and report the results in Table 5. Panel A presents the results with asset growth,

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[14] We use the future asset growth ratio, $\Delta A_{t+1}/A_t$, because contemporaneous asset growth is a direct function of capital expenditures. This approach is similar to that of Almeida, Campello, and Weisbach (2004), who use future changes in capital expenditures to proxy for growth opportunities. Sales growth and earnings forecast variables are computed contemporaneously with capital expenditures.

Panel B presents the results with sales growth, and Panel C presents the results with earnings forecast.

TABLE 5

The Sensitivity of Investment to Stock Prices and Other Measures of Growth Opportunities across KZ Index Portfolios of Firms

Firms' investment is regressed on Q, the asset growth ratio, the sales growth ratio, the earnings forecast ratio, and the ratio of cash flows to assets:

$$\frac{CAPX_{it}}{A_{it-1}} = \beta_i + \beta_t + \beta_1 Q_{it-1} + \beta_2 GROWTH_{it} + \beta_3 \frac{CF_{it}}{A_{it-1}} + \epsilon_{it},$$

where $CAPX_{it}/A_{it-1}$ is the ratio of capital expenditures to book assets; Q_{it-1} is the market value of equity plus assets minus the book value of equity, all divided by book assets; $GROWTH_{it}$ is the ratio of asset growth to assets (Panel A), the ratio of sales growth to sales (Panel B) and the ratio of analyst consensus earnings forecast to assets (Panel C); and CF_{it}/A_{it-1} is the ratio of cash flows to book assets. The regressions are estimated separately for each KZ index portfolio of firms with firm and year fixed effects included. The t-statistics (in parentheses) are heteroskedasticity-robust and are corrected for clustering of the residual at the firm level.

Portfolio Ranking	N	Q_{t-1}	$GROWTH_{it}$	CF_t/A_{t-1}	R^2
Panel A. $GROWTH_{it} = \Delta A_{t+1}/A_t$					
Lowest KZ index firms	14,441	0.0100 (8.54)	−0.0025 (−1.13)	0.1179 (9.61)	0.845
Quintile 2	14,013	0.0167 (8.87)	0.0024 (1.02)	0.1967 (10.42)	0.871
Quintile 3	13,868	0.0269 (9.16)	0.0032 (1.81)	0.2367 (10.61)	0.850
Quintile 4	14,147	0.0404 (9.51)	0.0079 (1.94)	0.2131 (10.02)	0.824
Highest KZ index firms	13,176	0.0586 (9.02)	0.0136 (2.21)	0.1502 (7.16)	0.762
Panel B. $GROWTH_{it} = \Delta S_t/S_{t-1}$					
Lowest KZ index firms	18,116	0.0095 (8.16)	0.0254 (7.49)	0.0837 (6.14)	0.839
Quintile 2	18,160	0.0157 (9.78)	0.0275 (7.63)	0.1332 (7.84)	0.863
Quintile 3	18,156	0.0259 (9.98)	0.0255 (7.16)	0.1628 (8.51)	0.842
Quintile 4	18,176	0.0364 (10.23)	0.0283 (8.00)	0.1812 (9.16)	0.819
Highest KZ index firms	18,122	0.0467 (10.49)	0.0369 (8.51)	0.1161 (5.44)	0.756
Panel C. $GROWTH_{it} = E[EARN_{t,t+3}]/A_{t-1}$					
Lowest KZ index firms	4,396	0.0082 (2.98)	0.0366 (1.87)	0.0790 (3.21)	0.878
Quintile 2	4,093	0.0163 (4.12)	0.0488 (1.65)	0.0919 (2.99)	0.899
Quintile 3	3,624	0.0216 (4.01)	0.0689 (1.96)	0.1656 (3.96)	0.901
Quintile 4	3,138	0.0386 (4.49)	0.0752 (2.01)	0.1764 (3.81)	0.888
Highest KZ index firms	2,423	0.0519 (4.18)	0.2039 (2.53)	0.0522 (1.17)	0.833

Consistent with our model, the coefficient β_2 is positive in all three panels (with the exception of the lowest KZ index firms in Panel A of Table 5) and increases systematically across the KZ index quintiles, irrespective of which measure of growth opportunities is used. In Panel A, the coefficient β_2 increases from −0.0025 for firms in quintile one to 0.0136 for firms in quintile five. In Panel B, the coefficient β_2 increases from 0.0254 to 0.0369 across the respective quintiles.

Finally, in Panel C, the coefficient β_2 increases from 0.0366 to 0.2039 across quintiles one and five.[15] All differences in extreme quintile coefficients are statistically significant at the 5% level or higher. Higher KZ index firms are more responsive in their investment to changes in the investment opportunity set than are lower KZ index firms.

Turning to the economic significance of the results, the standard deviations of asset growth, sales growth, and earnings forecast ratios are 0.36, 0.41, and 0.17, respectively. Therefore, for the highest KZ index firms, a one-standard-deviation increase in the asset growth ratio results in a 0.005 ($0.0136 \times 0.036 = 0.005$) increase in investment, a one-standard-deviation increase in sales growth results in a 0.014 ($0.0339 \times 0.41 = 0.014$) increase in investment, and a one-standard-deviation increase in earnings forecast results in a 0.035 ($0.2039 \times 0.17 = 0.035$) increase in investment. When compared to the results for Q (its standard deviation is 1.00 in our sample, which implies a $0.047 - 0.0586$ increase in investment for every one-standard-deviation increase in Q), the results for our non-stock-price-based measures of growth opportunities are also economically significant, although less so than that of Q. Because Q proxies for future as well as current growth opportunities, the stronger economic significance of the results for Q is expected.

The results in Table 5 are consistent with our hypothesis that firms with more significant debt overhang, information asymmetry, and expected financial distress costs (proxied by the high value of the KZ index) will benefit especially from the arrival of new investment opportunities. Therefore, these firms' investment will respond more strongly to changes in the investment opportunity set.

V.   Commentary and Conclusions

The debate over market rationality is important if stock prices affect the allocation of capital across firms. Bosworth (1975), MSV (1990), and Blanchard et al. (1993) find little evidence that stock prices affect the allocation of capital. However, BSW (2003) argue that stock prices do affect the allocation of capital if capital markets are irrational. Their argument raises the stakes in the debate over whether the stock market is rational.

In this paper, we present a model that analyzes firm investment decisions in rational capital markets in the presence of capital market imperfections. The market imperfections that we study include the costs of underinvestment resulting from debt overhang (Myers (1977)), the cost of information asymmetries between managers and outside investors (Myers and Majluf (1984)) and the costs of financial distress (Altman (1969)). The presented evidence is consistent with the view that capital market imperfections affect corporate investment. We show that more levered firms, firms with less cash and cash flow, and firms with lower dividends

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[15] We are able to obtain three-year forecasts from Institutional Brokers' Estimate System (IBES) for 17,674 firm-years (19.22% of our original sample). In a robustness check, we repeat the analysis with one-year-ahead forecasts (available for 43,899 firm-years, or 47.74% of the original sample). The results are similar. A small sample size is used, even with one-year-ahead forecasts, because IBES does not begin comprehensive coverage of firms until 1984.

are more sensitive in their investment decisions to changes in the investment opportunity set. Because these firms are more likely to suffer from debt overhang and information asymmetry problems, as well as more likely to encounter costly financial distress, the results indicate that firms with significant effects of market imperfections will benefit the most from the arrival of new investment opportunities and will undertake new projects and projects that previously were rejected. These firms will appear to have investment that is especially sensitive to changes in stock prices because changes in stock prices reflect changes in investment opportunities available to firms.

The results in this paper also imply that stock prices affect the allocation of capital across firms. According to our model, stock prices reflect the NPVs of projects available to firms. Thus, a stock price increase signals an improvement in the firm's investment opportunity mix, which stimulates the flow of capital to the firm. Conversely, a stock price decrease signals a deterioration in the mix of projects available to a firm, which results in capital flowing away from it. In our model, therefore, rational stock prices channel capital toward better investment projects.

The contributions of our paper are twofold. First, we present a model that builds on the role of capital market imperfections in affecting corporate investment decisions. We demonstrate that market imperfections can distort investment relative to the case when capital markets are perfect. We also demonstrate that changes in the investment opportunity set can reduce the effects of market imperfections and further stimulate capital investment for firms with more severe effects of capital market imperfections. Finally, we demonstrate that this "accelerator" mechanism of reduced market imperfections may give rise to a perceived increased sensitivity of investment to stock prices documented previously in the literature.

Our second contribution is empirical. Our empirical tests do not support the hypothesis that irrational stock prices affect firms' investment decisions. We demonstrate that low market-to-book and low equity issuance firms (i.e., firms more likely to be undervalued) do not make investment decisions fundamentally differently than high market-to-book and high equity issuance firms (i.e., firms more likely to be overvalued). This result indicates that firm mispricing does not affect firms' investment decisions.

We do find, however, that firms that are likely to suffer from such market imperfections as debt overhang, information asymmetry, and costly financial distress appear more sensitive in their investment to stock prices and to other non-stock-price-based measures of growth opportunities. These results are consistent with the hypothesis that market imperfections play an important role in affecting corporate investment.

Appendix A. Sample and Variable Construction

Our sample consists of all firms in Compustat for the period January 1970–December 2003. To abstract from the influences of extreme observations, we exclude all firms with book value of assets less than $10 million. We also exclude financial services firms (firms with a one-digit SIC code of 6) and utility firms (firms with a two-digit SIC code of 49).

After further excluding firm-years with no information on investment, cash flows, leverage, or earnings, we are left with 91,957 firm-years, representing 10,732 unique firms. We compute the following variables:

Dependent Variable

$CAPX_{it}/A_{it-1}$ = capital expenditures (data 128) over lagged assets (data 6).

Independent Variables

Q_{it-1} = the market value of equity (price times shares outstanding from CRSP) plus assets minus the book value of equity (data 60 + data 74) over lagged assets.

CF_{it}/A_{it-1} = cash flows (data 14 + data 18) over lagged assets.

Other Variables

KZ_{it} = the Kaplan and Zingales (1997) index:

$$KZ_{it} = -1.002\frac{CF_{it}}{A_{it-1}} - 39.368\frac{DIV_{it}}{A_{it-1}} - 1.316\frac{C_{it}}{A_{it-1}} + 3.139\frac{D_{it}}{A_{it-1}}.$$

DIV_{it}/A_{it-1} = dividends (data 21 + data 19) over lagged assets.

C_{it}/A_{it-1} = cash balances (data 1) over lagged assets.

D_{it}/A_{it-1} = debt (data 9 + data 34) over lagged assets.

$EQUITY\_ISSUE_{it}$ = equity issuance defined as

$$EQUITY\_ISSUE_{it} = \log\left(\frac{MVE_{it-1}}{MVE_{it-5}}\right) - r_{it-1},$$

the log of the ratio of time $t-1$ market value of equity to time $t-5$ market value of equity minus the log CRSP return over the period $t-5$ to $t-1$.

$\Delta A_{it+1}/A_{it}$ = lead assets minus assets over assets.

$\Delta S_t/S_{t-1}$ = sales (data 12) minus lagged sales over lagged sales.

$E[EARN_{t,t+3}]/A_{t-1}$ = median analyst earnings forecast in years t through $t+3$ over lagged assets.

Appendix B. The Effects of Costly Financial Distress on Capital Investment: A Numerical Example

Suppose there is a firm with $400.00 in cash and an obligation to pay $70.00 to bondholders one period from now. If the firm is unable to make the payment to bondholders, it enters into financial distress and incurs a cost of $300.00. Assume that this cost represents a loss of shareholder value from foregone future positive NPV opportunities because the firm must redirect resources to resolve the dispute with bondholders. Suppose the firm has four projects in its investment opportunity set, projects A, B, C, and D. Each project has a positive NPV. This situation is depicted in Panels A and B of Table B1.

If the firm undertakes all four projects and state 1 occurs, it enters into financial distress, which results in a total loss in value of $820.00 (−$820.00 = −$520.00 − $300.00). The NPV of this strategy is $85.00. If the firm undertakes projects B, C, and D, there are no states in which financial distress occurs. The NPV of this strategy is $145.00. It is in the interest of existing shareholders to reject project A even though it has a positive NPV. If project A is undertaken along with projects B, C, and D, shareholders' expected cash flow, depicted in the last row of Panel D of Table B1, is $582.50, while foregoing project A increases shareholders' expected cash flow to $585.00. This happens because shareholders bear the cost of financial distress in state 1 if project A is undertaken, which reduces their expected payoff. Therefore, initially only projects B, C, and D are chosen, and project A is foregone.

TABLE B1

The Effects of Costly Financial Distress on Capital Investment: A Numerical Example

Item	Available Projects					Combination of Undertaken Projects			
	A	B	C	·D	E	A, B, C, D	B, C, D	B, C, D, E	A, B, C, D, E
Panel A. Initial Financial Condition									
Cash on hand	$400	$400	$400	$400	$400	$400	$400	$400	$400
Debt payment	$70	$70	$70	$70	$70	$70	$70	$70	$70
Cost of financial distress	−$300	−$300	−$300	−$300	−$300	−$300	−$300	−$300	−$300
Panel B. Project Cash Flows in Various States of the World (probability of each state = 0.25)									
Cash flow in state 1	−$200	−$20	$0	−$300	$1,000	−$520	−$320	$680	$580
Cash flow in state 2	$0	−$10	$0	−$100	$0	−$110	−$110	−$110	−$110
Cash flow in state 3	$100	$50	$100	$0	−$100	$250	$150	$50	$150
Cash flow in state 4	$200	$100	$200	$1,000	−$300	$1,500	$1,300	$1,000	$1,200
Expected cash flow	$50	$30	$75	$150	$150	$230	$255	$405	$455
Required investment	$10	$10	$50	$50	$50	$120	$110	$160	$170
NPV	$15	$20	$25	$100	$100	$85	$145·	$245	$260
Panel C. Debtholders' Cash Flow in Various States of the World from All Undertaken Projects									
(probability of each state = 0.25)									
Cash flow in state 1						$0	$70	$70	$70
Cash flow in state 2						$70	$70	$70	$70
Cash flow in state 3						$70	$70	$70	$70
Cash flow in state 4						$70	$70	$70	$70
Expected cash flow						$52.50	$70	$70	$70
Panel D. Shareholders' Cash Flow in Various States of the World from All Undertaken Projects									
(probability of each state = 0.25)									
Cash flow in state 1						−$300	$10	$1,010	$910
Cash flow in state 2						$220	$220	$220	$220
Cash flow in state 3						$580	$480	$380	$480
Cash flow in state 4						$1,830	$1,630	$1,330	$1,530
Expected cash flow						$582.50	$585	$735	$785

Now suppose a new project (project E) arrives that has a positive NPV and cash flows that are negatively correlated with cash flows from the existing projects. If the firm simply adds this project to the pool of projects already undertaken, the total NPV increases to $245.00, as depicted in Panel B of Table B1. However, with the arrival of project E, it is in the interest of existing shareholders to undertake project A as well. The NPV of this strategy, presented in the last column of Table B1, is $260.00, and shareholders benefit from undertaking all five projects. To see this, even if they finance projects A and E with equity, their expected gain is $175.00 (from Panel D ($175.00 = $760.00 − $585.00)), which is greater than the required investment of $60.00 in projects A and E ($10.00 to undertake project A and $50.00 to undertake project E). Thus, the firm undertakes all projects and increases its investment by $60.00. At the same time, the firm's stock price increases by $115.00, the combined NPV of projects A and E. The comovement of investment and stock prices produces an apparent sensitivity of investment to stock prices of 0.52 ($60.00/$115.00).

If, however, the firm did not have to incur the cost of financial distress, it would have been in the interest of shareholders to undertake project A along with projects B, C, and D, even without project E in its investment opportunity set.[16] Hence, the arrival of project E would have increased the firm's investment by only $50.00, the amount required to undertake project E, and would have increased the stock price by $100.00, the NPV of project E. The resulting perceived sensitivity of investment to stock prices is 0.50 ($50.00/$100.00).

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[16]The NPV of this strategy would have been $160.00, and the expected shareholders' claim on projects' cash flows would have been $657.50, a $72.50 increase in the expected claim from $585. The increase in the expected claim is significantly greater than the required investment in project A of $10.

With costly financial distress, investment of firms subject to these costs appears more sensitive to changes in stock prices (investment sensitivity = 0.52) than that of firms for which the costs of financial distress are insignificant (investment sensitivity = 0.50).

In this calculation, we have assumed that the firm finances all projects with equity. There is no loss in value to existing shareholders, however, if all five projects are debt-financed. To see this, the $170.00 investment required to undertake all five projects can be raised with risk-free debt, since bondholders are guaranteed to be repaid in full in all states. Therefore, bondholders will be willing to contribute the full face value of debt to undertake all projects, and their expected return will be zero. In other words, the existing shareholders receive all of the cash flows in excess of that required to repay the face value of debt, while the bondholders pay the correct price and receive a risk-free return of zero.

If projects are financed with new equity, new shareholders also pay the correct price for their shares and receive a zero return from all five undertaken projects. However, the new shareholders will participate in the distribution of cash flows from future investment opportunities, which, from the setup above, have an NPV of $300.00. Therefore, the current shareholders are worse off if today's projects are equity-financed. It is in the interest of existing shareholders to finance projects A, B, C, D, and E themselves, or, if they are not willing to commit the capital, with risk-free debt.

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