DO INVESTMENT-CASH FLOW SENSITIVITIES PROVIDE USEFUL MEASURES OF FINANCING CONSTRAINTS?*

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No. This paper investigates the relationship between financing constraints and investment-cash flow sensitivities by analyzing the firms identified by Fazzari, Hubbard, and Petersen as having unusually high investment-cash flow sensitivities. We find that firms that appear less financially constrained exhibit significantly greater sensitivities than firms that appear more financially constrained. We find this pattern for the entire sample period, subperiods, and individual years. These results (and simple theoretical arguments) suggest that higher sensitivities cannot be interpreted as evidence that firms are more financially constrained. These findings call into question the interpretation of most previous research that uses this methodology.

> *"Our financial position is sound . . . Most of the company's funds are generated by operations and these funds grew at an average annual rate of 29% [over the past 3 years]. Throughout the company's history this self-financing concept has not been a constraint on the company's growth. With recent growth restrained by depressed economic conditions, the company's net cash position has grown substantially" [Hewlett-Packard 1982 Annual Report].*

A large finance and macroeconomics literature studies the relation between corporate investment and cash flow to test for the presence and importance of financing constraints. Beginning with "Financing Constraints and Corporate Investment" by Fazzari, Hubbard, and Petersen [1988], (hereinafter FHP [1988]), these studies divide a sample of firms according to an a priori measure of financing constraints and compare the investment-

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cash flow sensitivities of the different subsamples. The studies interpret a greater investment-cash flow sensitivity for firms considered more likely to face a larger wedge between the internal and the external cost of funds as evidence that the firms are indeed constrained. This methodology has been widely applied to identify firms that are more affected by financing constraints, and institutions that are more likely to alleviate those constraints. For example, Hoshi, Kashyap, and Scharfstein [1991] find that investment by Japanese firms that belong to a keiretsu (corporate group) is less sensitive to cash flow than investment by independent firms. They conclude that a group (and concomitant bank) affiliation alleviates underinvestment problems caused by capital market imperfections.

Despite the size and policy-importance of this literature, the fundamental assumptions underlying it have remained largely unexplored. While subsequent work has replicated the findings of FHP [1988] by using different a priori criteria, no paper (of which we are aware) has verified directly whether a higher investment-cash flow sensitivity is related to financing problems and, if it is, in what way. In particular, there is no test of the fundamental assumption—implicit in all these tests—that investment-cash flow sensitivities increase monotonically with the degree of financing constraints. As we show in Section I, this is particularly surprising because there is no strong theoretical reason to expect a monotonic relationship.

This paper investigates the relation between investment-cash flow sensitivities and financing constraints by undertaking an in-depth analysis of a sample of firms exhibiting an unusually high sensitivity of investment to cash flow. These firms are the 49 low dividend firms that FHP [1988] identify as financially constrained according to the investment-cash flow criterion.

By using detailed and previously unexplored data sources, we try to determine the availability of and the demand for funds for each of the sample firms. We examine each firm's annual report or 10-K for each sample year, and we read management's discussion of liquidity that describes the firm's future needs for funds and the sources it plans to use to meet those needs. We integrate this information with quantitative data and with public news to derive as complete a picture as possible of the availability of internal and external funds for each firm as well as each firm's demand for funds. On this basis we rank the extent to which the sample firms are financially constrained each year. We use the

firm-year classifications to group the sample firms over seven- or eight-year subperiods, and over the entire sample period. Finally, we compare investment-cash flow sensitivities across the different groups of firms for the entire sample period, for subperiods, and for individual years.

Surprisingly, we find that in only 15 percent of firm-years is there some question as to a firm's ability to access internal or external funds to increase investment. In 85 percent of firm-years the firms could have increased their investment—in many cases, substantially—if they had so chosen. In fact, almost 40 percent of the sample firms, including Hewlett-Packard (cited above), could have increased their investment in every year of the sample period. Our partially qualitative measures of financial constraints are strongly corroborated by quantitive data on debt to total capital, interest coverage, the presence of restrictions on dividends, and financial slack (the level of cash and unused line of credit relative to investment).

More strikingly, those firms classified as *less* financially constrained exhibit a significantly *greater* investment-cash flow sensitivity than those firms classified as more financially constrained. We find this pattern for the entire sample period, for subperiods, and for individual years. This pattern is also robust to different criteria to divide constrained and unconstrained firms. For example, firms with healthy interest coverage in every sample year or in every subperiod year have investment-cash flow sensitivities twice as large as the remaining firms in the sample.

As we explain in Section I, these results should not be very surprising. There is no strong theoretical reason for investment-cash flow sensitivities to increase monotonically with the degree of financing constraints. Nevertheless, we consider several possible reasons why estimated investment-cash flow sensitivities could decrease in the degree of financing constraints even if the true relationship is increasing.

First, cash flow may act as a proxy for investment opportunities not captured by Tobin's Q and do so differentially across firms. Our results, however, are robust to the use of an Euler equation test [Bond and Meghir 1994], which does not rely on Tobin's Q and thus is not affected by its mismeasurement.

Second, differences in sensitivities might be driven by a few influential outliers. We find evidence that the high overall sensitivity of our sample (FHP's [1988] low dividend payout firms) rela-

tive to FHP's higher dividend payout firms is explained by a relatively few company-years characterized by exceptionally high sales growth. We also find, however, that these outliers do not explain our cross-section results that the least constrained firms have the highest sensitivities.

Third, our finding of nonmonotonic relationship may be specific to a few distressed firms that are forced to use cash flow to repay their debt, and may not apply to more "normal" samples. The financial conditions of the constrained firms, though, are not consistent with this hypothesis.

In sum, we provide both theoretical reasons and empirical evidence that a greater sensitivity of investment to cash flow is not a reliable measure of the differential cost between internal and external finance. In so doing, we address (and refute) the criticisms in Fazzari, Hubbard, and Petersen [1996] [FHP 1996].

We conclude the paper with a discussion of the generality of our results. We argue that our analysis calls into question the interpretation of most previous research that uses this methodology.

The paper proceeds as follows. Section I presents the theoretical framework. Section II describes the sample. Section III explains the criteria used to identify the extent to which firms are financially constrained. Section IV reports the investment-cash flow regression results. Section V discusses the results and considers alternative explanations for them. Section VI discusses the implications and generality of our results for the previous literature. Section VII concludes.

I. Theoretical Framework

A. Definition of Financing Constraints

In order to discuss the relationship between investment-cash flow sensitivity and the degree of financing constraints, we must define what it means to be financially constrained. The most precise (but also broadest) definition classifies firms as financially constrained if they face a wedge between the internal and external costs of funds. By this definition all firms are likely to be classified as constrained. A small transaction cost of raising external funds would be sufficient to put a firm into this category. This definition, however, provides a useful framework to differentiate firms according to the extent to which they are financially con-

strained. A firm is considered more financially constrained as the wedge between its internal and external cost of funds increases.

Our classification scheme, which we detail below, is designed to distinguish the relative differences in the degree to which firms are financially constrained. In general, our unconstrained or less constrained firms are those firms with relatively large amounts of liquid assets and net worth.

In classifying firms, we are agnostic on whether the wedge between the cost of internal and external funds is caused by hidden information problems, as in Myers and Majluf [1984] and Greenwald, Stiglitz, and Weiss [1984]; or agency problems, as in Jensen and Meckling [1976], Grossman and Hart [1982], Jensen [1986], Stulz [1990], and Hart and Moore [1995]. In fact, unlike Blanchard, Lopez-de-Silanes, and Shleifer [1994], the purpose of our analysis is not to identify the source of the capital market imperfection, but rather to understand the effects capital market imperfections have on investment. We next review what economic theory has to say about the impact of financing constraints on investment.

B. The Impact of Financing Constraints on Investments

FHP [1988] was the first of many papers to consider higher investment-cash flow sensitivities as evidence of greater financing constraints. Given the magnitude and the importance of this literature, it is surprising that little attention has been given to the theoretical foundation of the investment-cash flow sensitivity criterion.[1] While it is easy to show that constrained firms should be sensitive to internal cash flow while unconstrained firms should not, it is not necessarily true that the magnitude of the sensitivity increases in the degree of financing constraints. This is the crucial question, given that investment is sensitive to cash flow for the vast majority of firms analyzed. (It is easy to justify this sensitivity based on the fact that external funds are more costly than internal funds for all firms as long as some transaction costs are involved.)

The difficulty of interpreting cross-sectional differences in investment-cash flow sensitivities can be illustrated with a simple one-period model. Consider a firm that chooses the level of investment to maximize profits. The return to an investment, I, is given by a production function $F(I)$, where $F' >$ and $F'' < 0$.

1. We thank Jeremy Stein for encouraging us to develop this point.

Investment can be financed either with internal funds (W) or with external funds (E). The opportunity cost of internal funds equals the cost of capital, R, which, for simplicity, we set equal to 1. Because of information, agency, or risk aversion problems, we assume that the use of external funds generates a deadweight cost, which—in a competitive capital market—is borne by the issuing firm. We represent (in reduced form) this additional cost of external funds with the function $C(E,k)$, where E is the amount of external funds raised and k is a measure of a firm's wedge between the internal and the external costs of funds. It is natural to assume that the total cost of raising external funds increases in the amount of funds raised and in the extent of the agency or information problems (represented by k). All the a priori measures of financing constraints used in the literature can be thought of as different proxies for k (which is unobservable) or of W (the availability of internal funds).

Each firm, then, chooses I to maximize,

$$\max F(I) - C(E,k) - I, \quad \text{such that } I = W + E. \tag{1}$$

To guarantee that the above program is well behaved, we also assume that $C(.)$ is convex in E.[2]

The first-order condition of problem (1), then, is given by

$$F_1(I) = 1 + C_1(I - W, k), \tag{2}$$

where $C_1(0)$ represents the partial derivative of C with respect to its first argument and $F_1()$ the first derivative of F with respect to I. The effects of the availability of internal finance on investments can be easily obtained by implicit differentiation of (2):

$$\frac{dI}{dW} = \frac{C_{11}}{C_{11} - F_{11}}, \tag{3}$$

which is clearly positive (to the extent that C is convex). In other words, in an imperfect capital market world, investments are sensitive to internal funds; while in a perfect capital market world, they are not (because $C(.) = 0$ and thus $C_{11} = 0$).

Similarly, it is possible to derive the sensitivity of investment to the wedge between the cost of internal and external financing. By implicit differentiation of (2) we obtain

2. This is a reasonable, but not obvious assumption. For example, Calomiris and Himmelberg [1995] document that the average transaction cost of issuing securities decreases in the amount raised, which suggests that C() may be concave. While these transaction costs may be only a small component of the overall cost $C(.)$, we note that this basic assumption might not be warranted.

$$\frac{dI}{dk} = \frac{-C_{12}}{C_{11} - F_{11}}, \tag{4}$$

which is negative if the marginal cost of raising external finance is increasing in k (i.e., $C_{12} > 0$).

Most papers in this literature, however, do not test either of these two propositions. On the one hand, the estimated investment-cash flow sensitivity is generally positive and significant for all firms, suggesting that all firms are constrained in some sense, and so, making the test of the first implication redundant. Second, most of the proxies for W or k used in the literature are only able to identify constrained firms, not constrained firm-years. This makes it impossible to disentangle the effect of financing constraints from a firm-specific effect on the level of investment.

For these reasons, previous papers focus on cross-sectional differences in the investment-cash-flow sensitivity across groups of firms likely to have a different wedge between internal and external funds. But this corresponds to looking at differences in dI/dW as a function of W or k. Such an exercise is meaningful only if the investment-cash flow sensitivity is monotonically decreasing with respect to W (or increasing with respect to k); in other words, only if $d^2\mathrm{I}/dW^2$ is negative (or $d^2I/dWdk$ is positive). From equation (3) we obtain

$$\frac{d^2I}{dW^2} = \frac{F_{111}C_{11}^2 - C_{111}F_{11}^2}{(C_{11} - F_{11})^3}, \tag{5}$$

If both $C_{11}()$ and $F_{11}()$ are different from zero, we can rewrite equation (5) as

$$\frac{d^2I}{dW^2} = \left(\frac{F_{111}}{F_{11}^2} - \frac{C_{111}}{C_{11}^2}\right)\frac{F_{11}^2C_{11}^2}{(C_{11} - F_{11})^3}. \tag{6}$$

Given that the second term is always positive, it follows that d^2I/dW^2 is negative if and only if $[F_{111}/F_{11}{}^2 - C_{111}/C_{11}{}^2]$ is negative. This condition implies a certain relationship between the curvature of the production function and the curvature of the cost function at the optimal level of investment. It is easy to see how such a condition can be violated. For example, if the cost function is quadratic, d^2I/dW^2 will be positive if the third derivative of the production function is positive (as is the case with a simple production function like I^ρ, where $0 < \rho < 1$). In such a case the investment-cash flow sensitivity *increases* with a firm's internal

liquidity. Of course, many simple production functions have positive third derivatives. Although we will not produce them here, the conditions necessary to ensure that $d^2I/dWdk$ be positive are at least as demanding.

In sum, even in a one-period model, investment-cash flow sensitivities do not necessarily increase with the degree of financing constraints. In a multiperiod model, precautionary savings motives make it even more difficult to assess the theoretical relationship between investment-cash flow sensitivities and the degree of financing constraints. For example, Gross [1995] builds and simulates an intertemporal investment model and finds a nonmonotonic relationship between investment-cash flow sensitivities and the extent of financing constraints.

Finally, the relationship between investment-cash flow sensitivities and degree of financing constraints can be further complicated by the presence of irrational or overly risk-averse managers, who choose to rely primarily on internal cash flow to invest despite the availability of low cost funds.

II. Sample

In this paper we analyze the sample of 49 low-dividend paying firms in FHP [1988]. FHP divide all manufacturing firms in the Value Line database with uninterrupted data from 1970 to 1984 into three classes based on dividend payout policy. Their 49 Class 1 firms (which we analyze) have a dividend payout ratio of less than 10 percent in at least ten of the fifteen years. FHP classify 39 firms that have a dividend payout ratio between 10 percent and 20 percent as Class 2 firms, and all 334 other firms in their sample as Class 3 firms. FHP argue that the Class 1 firms are more likely, a priori, to have been financially constrained. In their analysis they find that the Class 1 firms have an investment-cash flow sensitivity that is significantly greater than that for firms that pay higher dividends.

We choose this sample for three reasons. First, these firms exhibit a strong relation between investment and cash flow. Second, FHP argue strongly that these firms are financially constrained, most likely because of information problems. Because FHP [1988] can legitimately be considered the parent of all papers in this literature, there can be no disagreement that we have adversely selected our sample. Finally, given the high cost of our research design, the number of firms is manageable.

We follow this sample for the same fifteen years, 1970 to

1984, studied by FHP [1988]. For each firm we collected data from several sources. First, we collected letters to shareholders, management discussions of operations and liquidity (when available), financial statements, and the notes to those statements from the annual report or 10-K for each firm-year. We obtained *Wall Street Journal Index* entries over the fifteen-year sample period.[3] We obtained standard accounting variables from COMPUSTAT except those for Coleco which we obtained from Coleco's annual reports. Because FHP obtained their data from Value Line not COMPUSTAT, our data are not precisely the same as theirs.

We measure investment or capital expenditures using COMPUSTAT item 128. We measure cash flow as the sum of earnings before extraordinary items (item 18) and depreciation (item 14). We deflate investment and cash flow by capital which we measure as net property, plant, and equipment (item 8) at the beginning of the fiscal year. This measure of capital differs slightly from the replacement cost measure employed by FHP.

We measure average Tobin's Q as the market value of assets divided by the book value of assets (item 6) where the market value of assets equals the book value of assets plus the market value of common equity less the sum of the book value of common equity (item 60) and balance sheet deferred taxes (item 74). As do most papers in this literature, we calculate Q at the beginning of a firm's fiscal year.[4] (Our results are similar when we use end-of-period Q.)

In Table I we compare the basic regression results for our sample with those reported in Table 4 of FHP [1988]. These regressions regress investment on cash flow and Q, and control for fixed firm and year effects. Our results are qualitatively similar to those reported by FHP, although they differ slightly in some details.[5] For each of the three time periods, our coefficients on cash flow are lower than those reported by FHP. Those differ-

3. Fiscal years ending before June 15 are assigned to the previous calendar year; fiscal years ending after June 15 are assigned to the current calendar year.

4. Our measure differs from FHP's in two ways. First, FHP compute Q based on replacement costs, while we simply use a market-to-book ratio. The results in Perfect and Wiles [1994] indicate that the improvements obtained from the more involved computation of Q are fairly limited, particularly when regressions are estimated with firm fixed effects. Second, FHP use the average market value of equity in the fourth quarter while we use the actual market value of equity at fiscal year end.

5. We use 719 observations, not 735, because firms switched fiscal years (three firm-years), firms did not file financial statements with the SEC (six firm-years), and firms did not have an available stock price (seven firm-years). FHP [1988] do not report how many observations they include.

TABLE I

COMPARISON OF REGRESSION OF INVESTMENT ON CASH FLOW AND Q WITH FAZZARI, HUBBARD, AND PETERSEN RESULTS

Regression of investment on cash flow and Q for 49 low-dividend firms from Fazzari, Hubbard, and Petersen [1988], (hereinafter FHP [1988]), from 1970 to 1984 compared with estimates in FHP. KZ refers to our estimates. Investment is capital expenditures (COMPUSTAT item 128). Cash flow equals the sum of earnings before extraordinary items (COMPUSTAT item 18) and depreciation (COMPUSTAT item 14). Investment and cash flow are deflated by beginning of year capital (K_{t-1}) which we define as net property, plant, and equipment (COMPUSTAT item 8). Q equals the market value of assets divided by the book value of assets (COMPUSTAT item 6). Market value of assets equals the book value of assets plus the market value of common stock less the sum of the book value of common stock (COMPUSTAT item 6) and balance sheet deferred taxes (COMPUSTAT item 74). All regressions include firm fixed effects and year effects. Standard errors are in brackets.

	KZ 1970–84	KZ 1970–84	FHP 1970–84	KZ 1970–79	KZ 1970–79	FHP 1970–79	KZ 1970–75	KZ 1970–75	FHP 1970–75
CF_t/K_{t-1}	0.395	0.500	0.461	0.477	0.578	0.540	0.558	0.634	0.670
	[0.026]	[0.023]	[0.027]	[0.035]	[0.030]	[0.036]	[0.040]	[0.034]	[0.044]
Q_{t-1}	0.039		0.0008	0.030		0.0002	0.021		−0.0010
	[0.005]		[0.0004]	[0.006]		[0.0004]	[0.006]		[0.0004]
Adj. R^2	0.584	0.548	0.46	0.649	0.627	0.47	0.764	0.753	0.55
N obs.	719	719	N.A.	476	476	N.A.	280	280	N.A.

ences, however, appear to be only marginally significant, if at all. At the same time, our coefficients for Q are significantly greater than those reported by FHP.

We attribute the differences between our results and FHP's to the different definitions of Q. When we exclude Q from our regressions, we obtain coefficients on cash flow that exceed those in FHP except for the 1970–1975 period where our coefficient is insignificantly smaller. Because the FHP measure is constructed with an average stock price in the previous year rather than the (more appropriate) stock price at the beginning of the year, we suspect that our measure of Q provides better information about investment opportunities. The FHP measure will not distinguish between a firm whose stock price declines from 20 to 10 and a firm whose stock price increases from 10 to 20 at the end of the previous year.[6]

III. Classification Scheme

A. Description

The SEC requires companies listed on a stock exchange that have more than 500 shareholders and $5 million in assets to file an annual report or 10-K that contains the basic financial statements and their notes, as well as all material information regarding a company's business and financial condition. The annual reports are generally introduced by a letter to shareholders from the chief executive officer (CEO). This letter usually describes the major events of the previous fiscal year and the major projects planned for the future.

In 1977 the SEC strengthened these reporting requirements by adopting Regulation S-K, which requires firms to discuss explicitly their liquidity, capital resources, and results of operations. This section is usually titled management's discussion of operations. Item 303 of Regulation S-K states:

> (1) Liquidity. Identify any known trends or any known demands, commitments, events, or uncertainties that will result in . . . the registrant's liquidity increasing or decreasing in any material way.

6. FHP [1996] question our measure of Q as a possible source of error because we use book value rather than replacement value of assets. This concern is unfounded for two reasons. First, our measure of Q explains more variation in investment than the measure used by FHP, suggesting that their measure is noisier than ours. Second, as we show below, we obtain similar results using an Euler equation approach that does not rely on Q.

> If a material deficiency is identified, indicate the course of action that the registrant has taken or proposes to take to remedy the deficiency. Also identify and separately describe internal and external sources of liquidity, and briefly discuss any material unused sources of liquid assets.
>
> (2) Capital Resources. (i) Describe the registrant's material commitments for capital expenditures as of the end of the latest fiscal period, and indicate the general purpose of such commitments and the anticipated source of funds needed to fulfill such commitments . . . (ii) Describe any known material trends, favorable or unfavorable in the registrant's capital resources. Indicate any expected material changes in the mix and the relative cost of such resources.
>
> Instructions: 5. The term "liquidity" . . . refers to the ability of an enterprise to generate adequate amounts of cash to meet the enterprise's needs for cash. . . . Liquidity shall generally be discussed on both a long-term and short-term basis.[7]

In short, Regulation S-K explicitly requires firms to disclose whether or not they are having difficulty in financing their investments. Consistent with the timing of the new SEC regulations, post-1977 annual report information for our sample firms tends to be more detailed than the information for earlier years. To the extent that our classification scheme has errors, they should be smaller for years after 1977.

We use the qualitative information in the annual reports, together with quantitative information in the companies' financial statements and notes, to classify each firm-year into one of five groups.

The first group contains firms that we deem definitely not financially constrained in that year. We refer to these firm-years as not financially constrained (NFC). We place a firm-year in the NFC group if the firm initiated or increased cash dividends, repurchased stock, or explicitly indicated in its annual report that the firm had more liquidity than it would need for investment in the foreseeable future.[8] We also were more likely to label a firm-year NFC if the firm had a large cash position (relative to investment) or if the firm's lenders did not restrict the firm from making

7. See SEC 63031 in Murray, Decker, and Dittmar [1993].

8. For example, Plantronics' 1971 annual report states: "We ended the year in an exceptionally strong financial condition for a company of our size. During the year we paid off all long-term debt, and our cash and cash-equivalent assets have throughout the year exceeded all current liabilities."

large dividend payments (relative to investment). NFC firm-years, therefore, tend to include financially healthy companies with low debt and high cash. In NFC firm-years, therefore, *we find no evidence that the firms could not have invested appreciably more if their managers had so chosen.* In NFC firm-years, firms also have large amounts of internal funds and collateralizable resources relative to the amount of funds required.

The second group includes firm-years that we label likely not to be financially constrained (LNFC). In LNFC firm-years the firms are healthy financially and do not give any indication of being liquidity constrained. These firms also tend to have sizable cash reserves, unused lines of credit, and healthy interest coverage. We distinguish LNFC firm-years from NFC firm-years by the magnitude of the liquidity measures and by the absence of an explicit statement of excess liquidity. Again, in LNFC firm-years we find no evidence that these firms could not have invested more if their managers had so chosen. For example, despite the quote in our introduction, we classify Hewlett-Packard as LNFC in five firm-years in the 1970s.

The third group includes firm-years we found difficult to classify either as financially constrained or as unconstrained. We call these firm-years possibly financially constrained (PFC). In PFC firm-years, firms do not report any clear signs of financing constraints, but they do not look particularly liquid either. Frequently these firms face an adverse product market environment, but are not explicitly strapped for cash. This category also includes firm-years that provide contradictory indications of their financial situation. For example, this might include a company that increases its dividend, but laments its lack of financial resources in the letter to shareholders.

The fourth group contains all firm-years in which firms are likely to be financially constrained (LFC). This group includes firms that mention having difficulties in obtaining financing. For example, we include firm-years in which firms postpone an equity or convertible debt offering due to adverse market conditions, or claim they need equity capital but are waiting for improved market conditions. Generally, these firms are prevented from paying dividends and have little cash available. Firms that cut dividends also are more likely to fall in this category, unless other adverse factors assign them to the fifth group.

The last group includes all firm-years in which firms are undoubtedly financially constrained (FC). In these firm-years, these

companies are in violation of debt covenants, have been cut out of their usual source of credit, are renegotiating debt payments, or declare that they are forced to reduce investments because of liquidity problems.

Our classification scheme is subject to the criticism that managers do not always report truthfully, and, therefore, some firm-years will be misclassified. We do not view management misreporting as a serious problem for several reasons. First, managers are held liable not only for disclosing false information, but also for not disclosing material information. This is particularly true after 1977 when Regulation S-K is in effect.[9] Second, we read annual reports over a fifteen-year period. While a firm may be able to misreport in any given firm-year, it seems unlikely that a firm can misreport every year. Third, we do not rely exclusively on the management discussions, but also read the financial statements carefully. Finally, any management reluctance to report negative information should bias our results against finding financially constrained companies and differences across groups. To the extent that we find some companies to be financially constrained, we can be certain that they are indeed constrained.

Overall, our classification scheme captures relative differences in sample firms' availability of internal and external funds in a given year. The financial statements and management discussions strongly indicate that NFC (and LNFC) firms could have invested more (often substantially more) in that year had they so chosen. In the language of our model, these are firms for whom W is very high even after they invest. Therefore, these firms should face a $C(E,k)$ that is close to 0, if not equal to 0. This is unlikely to be true for the PFC firms, and definitely not true for the LFC and FC firms. Our classification scheme, therefore, captures relative differences in sample firms' wedge between external and internal finance.

B. Classification Results

Table II summarizes our classification of firm-years. We classify 54.5 percent of firm-years as not (NFC) and 30.9 percent of firm-years as likely not financially constrained (LNFC) for *a total of 85.3 percent of firm-years in which we find no evidence of financing constraints that restrict investment.* We classify 7.3 percent

9. For example, the SEC took action against Caterpillar, Inc. for not reporting that a large increase in Caterpillar's 1989 net income was caused by a hyperinflation in Brazil.

TABLE II

SUMMARY OF ANNUAL FINANCING CONSTRAINT STATUS

Distribution of financing constraints by year for 49 low-dividend firms are from FHP [1988], from 1970 to 1984. Firm financing constraint status for each year are not financially constrained (NFC), likely not financially constrained (LNFC), possibly financially constrained (PFC), likely financially constrained (LFC), and financially constrained (FC).

	NFC Not financially constrained	LNFC Likely not financially constrained	PFC Possibly financially constrained	LFC Likely financially constrained	FC Definitely financially constrained	NFC + LNFC Not or likely not financially constrained	PFC + LFC + FC Possibly, likely, or definitely financially constrained
1970	34.0%	44.7%	14.9%	2.1%	4.3%	78.7%	21.3%
1971	38.3	34.0	17.0	10.7	0.0	72.3	27.7
1972	43.8	35.4	12.5	8.3	0.0	79.2	20.8
1973	39.6	45.8	6.3	4.2	4.2	85.4	14.6
1974	36.7	28.6	12.2	16.3	6.1	65.3	34.7
1975	30.6	42.9	14.3	8.2	4.1	73.5	26.5
1976	51.0	38.8	2.0	4.1	4.1	89.8	10.2
1977	59.2	28.6	4.1	0.0	8.2	87.8	12.2
1978	67.3	26.5	2.0	2.0	2.0	93.8	6.2
1979	61.2	26.5	10.2	2.0	0.0	87.8	12.2
1980	73.5	20.4	4.1	2.0	0.0	93.9	6.1
1981	71.4	20.4	6.1	0.0	2.0	91.8	8.2
1982	69.4	24.5	2.0	2.0	2.0	93.9	6.1
1983	69.4	24.5	2.0	4.1	0.0	93.9	6.1
1984	69.4	22.4	0.0	6.1	2.0	91.8	8.2
Total	54.5	30.9	7.3	4.8	2.6	85.3	14.7

of firm-years as possibly constrained, 4.8 percent as likely constrained, and 2.6 percent as definitely constrained for a total of only 14.7 percent firm-years in which there is some possibility of financing constraints. The fraction of firms that are at least possibly constrained, varies over time, with more firms being potentially constrained in the early part of the sample (when these firms were smaller), and particularly around the 1974–1975 recession. This time pattern is consistent with the results in FHP [1988] and in Table I that investment-cash flow sensitivities decline over the sample period. (In the Appendix we report the year-by-year classifications for all 49 firms.)

We consider the accuracy of our classification scheme by reporting quantitative measures of operational and financial health across our five classifications in Table III. In panel A, median cash flow, net cash flow (cash flow less investment), and Tobin's Q decline monotonically across the five categories. For example, the median level of net cash flow for NFC firms is 11 percent of capital (net property, plant, and equipment) while the median level of net cash flow for FC firms is almost -20 percent. This suggests that NFC firms could have increased their investment without tapping external sources of capital.

Panel A also suggests that our classification scheme is successful in capturing the degree of financing constraints. Equation (3) predicts that investment will decline as financing constraints increase. Consistent with this, the median level of investment is significantly lower for LFC and FC firm-years than for the other three groups. (We test this more formally in subsection IV.C, where we control for investment opportunities.) Furthermore, the mean level of investment in acquisitions (as a fraction of capital) is substantially higher for firms in the first two groups (NFC and LNFC) than for firms in the other three groups.[10] Acquisitions are completely absent in FC firm-years.

Panel B reports summary statistics on firm financial status. Interest coverage—earnings before interest, taxes, depreciation, and amortization, or EBITDA (COMPUSTAT item 13) to interest expense (item 15)—declines monotonically across our classifications.[11] Debt to total capital also decreases monotonically: debt is

10. We calculate acquisitions as the value of businesses or companies acquired in a given firm-year as a fraction of beginning-of-year capital. We value purchase acquisitions using information in the statement of changes. We value pooling acquisitions using the notes to financial statements.

11. We set interest coverage to 100 if coverage exceeds 100 or interest expense is negative. We set interest coverage to 0 if EBITDA is negative.

TABLE III

SUMMARY STATISTICS FOR FIRM CHARACTERISTICS BY YEARLY FINANCING CONSTRAINT STATUS

Distribution of financial variables by annual financing constraint status for 49 low-dividend firms from FHP [1988] from 1970 to 1984. Firm financing constraint status for each year is not financially constrained (NFC), likely not financially constrained (LNFC), possibly financially constrained (PFC), likely financially constrained (LFC), and financially constrained (FC). Each entry reports the median, mean, tenth percentile, ninetieth percentile, and number of observations. Investment (I_t), cash flow Q, and capital (K_{t-1}) are defined in Table I. Acquisitions (Acqs.) equals the value of purchase and pooling acquisitions. Interest coverage is the ratio of earnings before interest, taxes, and depreciation (EBITDA) to interest expense. Debt is the sum of the book value short-term and long-term debt. Total capital is the sum of debt, the book value of preferred stock, and the book value of common equity. Free divs. is the amount of retained earnings that are not restricted from being paid out as dividends. Cash is cash and marketable securities. Unused line$_t$ is the amount of unused line of credit at the end of year t. Slack is the sum of cash and unused line. Change in debt is the change in sum of the book value of short-term and long-term debt. Equity issue is the sum of the equity issued to the public and to acquisition targets.

	NFC Not fin. constr.	LNFC Likely not fin. constr.	PFC Possibly fin. constr.	LFC Likely fin. constr.	FC Fin. constr.	All firm-years
A. Investment, cash flow, growth						
I_t/K_{t-1}	0.368	0.324	0.359	0.273	0.243	0.348
	0.461	0.413	0.450	0.350	0.313	0.436
	0.159	0.159	0.122	0.073	0.068	0.127
	0.831	0.831	0.824	0.909	0.544	0.810
	393	221	52	34	19	719
Cash Flow$_t/K_{t-1}$	0.506	0.350	0.313	0.243	0.020	0.421
	0.614	0.435	0.366	0.191	−0.047	0.505
	0.209	0.104	−0.125	−0.126	−0.436	0.122
	1.075	0.871	1.084	0.528	0.366	1.007
	393	221	52	34	19	719
(Cash Flow$_t - I_t$)$/K_{t-1}$	0.110	0.026	−0.026	−0.071	−0.198	0.051
	0.155	0.022	−0.085	−0.159	−0.360	0.069
	−0.180	−0.316	−0.474	−0.642	−0.785	−0.285
	0.503	0.323	0.420	0.141	−0.076	0.442
	393	221	52	34	19	719
Q_t	1.313	1.171	1.159	1.096	1.082	1.231
	1.647	1.542	1.312	1.527	1.402	1.580
	0.809	0.755	0.793	0.734	0.795	0.785
	2.781	2.799	1.934	2.659	1.789	2.749
	393	221	52	34	19	719
Fraction firms with acquisitions in year$_t$	0.244	0.244	0.154	0.176	0.000	0.228
	393	221	52	34	19	719

TABLE III
(CONTINUED)

	NFC Not fin. constr.	LNFC Likely not fin. constr.	PFC Possibly fin. constr.	LFC Likely fin. constr.	FC Fin. constr.	All firm-years
Acqs.$_t/K_{t-1}$	0.000	0.000	0.000	0.000	0.000	0.000
	0.122	0.159	0.063	0.023	0.000	0.121
	0.000	0.000	0.000	0.000	0.000	0.000
	0.287	0.300	0.044	0.029	0.000	0.252
	388	217	52	34	19	710
Sales growth$_t$	0.211	0.150	0.123	0.136	0.008	0.180
	0.226	0.165	0.097	0.113	0.049	0.188
	0.021	−0.071	−0.136	−0.145	−0.275	−0.051
	0.484	0.385	0.319	0.338	0.305	0.452
	393	221	52	34	19	719
Inventory growth$_t$	0.199	0.117	0.144	0.063	−0.064	0.154
	0.215	0.160	0.135	0.049	−0.013	0.179
	−0.073	−0.175	−0.056	−0.499	−0.487	−0.135
	0.545	0.475	0.376	0.562	0.543	0.512
	393	221	52	34	19	719
B. Financial policy						
Interest coverage$_t$	7.971	5.886	4.203	2.836	1.093	6.406
	18.026	11.777	4.745	3.455	1.650	14.023
	2.746	1.608	0.000	0.666	0.000	1.707
	46.722	23.605	9.598	6.960	3.827	33.325
	393	221	52	34	19	719
Debt$_t$ to total capital$_t$	0.296	0.351	0.431	0.541	0.565	0.349
	0.293	0.352	0.454	0.573	0.621	0.344
	0.051	0.117	0.258	0.316	0.361	0.075
	0.526	0.585	0.689	0.791	0.912	0.585
	393	221	52	34	19	719
Dividends$_t/K_t$	0.000	0.000	0.000	0.000	0.000	0.000
	0.015	0.006	0.006	0.002	0.001	0.011
	0.000	0.000	0.000	0.000	0.000	0.000
	0.046	0.023	0.028	0.028	0.007	0.037
	393	221	52	34	19	719
Fraction of years dividends restricted	0.061	0.276	0.462	0.686	0.789	0.206
	393	221	52	34	19	719
Free divs.$_t/K_{t-1}$	0.208	0.013	0.000	0.000	0.000	0.101
	0.334	0.139	0.043	0.019	0.000	0.229
	0.004	0.000	0.000	0.000	0.000	0.000
	0.740	0.430	0.078	0.089	0.000	0.634
	247	129	34	29	15	454

TABLE III
(CONTINUED)

	NFC Not fin. constr.	LNFC Likely not fin. constr.	PFC Possibly fin. constr.	LFC Likely fin. constr.	FC Fin. constr.	All firm-years
Cash_t/K_{t-1}	0.331	0.150	0.150	0.077	0.085	0.168
	0.726	0.253	0.263	0.156	0.139	0.364
	0.050	0.034	0.041	0.029	0.016	0.033
	1.276	0.596	0.721	0.389	0.292	0.784
	393	221	52	34	19	719
$\text{Unused line}_t > 0$	0.723	0.652	0.654	0.529	0.579	0.683
	393	221	52	34	19	719
$\text{Unused line}_t/K_{t-1}$	0.270	0.178	0.136	0.043	0.072	0.203
	0.523	0.313	0.291	0.151	0.159	0.415
	0.000	0.000	0.000	0.000	0.000	0.000
	1.097	0.733	0.900	0.449	0.900	0.979
	393	221	52	34	19	719
Slack_t/K_{t-1}	0.725	0.420	0.344	0.211	0.229	0.557
	1.249	0.566	0.449	0.374	0.320	0.919
	0.217	0.118	0.059	0.044	0.001	0.126
	2.039	1.129	0.923	0.721	1.065	1.679
	393	221	52	34	19	719
$\text{Ch. debt}_t/K_{t-1}$	0.048	0.048	0.153	0.272	0.017	0.062
	0.168	0.157	0.405	0.473	0.012	0.191
	−0.304	−0.354	−0.470	−0.414	−0.546	−0.354
	0.718	0.760	0.983	1.581	0.974	0.797
	393	221	52	34	19	719
$\text{Equity issue}_t/K_{t-1}$	0.000	0.000	0.000	0.000	0.000	0.000
	0.224	0.149	0.042	0.020	0.046	0.177
	0.000	0.00	0.00	0.000	0.000	0.000
	0.634	0.419	0.044	0.000	0.256	0.455
	373	193	38	31	16	651

the sum of the book value of short-term and long-term debt (items 9 and 34), while total capital is the sum of debt, the book value of preferred stock, and the book value of common equity. It is worth pointing out that NFC firm-years have a large median interest coverage of almost eight times while the LNFC firm-years have a median coverage of almost six. In contrast, the median coverage in LFC firm-years is less than three times and in FC firm-years barely exceeds one.

The notes to the financial statements typically state whether a firm's debt covenants, if any, restrict a firm from paying dividends. We interpret a firm as being more financially constrained the greater the restrictions placed on dividend payments by covenants. Table III reports that the fraction of firm-years in which debt covenants forbid the payment of dividends increases monotonically across our classifications. NFC firm-years are restricted 6.1 percent of the time, while LFC and FC firms are restricted more than 68 percent of the time.

In the majority of firm-years the notes to financial statements also report exactly how much of retained earnings are free for dividend payments under the strictest debt covenants.[12] Panel B of Table III indicates that this amount falls monotonically across our five groups. In NFC firm-years the median amount of earnings free for dividends equals 20.8 percent of beginning-of-year capital and almost 58 percent of the year's investment. *In other words, the median NFC firm could have paid out a dividend equal to 58 percent of its capital expenditures without the permission of existing lenders.*

Finally, cash (COMPUSTAT item 1), unused line of credit, and slack (the sum of cash and unused line of credit) all decline monotonically across our classifications. Slack provides a measure of the amount of funds or liquidity immediately available to a firm at year-end. Slack may overstate true liquidity slightly because some firms were required to maintain compensating balances. That qualification notwithstanding, the median slack in NFC firm-years is 72.5 percent of beginning-of-year capital and 191 percent of the year's investment. In LNFC firm-years the analogous amounts are 42 percent and 119 percent.

As an additional check, we estimate ordered logit models of the probability that a firm falls in one of the five categories: with NFC being the lowest state and FC the highest. The results are presented in Table IV. The likelihood of being classified as financially constrained is significantly greater in firms with higher debt to total capital, higher Q, and for whom dividend payments are forbidden. The likelihood is significantly lower in firms with high cash flow, high cash, high dividends paid, high retained earnings free for dividends, and with any unused line of credit at

12. This information is not reported in years that a firm has no debt as well as some of the earlier firm-years.

TABLE IV

ORDERED LOGITS FOR PREDICTABILITY OF FINANCING CONSTRAINT STATUS

Ordered logits for the determination of annual financing constraint status for 49 low-dividend firms are from FHP [1988] from 1970 to 1984. Financing constraint for each year is ordered from not financially constrained (NFC), likely not financially constrained (LNFC), possibly financially constrained (PFC), likely financially constrained (LFC), to financially constrained (FC). Variable definitions are in Tables I and III. Standard errors are in brackets.

Dependent variable is financing constraint status				
Cash flow$_t$/K_{t-1}	−0.886	−1.164	−0.688	−0.839
	[0.230]	[0.256]	[0.222]	[0.235]
Q_t	0.276	0.370		
	[0.080]	[0.087]		
Debt/total capital$_t$	2.071	2.251	1.825	1.938
	[0.470]	[0.480]	[0.464]	[0.471]
Dividends$_t$/K_{t-1}	−23.039	−21.787	−22.551	−20.409
	[5.949]	[6.134]	[5.905]	[6.043]
Dividends restricted ($Y = 1, N = 0$)	1.496	1.365	1.472	1.294
	[0.213]	[0.224]	[0.213]	[0.222]
Unrestricted ret. earnings/K_{t-1}	−1.897	−1.936	−1.896	−1.956
	[0.497]	[0.513]	[0.499]	[0.513]
Cash$_t$/K_{t-1}	−1.704	−1.590	−1.675	−1.567
	[0.311]	[0.323]	[0.311]	[0.320]
Unused line of credit > 0	−0.711	−0.547	−0.758	−0.511
	[0.176]	[0.207]	[0.175]	[0.206]
_cut1	−0.252	0.608	−0.693	0.119
	[0.312]	[0.480]	[0.285]	[0.462]
_cut2	1.973	2.928	1.510	2.413
	[0.328]	[0.499]	[0.298]	[0.478]
_cut3	2.987	3.988	2.501	3.433
	[0.353]	[0.518]	[0.320]	[0.494]
_cut4	4.307	5.353	3.790	4.736
	[0.413]	[0.562]	[0.378]	[0.532]
Year dummies	No	Yes	No	Yes
Log likelihood	−645.0	−627.0	−650.6	−635.7
Pseudo-R^2	0.201	0.223	0.194	0.213

all. All the coefficients are statistically significant at the 1 percent level, and all the coefficients except perhaps the one on Q have the expected sign. Q has a positive impact on the probability of being financially constrained. This is true despite the univariate result in Table III that Q decreases with firm financial health. The likely explanation for this result is Q's partial correlation with cash flow. In the absence of cash flow, the coefficient on Q becomes negative. One way to interpret this result is that con-

ditional on having a low cash flow, we classify a firm as more likely to be constrained if it has more investment opportunities (high Q).

Overall, we feel that the monotonic patterns of most of the operating and financial variables in Table III and the results in Table IV provide a strong quantitative validation of our classification scheme.

C. Overall Financial Status

In order to analyze investment-cash flow sensitivities over fifteen years, we aggregate each firm's annual financial status into an overall measure of financial status. We refer to this as sample financial status (rather than firm-year financial status). We distinguish firms that were never financially constrained from those that were. We do this to account for the likelihood that firms which become constrained will behave as if they are constrained.

Our classification provides a great deal of variation. Nineteen firms are never constrained: they are classified as NFC or LNFC in all fifteen sample years. These firms never showed any sign of being financially constrained over the entire period. Eight firms are possibly constrained. These firms were possibly constrained in at least one year and not constrained (NFC and LNFC) in all the rest. Finally, 22 firms are likely constrained. These firms were classified as LFC or FC in at least one sample year.

We also aggregate annual financial status into overall status over two subperiods: 1970 to 1977 and 1978 to 1984. We classify firms according to whether they were likely constrained, possibly constrained, or not constrained within each subperiod. We do this for four reasons. First, the classification over the entire sample period will classify a firm as financially constrained even if that firm was constrained in only one of fifteen years. By measuring financial status over subperiods, we increase the precision of our classifications. Second, the research design in FHP biases the sample toward companies that were small in 1970, but were established enough by 1984 to be included in the Value Line data set. Therefore, a firm in the earlier part of the sample is conceivably different from the same firm later on. Third, as noted earlier, the information contained in the management discussions and footnotes of annual reports improves after 1977. Therefore, we believe that the precision of our classifications increases in the

second subperiod. Finally, as noted earlier, FHP [1988] report that the sensitivity of investment to cash flow is particularly strong in the first half of the sample, when these firms were smaller and more likely to have been financially constrained.

IV. Regression Results

Armed with a direct measure of a firm's financially constrained status, we can now test whether the worsening of financing constraints is associated with a monotonic increase in investment-cash flow sensitivity (as would occur if d^2I/dW^2 were negative).

A. Financing Constraints and Investment-Cash Flow Sensitivities

We first examine the relationship between financing constraints and investment-cash flow sensitivities by following the FHP methodology and estimating separate regressions by firm sample financial status. We use the regression specifications presented in Table I over the entire sample period. Table V presents our basic results. Firms classified as never constrained (NFC or LNFC in every sample year) exhibit the highest investment-cash flow sensitivity (0.702), exceeding that for the entire sample (0.395), for firms that were likely constrained (0.340), and for firms that were possibly constrained (0.180). The coefficient for the never constrained firms is economically and statistically greater than the coefficients for the other firms.

As we noted earlier, we are not entirely comfortable with the classification of possibly constrained firms. If managers tend to underreport negative information about their firm's financial condition, then it would be appropriate to group the eight possibly constrained firms with the likely constrained firms. Not surprisingly, this grouping lowers the coefficient on constrained firms to 0.250, and widens the gap between constrained firms and unconstrained firms. It is worth pointing out that the 0.250 sensitivity is insignificantly different from that of the high-dividend FHP Class 3 firms and actually smaller than that of the FHP Class 2 firms.

Alternatively, it is possible that we have been excessively conservative and have classified firms as possibly constrained when they were, in fact, unconstrained. Accordingly, we also estimate a regression in which we group the possibly constrained

TABLE V

REGRESSION OF INVESTMENT ON CASH FLOW AND Q BY FINANCIALLY CONSTRAINED STATUS OVER ENTIRE SAMPLE PERIOD

Regression of investment on cash flow and Q for 49 low-dividend firms from FHP [1988] from 1970 to 1984. Variables are defined in Table I. Regressions are estimated for total sample and by financially constrained status where 19 firms are never financially constrained over the entire period (NFC or LNFC in every year), 8 firms are possibly financially constrained at some time (PFC in some year), and 22 firms are likely financially constrained at some time in the period (LFC or FC). Overall status is based on firm financing constraint status for each year of not financially constrained (NFC), likely not financially constrained (LNFC), possibly financially constrained (PFC), likely financially constrained (LFC), and financially constrained (FC). All regressions include firm fixed effects and year effects. Standard errors are in brackets.

	All firms N = 49	Firms never constrained N = 19	Firms possibly constrained N = 8	Firms likely constrained N = 22	Firms never/possibly constrained N = 27	Firms possibly/likely constrained N = 30
CF_t/K_{t-1}	0.395	0.702	0.180	0.340	0.439	0.250
	[0.026]	[0.041]	[0.060]	[0.042]	[0.035]	[0.032]
Q_{t-1}	0.039	0.009	0.016	0.070	0.033	0.059
	[0.005]	[0.006]	[0.049]	[0.018]	[0.006]	[0.017]
Adj. R^2	0.584	0.793	0.240	0.410	0.655	0.358
N obs.	719	279	113	327	392	440

firms with the never constrained firms. While this lowers the investment-cash flow sensitivity substantially (to 0.439), it does not alter the basic result that unconstrained firms exhibit a greater investment-cash flow sensitivity.

In Tables VI and VII, we repeat our basic analysis, but break the sample into two subperiods: 1970 to 1977 and 1978 to 1984. Table VI treats a firm in the 1970–1977 subperiod as different from the same firm in the 1978–1984 subperiod. The regressions presented in Table VI, therefore, include 98 firm-subperiods (with firm-subperiod fixed effects). Again, the coefficients sharply reject the hypothesis that financially constrained firms have greater investment-cash flow sensitivities. In Table VI, firms that are not constrained in a subperiod have an investment-cash flow sensitivity of 0.680. This is significantly greater than the sensitivity of 0.436 for all firm subperiods and greater than the sensitivity of firms that are possibly constrained (at 0.259) or likely constrained (at 0.274).

Table VI also presents regression results for the fifteen firm-subperiods for which we classify the firm as NFC in every year in the subperiod.[13] Ten of the fifteen subperiods fall in the 1978–1984 period during which even FHP argue the sample firms were *less likely* to be constrained. *Strikingly, the investment-cash flow sensitivity for these fifteen subperiods of 0.779 exceeds any of the coefficients for any group of firms we present in Tables VI and VII*.

Based on our classification scheme and the quantitative support for that scheme in Tables III and IV, we find it impossible to argue that these firms were unable to invest more during any of these fifteen subperiods. We also find it difficult to argue that these firms faced a particularly high cost of external finance. Hewlett-Packard, for example, is included among these fifteen subperiods in 1978–1984 (although not in 1970–1977). And Hewlett-Packard has an investment-cash flow sensitivity of 0.97 over the 1978–1984 subperiod, 0.91 over the 1970–1977 subperiod, and 1.15 over the entire sample period. It is worth stressing that the fifteen firms that are NFC in every subperiod year have financial characteristics that are similar to those of FHP's Class 3 firms that pay high dividends and have a low investment-cash flow sensitivity (0.23). For example, the NFC firms and FHP's Class 3 firms have interest coverage ratios that are economically

13. We do not create this classification over the entire sample period because we classify only two firms as NFC in all fifteen years.

TABLE VI

REGRESSION OF INVESTMENT ON CASH FLOW AND Q BY FINANCIALLY CONSTRAINED STATUS IN TWO SUBPERIODS TREATING FIRM-SUBPERIODS AS DIFFERENT FIRMS

Regression of investment on cash flow and Q for 49 low-dividend firms from FHP [1988] from 1970 to 1984. Variables are defined in Table I. Sample is divided into two subperiods, 1970–1977 and 1978–1984. Firm financial constraint status is determined within each subperiod. Fifty-seven firm-subperiods are never financially constrained (NFC or LNFC every year), 14 firm-subperiods are possibly financially constrained (PFC in some year), 27 firm-subperiods are likely financially constrained (LFC or FC in some year), and 15 firm-subperiods are NFC every year. Overall subperiod status is based on firm financing constraint status for each year of not financially constrained (NFC), likely not financially constrained (LNFC), possibly financially constrained (PFC), likely financially constrained (LFC), and financially constrained (FC). Regressions include firm fixed effects for each subperiod, resulting in up to 98 firm-period fixed effects, and year effects. Standard errors are in brackets.

	All firms N = 98	Firms never constrained N = 57	Firms possibly constrained N = 14	Firms likely constrained N = 27	Firms never/possibly constrained N = 71	Firms possibly/likely constrained N = 41	Firms NFC every year N = 15
CF_t/K_{t-1}	0.436	0.680	0.259	0.274	0.523	0.262	0.779
	[0.028]	[0.041]	[0.067]	[0.050]	[0.034]	[0.037]	[0.084]
Q_{t-1}	0.033	0.010	0.081	0.048	0.025	0.054	0.002
	[0.005]	[0.006]	[0.059]	[0.023]	[0.006]	[0.021]	[0.009]
Adj. R^2	0.604	0.721	0.402	0.391	0.661	0.402	0.837
N obs.	719	416	98	205	514	303	110

TABLE VII

REGRESSION OF INVESTMENT ON CASH FLOW AND Q BY FINANCIALLY CONSTRAINED STATUS OVER 1970–1977 AND 1978–1984

Regression of investment on cash flow and Q for 49 low-dividend firms from FHP [1988] from 1970 to 1984. Variables are defined in Table I. Sample is divided into two subperiods, 1970–1977 and 1978–1984. Firm financing constraint status is determined within each subperiod. Fifty-seven firm-subperiods are never financially constrained (NFC or LNFC every year), 14 firm-subperiods are possibly financially constrained (PFC in some year), 27 firm-subperiods are likely financially constrained (LFC or FC in some year), and 15 firm-subperiods are NFC every year. Overall subperiod status is based on firm financing constraint status for each year of not financially constrained (NFC), likely not financially constrained (LNFC), possibly financially constrained (PFC), likely financially constrained (LFC), and financially constrained (FC). Regressions include firm fixed effects for each subperiod. Standard errors are in brackets.

	1970–1977						
	All firms N = 49	Firms never constrained N = 23	Firms possibly constrained N = 7	Firms likely constrained N = 19	Firms never/possibly constrained N = 80	Firms possibly/likely constrained N = 19	Firms NFC every year N = 5
CF_t/K_{t-1}	0.505	0.746	0.247	0.364	0.553	0.306	0.783
	[0.037]	[0.051]	[0.086]	[0.069]	[0.045]	[0.049]	[0.142]
Q_{t-1}	0.035	0.006	0.027	0.025	0.023	0.029	0.002
	[0.017]	[0.007]	[0.082]	[0.023]	[0.007]	[0.022]	[0.015]
Adj. R^2	0.696	0.827	0.381	0.454	0.755	0.446	0.832
N obs.	378	179	50	149	229	199	40
	1978–1984						
	All firms N = 49	Firms never constrained N = 34	Firms possibly constrained N = 7	Firms likely constrained N = 8	Firms never/possibly constrained N = 41	Firms possibly/likely constrained N = 15	Firms NFC every year N = 10
CF_t/K_{t-1}	0.326	0.571	0.272	0.141	0.470	0.160	0.800
	[0.044]	[0.069]	[0.152]	[0.061]	[0.058]	[0.053]	[0.126]
Q_t	0.054	−0.019	0.154	0.413	0.007	0.272	−0.054
	[0.026]	[0.028]	[0.088]	[0.084]	[0.027]	[0.073]	[0.047]
R^2	0.392	0.467	0.422	0.459	0.439	0.402	0.703
N obs.	341	237	48	56	285	104	70

and statistically indistinguishable. It seems difficult to understand how one set of firms can be constrained while the other is not.

Table VII presents results for each of the two subperiods separately. Again, we find no evidence that financing constraints explain the sensitivity of investment to cash flow. In both subperiods the firms that we classify as NFC every year and as never constrained have a significantly higher investment-cash flow sensitivity than the other groups of firms. Furthermore, in the 1978–1984 period where we are more certain of our classifications, the sensitivity declines monotonically with the extent to which we classify firms as constrained.

B. Quantitative Definitions of Financially Constrained Status

Given the results in the previous section, some readers may be concerned that we have misclassified firms by using qualitative data. (For example, see FHP [1996].) To address this concern, we report the results of grouping firms based on quantitative/objective data.

In regressions (1)–(3) of Table VIII, we present estimates of the investment-cash flow sensitivities for (i) the 25 percent of sample firms whose interest coverage never drops below 2.5 and (ii) firms whose dividends are never restricted over the entire sample period. Given the two severe recessions over the sample period, these criteria should identify firms that were relatively financially healthy. The investment-cash flow sensitivity for the thirteen firms whose coverage never drops below 2.5 is significantly greater at 0.673 than the sensitivity of 0.395 for the entire sample. The investment-cash flow sensitivity for the seventeen firms whose dividends are never restricted at 0.435 also exceeds the sensitivity for the entire sample, although not significantly.

In regressions (4)–(6) we split the sample into subperiods as we did in Table VI. We present estimates of the investment-cash flow sensitivities for (i) the 25 percent of firm-subperiods whose interest coverage never drops below 4.5 in the subperiod, and (ii) firms whose dividends are never restricted over the subperiod. The patterns are qualitatively similar and quantitatively stronger than those for the entire sample period. The investment-cash flow sensitivity for the 21 firms whose coverage never drops below 4.5 in a subperiod is a remarkably high 0.801. We should point out that the median interest coverage for firms rated BBB by Standard & Poor's in 1979–1981 was 3.82; the median for

TABLE VIII

REGRESSION OF INVESTMENT ON CASH FLOW AND Q BY OTHER MEASURES OF FINANCIALLY CONSTRAINED STATUS OVER ENTIRE SAMPLE PERIOD AND ENTIRE SUBPERIOD

Regression of investment on cash flow and Q for 49 low-dividend firms from FHP [1988] from 1970 to 1984. Variables are defined in Tables I and III. Regressions (1)–(3) are estimated for total sample and by (i) whether firms ever had interest coverage below 2.5; and (ii) firms are not explicitly restricted from paying dividends over the entire sample period. Interest coverage is the ratio of EBITDA to interest expense. Regressions (4)–(6) are estimated using firm financial status over sample subperiods 1970–1977 and 1978–1984. Regressions (1)–(3) include firm fixed effects and year effects. Regressions (4)–(6) include firm fixed effects for each subperiod, resulting in up to 98 firm-period fixed effects, and year effects. Standard errors are in brackets.

	(1) All firms N = 49	(2) Firms that never have coverage below 2.5 from 1970–1984 N = 13	(3) Firms that never have restricted dividends N = 17	(4) All firms subperiods 1970–1984 and 1978–1984 N = 98	(5) Firms that never have coverage below 4.5 in subperiod N = 25	(6) Firms that never have restricted dividends in subperiod N = 56
CF_t/K_{t-1}	0.395	0.673	0.435	0.436	0.801	0.499
	[0.026]	[0.056]	[0.042]	[0.028]	[0.062]	[0.038]
Q_{t-1}	0.039	0.011	0.035	0.033	−0.003	0.027
	[0.005]	[0.008]	[0.007]	[0.005]	[0.008]	[0.006]
Adj. R^2	0.584	0.756	0.674	0.604	0.772	0.715
N obs.	719	191	247	719	189	402

firms rated A was 6.56. In other words, these firms are not likely to have faced particularly high costs of external finance in absolute terms in the subperiods. More importantly, in relative terms it is virtually certain that they faced lower costs of external finance than the other firms in our sample and, yet, show a higher investment-cash flow sensitivity.

C. Predetermined Classification of Financially Constrained Status

One important potential criticism of our results is that our use of financial status over the entire period (or subperiod) may "hardwire" our results. Firms that only increase investment when they have the cash flow to do so will exhibit a high investment-cash flow sensitivity and will be less likely to become constrained subsequently. In contrast, firms that increase investment when they do not have cash flow will exhibit a low sensitivity and will be more likely to become constrained later (if they finance some of the investment with debt). It is possible, therefore, that the investment-cash flow sensitivities we have estimated reflect the way investment was financed, and that this drives our overall measure of financial status rather than vice versa.

Although it is fairly standard in this literature to sort firms according to within-sample characteristics (for example, FHP [1988], Hoshi, Kashyap, and Scharfstein [1991], and Lamont [1996]), this approach has received an increasing number of criticisms (see Schiantarelli [1995]). To address this concern, we use a definition of financial status that reflects only past (not future) information. Specifically, we measure firm financial status based on the previous year's financial status. This should isolate the effect of financial status, rather than possibly reflecting the way in which investment was financed. In other words, we believe that this specification is the most appropriate one to use to test for the effect of financing constraints on investment-cash flow sensitivities.

In regression (1) of Table IX we present differential estimates of the investment-cash flow sensitivities by interacting cash flow with predetermined annual measures of financing-constraint status.[14] We use four financing constraint dummies: LNFC equals

14. Our results are qualitatively identical when we also include dummy variables for the intercept term.

TABLE IX

REGRESSION OF INVESTMENT ON CASH FLOW AND Q BY ANNUAL FINANCING CONSTRAINT STATUS, RESTRICTED DIVIDEND STATUS, AND LOW SLACK STATUS

Regression of investment on cash flow, Q, and cash flow interacted with financially constrained status, restricted dividend status, and low cash and unused line of credit status for 49 low-dividend firms are from FHP [1988] from 1970 to 1984. Variables are defined in Tables I and III. Firm financing constraint for each year is not financially constrained (NFC), likely not financially constrained (LNFC), possibly financially constrained (PFC), likely financially constrained (LFC), or financially constrained (FC). The noninteracted cash flow variable represents years in which firms are NFC. Regressions (1) and (2) use financial constraint status at the beginning of the fiscal year (based on status at the end of the previous fiscal year). Regression (3) interacts cash flow with a dummy variable that equals one if a firm's covenants restrict it from paying dividends in the previous fiscal year. Regression (4) interacts cash flow with a dummy variable that equals one if a firm's slack in the previous fiscal year is in the lowest quartile of firm-years (less than 0.28 of net property, plant, and equipment). Slack is the sum of cash and unused line of credit. Regressions include firm fixed effects and year effects. Standard errors are in brackets.

(1) Interact annual financial constraint status		(2) Investment by annual financial constraint status		(3) Interact annual restricted dividend status		(4) Interact annual low slack status	
CF_t/K_{t-1}	0.407	Constant	0.202	CF_t/K_{t-1}	0.358	CF_t/K_{t-1}	0.359
	[0.043]		[0.027]		[0.029]		[0.027]
CF_t/K_{t-1}	0.013	LNFC	−0.060	CF_t/K_{t-1}	−0.106	CF_t/K_{t-1}	−0.061
× LNFC	[0.035]		[0.026]	× restricted dividends	[0.052]	× low slack	[0.040]
CF_t/K_{t-1}	−0.235	PFC	−0.112				
× PFC	[0.055]		[0.045]				
CF_t/K_{t-1}	−0.382	LFC	−0.167				
× LFC	[0.086]		[0.054]				
CF_t/K_{t-1}	−0.394	FC	−0.251				
× FC	[0.162]		[0.069]				
Q_{t-1}	0.041	Q_{t-1}	0.101	Q_{t-1}	0.048	Q_{t-1}	0.051
	[0.011]		[0.011]		[0.011]		[0.011]
Adj. R^2	0.504		0.342		0.476		0.475
N obs.	674		674		674		674

one if the firm is likely not financially constrained in the previous fiscal year; PFC, if the firm is possibly financially constrained that year; LFC, if the firm is likely financially constrained that year; and FC, if the firm is definitely financially constrained that year. The base or constant term measures investment in NFC firm-years. We stress that this classification scheme uses only information available at the beginning of the fiscal year. The results are qualitatively identical to those in the previous sections. The investment-cash flow sensitivities are significantly lower for FC, LFC, and PFC firm-years than for LNFC and NFC firm-years. The results are qualitatively identical if FC and LFC firm-years and LNFC and NFC firm-years are classified together.

Although we prefer the above method because it fully uses the annual information on each firm's financial status, we also tried an alternative approach that is somewhat more consistent with the previous literature. (These results are not reported in a table.) For each year from 1970 to 1977, we divided the sample into two groups depending on whether the firm was classified as unconstrained (NFC and LFNC) or constrained (LFC and FC) in that year. We then used the following seven years to estimate separate sensitivity coefficients for the two groups. In all eight paired regressions, the estimated investment-cash flow sensitivity of the unconstrained firms is higher than that of the constrained firms. In five of the eight regressions this difference is statistically significant.

These findings confirm our previous empirical results and support our theoretical claim that investment-cash flow sensitivity is not necessarily increasing in the degree of financing constraints. The one remaining question, perhaps, is our measure of financing constraints. Fortunately, the simple model we presented in Section I provides a way to test the reliability of our indicators. Equation (3) makes the unequivocal theoretical prediction that, ceteris paribus, investment should decrease in the degree of financing constraints. By looking at the relation of our annual financing constraint measures to investment, we can assess the validity of those measures. We do this by introducing our annual financing constraint indicators in a standard Q model of investment (and controlling for fixed firm and year effects). This test is not possible in the earlier regressions because overall financing constraint status is collinear with firm fixed effects.

The results are reported in regression (2) of Table IX. Controlling for Q, investment levels decline monotonically in the de-

gree of financing constraints. For example, investment after LFC firm-years is −0.17 lower than after NFC firm-years. The results are strongly consistent with the predictions derived in equation (3). They also suggest that our lagged measure of financing constraints successfully captures the degree of financing constraint.[15]

In regressions (3) and (4) we repeat the analysis in regression (1), but instead use quantitative measures of financial status, again, based on the previous year's results. In regression (3) we interact cash flow with a dummy variable that equals one when debt covenants restrict the firm from paying dividends. Again, we find that the investment-cash flow sensitivity is significantly *lower, not higher,* for firms restricted from paying dividends. In regression (4) we interact cash flow with a dummy variable that equals one if in the previous firm-year our slack variable—the sum of cash and unused lines of credit as a fraction of capital—is in the lowest quartile of firm-years. The low slack cutoff is 28 percent of beginning-of-year capital (net property, plant, and equipment). Our results are not sensitive to this cutoff. It seems reasonable to assume that firms with less slack are more financially constrained than firms with more slack. Again, we find that the investment-cash flow sensitivity is lower, not higher, for firms with low slack.

Overall, then, we obtain qualitatively identical results using both qualitative and quantitative measures of financing constraints that are predetermined.

D. Sensitivity to Cash Stock

Although most of the literature focuses on the sensitivity of investment to cash flow, some authors (e.g., Kashyap, Lamont, and Stein [1994]) focus on the sensitivity of investment to the cash stock (cash and marketable securities) that a firm has available at the beginning of the year. For completeness, in Table X we reestimate the annual financing constraint regressions in Table IX using this alternative measure of liquidity. (The results we report are qualitatively identical when we instrument cash holdings with its lagged value.)

In the regression in column (1) we measure liquidity as cash

15. These results are also interesting for the debate on the relationship between investment and Q in financially constrained firms. Chirinko [1995] argues that the effects of financing constraints will be fully reflected in a firm's market value and, thus, on its Q. To the contrary, our results suggest that Q is not sufficient to explain the investment of financially constrained firms.

TABLE X
REGRESSION OF INVESTMENT ON CASH FLOW, CASH STOCK, AND Q BY ANNUAL FINANCING CONSTRAINT STATUS

Regression of investment on cash flow, cash stock, Q, and cash flow and cash stock interacted with financially constrained status for 49 low-dividend firms from FHP [1988] from 1970 to 1984. Variables are defined in Tables I and III. Firm financing constraint status for each year is not financially constrained (NFC), likely not financially constrained (LNFC), possibly financially constrained (PFC), likely financially constrained (LFC), or financially constrained (FC). The noninteracted cash flow variable represents years in which firms are NFC. Regressions include firm fixed effects and year effects. Standard errors are in brackets.

(1) Cash stock only		(2) Cash stock and cash flow		(3) Sum of cash stock and cash flow	
$\text{Cash}_{t-1}/K_{t-1}$	0.164	$\text{Cash}_{t-1}/K_{t-1}$	0.101	$[\text{Cash}_{t-1} + CF_t]/K_{t-1}$	0.163
	[0.015]		[0.015]		[0.011]
$\text{Cash}_{t-1}/K_{t-1}$	0.056	$\text{Cash}_{t-1}/K_{t-1}$	0.014	$[\text{Cash}_{t-1} + CF_t]/K_{t-}$	0.079
× LNFC	[0.057]	× LNFC	[0.060]	× LNFC	[0.024]
$\text{Cash}_{t-1}/K_{t-1}$	−0.154	$\text{Cash}_{t-1}/K_{t-1}$	0.269	$[\text{Cash}_{t-1} + CF_t]/K_{t-}$	−0.037
× PFC	[0.125]	× PFC	[0.129]	× PFC	[0.041]
$\text{Cash}_{t-1}/K_{t-1}$	−0.463	$\text{Cash}_{t-1}/K_{t-1}$	0.249	$[\text{Cash}_{t-1} + CF_t]/K_{t-}$	−0.174
× LFC	[0.219]	× LFC	[0.257]	× LFC	[0.064]
$\text{Cash}_{t-1}/K_{t-1}$	−0.523	$\text{Cash}_{t-1}/K_{t-1}$	0.321	$[\text{Cash}_{t-1} + CF_t]/K_{t-}$	−0.196
× FC	[0.340]	× FC	[0.355]	× FC	[0.121]
		CF_t/K_{t-1}	0.342		
			[0.033]		
		CF_t/K_{t-1}	0.076		
		× LNFC	[0.041]		
		CF_t/K_{t-1}	−0.222		
		× PFC	[0.062]		
		CF_t/K_{t-1}	−0.384		
		× LFC	[0.108]		
		CF_t/K_{t-1}	−0.405		
		× FC	[0.179]		
Q_{t-1}	0.085	Q_{t-1}	0.040	Q_{t-1}	0.040
	[0.011]		[0.010]		[0.010]
Adj. R^2	0.306		0.441		0.393
N obs.	674		674		674

stock deflated by net property plant and equipment, both at the beginning of the year. The regression estimates the sensitivity of investment to cash stock as a function of a firm's financial status. Our findings are qualitatively identical to those in Table IX: the least constrained firms show the highest sensitivity.

In column (2) we include both measures of liquidity: cash

flow and cash stock. The sensitivity of investment to cash flow decreases with the degree of financing constraints—the same pattern encountered throughout the paper. In contrast, the sensitivity of investment to cash stock now increases with the degree of financing constraints. These latter results, however, are not statistically significant; none of the coefficients are statistically different from each other.

These results may raise the question of which sensitivity is the relevant one. The theory, however, does not distinguish between cash flow and cash stock: the effect of an extra dollar of funds should be the same, independent of whether it enters the firm this period (as cash flow) or whether it was present in the firm at the beginning of the period (as cash stock). For this reason, we estimate a regression in column (3) of Table X that measures liquidity as the sum of cash flow and cash stock. Our main finding is confirmed: the least constrained firms show a significantly higher sensitivity of investment to internal funds.

We also estimated (but do not report in a table) the regressions in Tables V and VII with cash stock and cash flow. In all regressions, our basic finding holds: investment-cash flow sensitivities decrease significantly with the degree of financing constraints. The results for investment-cash stock sensitivities are mixed. Over the entire sample period, investment-cash stock sensitivities increase significantly with the degree of financing constraints. However, this pattern does not hold for either the 1970–1977 or the 1978–1984 subperiod.

E. Alternative Specifications

We considered, but do not report, a number of alternative specifications of our basic regressions. (1) We removed Q as an independent variable leaving cash flow as the only independent variable. (2) We added the ratio of sales to capital as an independent variable with Q and cash flow to capital. (3) We included two lags of cash flow and Q as independent variables. (4) To reduce the influence of outliers, we: (i) winsorized investment, cash flow, and Q; (ii) deflated investment and cash flow by total assets rather than by capital; (iii) eliminated observations with negative cash flow; and (iv) measured cash flow using EBITDA. (5) We ran regressions for each firm individually. (6) We checked whether the results hold if we exclude any particular firm from the sample. Our results are qualitatively and statistically identical under

all of these alternatives. These specifications and results, therefore, address the concerns raised by FHP [1996] that our empirical results could be the artifact of a censored regression.[16]

We also tested the robustness of our results with respect to different definitions of investment. Besides the standard definition (COMPUSTAT item 128), we used the following: (1) COMPUSTAT item 30, which includes increases in property, plant, and equipment from acquisitions that use purchase accounting; (2) change in net property, plant, and equipment; (3) change in net property, plant, and equipment adding back depreciation; and (4) the sum of capital expenditures and research and development. All four adjustments yield results that are qualitatively and statistically identical to our basic results. Finally, we estimated inventory regressions similar to those estimated by Carpenter, Fazzari, and Petersen [1995]. Again, we find no evidence that the sensitivity of inventory investment to cash flow increases with financing constraints.

V. Discussion of the Results

The results indicate that a high sensitivity of investment to cash flow is not associated with financially constrained firms in our sample. This contrasts with the results in FHP [1988] and many subsequent papers. This section argues in greater detail that our findings are not specific to our sample, but, instead, likely capture general features of the relationship between corporate investment and cash flow. Section VI discusses the implications of these findings for the previous literature.

A. Cash Flow as a Proxy for Investment Opportunities?

One possible criticism is that our sorting criteria are correlated with the mismeasurement of Q and that this effect overcomes the effect of financing constraints (which go in the opposite direction). This criticism was first made in Poterba's [1988] discussion of FHP [1988]. Poterba points out that if cash flow provides more information about future investment opportunities for certain groups of firms (like nondividend paying firms), such firms on average would have a greater investment-cash flow sen-

16. In fact, we believe it is telling that FHP [1996] criticize our results hypothetically, rather than by showing that the criticisms hold in the data.

sitivity, independent of their financial status. FHP [1996] present a similar criticism of our results.

In the literature following FHP [1988], this measurement problem has been addressed by using the so-called Euler equation approach (see Whited [1992]; Bond and Meghir [1994]; and Hubbard, Kashyap, and Whited [1995]). This approach directly tests the first-order conditions of an intertemporal maximization problem that does not require a measurement of Q and, therefore, is (supposedly) unaffected by Q's mismeasurement.

To test the robustness of our findings, we followed the Euler equation approach developed in Bond and Meghir [1994], who explicitly model the wedge between internal and external finance. Their empirical implementation involves regressing investment on lagged investment and its square, sales, cash flow, and debt squared, and testing whether the coefficient on cash flow is different across firms with different dividend policies. When we implement this approach, we obtain results qualitatively identical to those from our basic specification. Our least constrained firms exhibit the highest coefficients.

In sum, the Euler equation approach provides no evidence that our findings are driven by mismeasurement of Q. (The alternative interpretation—that the Euler equation approach fails to control for differences in investment opportunities—would call into question all the results in the literature derived using that methodology.)

B. The Impact of Outliers

The papers in this literature typically deflate all the variables by the value of capital (net property, plant, and equipment) at the beginning of the fiscal year. This method provides consistent estimates if all variables are recorded at short intervals or if there is no growth. In practice, however, neither of the two assumptions is satisfied. Variables are recorded at annual intervals, and companies grow substantially over the sample period: a median of 18 percent per year for our sample. If both investment and cash flow grow at a rate similar to the growth rate of sales, then part of the comovement of investment and cash flow may be due to a scale factor. This effect would bias the estimates of the investment-cash flow sensitivity toward one, particularly in firms with higher annual growth rates.

To account for this possibility, we estimate regressions that

eliminate or downweight observations with high growth rates. The first four columns of Table XI report the results of regressions that exclude firm-years with more than 30 percent sales growth (the upper quartile). When we eliminate these observations, the median rate of sales growth for the constrained, possibly constrained, and not constrained firms is essentially equal (between 11 percent and 12 percent). The investment-cash flow sensitivities decline substantially. Nevertheless, the pattern across the three groups of firms remains qualitatively the same, and the difference in sensitivities is still statistically significant. The second four columns of Table XI report qualitatively similar results when we eliminate firm-years in which net property, plant, and equipment more than doubled.[17] Finally, we obtain qualitatively and statistically similar results (in unreported regressions) when we apply a robust estimation technique that downweights outliers.[18]

In sum, our cross-sectional results are not driven by outliers. The same cannot be said for the overall results in FHP [1988]. Eliminating or downweighting high growth firm-years reduces the estimated investment-cash flow sensitivity of the entire low dividend payout sample to between 0.20 and 0.25. This is effectively identical to the estimate of 0.23 obtained by FHP for their unconstrained, high payout firms. Given that these firms are less likely to experience such extreme growth rates, these results indicate that FHP's overall findings (across payout classes) are at least partially driven by extreme observations.

Unfortunately, this problem is not likely to be restricted to FHP [1988]. Any splitting criterion that sorts firms into subsamples with differential outliers in growth rates—for example, splits on size and dividend payout ratios—may be biased toward finding a difference in coefficients on cash flow. This bias may partially account for the large body of evidence finding a higher investment-cash flow sensitivity in fast growing companies, that tend to be classified as financially constrained.

17. Following a suggestion of David Scharfstein, we investigated all the observations where property, plant, and equipment more than doubled in a single year. In most of these cases the increase in investment appears to have been driven by a sudden surge in both the demand for the firm's product and firm profits.

18. This method, implemented by STATA, performs an initial screening to eliminate gross outliers prior to calculating starting values and then performs, as suggested by Li [1985], Huber iterations followed by biweight iterations. The results are available upon request.

TABLE XI

REGRESSION OF INVESTMENT ON CASH FLOW AND Q BY FINANCIALLY CONSTRAINED STATUS OVER ENTIRE PERIOD WITHOUT HIGH SALES GROWTH OR HIGH INVESTMENT GROWTH OBSERVATIONS

Regression of investment on cash flow and Q for 49 low-dividend firms from FHP [1988] from 1970 to 1984. Variables are defined in Table I. Regressions are estimated for total sample and by financially constrained status, where 19 firms are never financially constrained over the entire period (NFC or LNFC in every year), 8 firms are possibly financially constrained at some time (PFC in some year), and 22 firms are likely financially constrained at some time in the period (LFC or FC). Overall status is based on firm financing constraint status for each year of not financially constrained (NFC), likely not financially constrained (LNFC), possibly financially constrained (PFC), likely financially constrained (LFC), and financially constrained (FC). All regressions include firm fixed effects and year effects. Standard errors are in brackets.

	No firm-years with more than 30% sales growth				No firm-years with investment exceeding initial capital (K_{t-1})			
	All firms N = 49	Firms never constrained N = 19	Firms possibly constrained N = 8	Firms likely constrained N = 22	All firms N = 49	Firms never constrained N = 19	Firms possibly constrained N = 8	Firms likely constrained N = 22
CF_t/K_{t-1}	0.246	0.531	0.104	0.233	0.203	0.366	0.149	0.211
	[0.050]	[0.124]	[0.045]	[0.058]	[0.031]	[0.042]	[0.046]	[0.032]
Q_{t-1}	0.051	0.033	0.048	0.049	0.046	0.023	−0.001	0.067
	[0.012]	[0.014]	[0.053]	[0.024]	[0.009]	[0.010]	[0.027]	[0.013]
Adj. R^2	0.328	0.502	0.155	0.270	0.449	0.597	0.252	0.427
N obs.	535	201	79	255	679	263	109	307

C. Financially Constrained Equals Financially Distressed?

It is plausible that financially distressed firms will exhibit low investment-cash flow sensitivities. For example, an insolvent firm might be forced by its creditors to use additional cash flow to repay debt rather than for capital expenditures. This necessarily will reduce the sensitivity of investment to cash flow. If the firms we classify as constrained and possibly constrained are, in fact, financially distressed, this would reduce the generality and impact of our results.

Tables III and XII, however, refute this argument. Table III presents firm characteristics by firm-year financial status; Table XII presents firm characteristics by overall sample financial status. First, the bottom of Table III indicates that firms increase their debt, rather than repay it in the years we classify them as possibly, likely, or definitely constrained. Second, although one might argue that the definitely constrained firm-years are distressed (median interest coverage of 1.09), Table III shows that this is not likely to be the case for the likely constrained firm-years (median interest coverage of 2.84) and definitely not the case for the possibly constrained firm-years (median interest coverage of 4.20). Third, Table XII shows that over the entire sample period, firms we classify as possibly constrained are approximately as healthy as firms we classify as never constrained. Finally, it is unreasonable to describe the likely constrained firms as distressed over the entire sample period (median interest coverage of 4.84), despite the fact that they are less healthy overall than the other two groups. In fact, FHP [1988] intended to eliminate distressed firms because they explicitly excluded firms with overall negative real sales growth from their sample.

VI. Implications for Previous Work

The discussion above suggests that our findings are not caused by econometric problems or an inappropriate classification scheme. In our sample there is a negative, rather than positive, correlation between investment-cash flow sensitivities and the degree of financing constraints. This shows that a nonmonotonic relationship (or even an inverse relationship) is not only theoretically possible, but is also empirically relevant. Only future work will be able to ascertain how pervasive this nonmonotonicity is. However, our paper shows that monotonicity cannot be taken for granted.

TABLE XII

MEDIAN FIRM CHARACTERISTICS BY FINANCIALLY CONSTRAINED STATUS IN ENTIRE SAMPLE PERIOD

Median firm characteristics by overall financial status for 49 low-dividend firms from FHP [1988] from 1970 to 1984. Overall status is based on firm financing constraint status for each year of not financially constrained (NFC), likely not financially constrained (LNFC), possibly financially constrained (PFC), likely financially constrained (LFC), and financially constrained (FC). For the entire period, 19 firms are never financially constrained over the entire period (NFC or LNFC in every year), 8 firms are possibly financially constrained at some time (PFC in some year), and 22 firms are likely financially constrained at some time in the period (LFC or FC). Each entry reports the median and number of observations. Investment (I_t), cash flow, Q, and capital (K_{t-1}) are defined in Table I. Interest coverage is the ratio of earnings before interest, taxes, and depreciation (EBITDA) to interest expense. Debt is the sum of the book value of short-term and long-term debt. Total capital is the sum of debt, the book value of preferred stock, and the book value of common equity. Free divs. is the amount of retained earnings that are not restricted from being paid out as dividends. Cash is cash and marketable securities. Unused line$_t$ is the amount of unused line of credit at the end of year t. Slack is the sum of cash and unused line.

	Never constrained N = 279	Possibly constrained N = 113	Likely constrained N = 327	All firm-years N = 719
A. Investment, cash flow, growth				
I_t/K_{t-1}	0.348	0.403	0.337	0.348
Cash Flow$_t/K_{t-1}$	0.451	0.517	0.364	0.421
(Cash Flow$_t - I_t)/K_{t-1}$	0.081	0.142	0.001	0.051
Q_t	1.262	1.438	1.200	1.231
Sales growth$_t$	0.194	0.176	0.172	0.180
B. Financial policy				
Interest coverage$_t$	8.070	9.928	4.842	6.406
Debt$_t$ to total capital$_t$	0.289	0.249	0.415	0.349
Fraction of years dividends restricted	0.115	0.070	0.327	0.206
Free divs.$_t/K_{t-1}$	0.186	0.315	0.023	0.101
Cash$_t/K_{t-1}$	0.215	0.239	0.109	0.168
Unused line$_t > 0$	0.631	0.649	0.730	0.683
Unused line$_t/K_{t-1}$	0.153	0.208	0.256	0.203
Slack$_t/K_{t-1}$	0.626	0.630	0.481	0.557
Ch. debt$_t/K_{t-1}$	0.048	0.000	0.094	0.062
Years with equity issue	0.234	0.167	0.189	0.203

One might argue that we have only raised a possibility, and that our findings do not generalize beyond the specific FHP [1988] sample. In fact, FHP [1996]—citing the large body of evidence which finds that an increased sensitivity is associated with a priori measures of financing constraints—dismiss our results as little more than an empirical counterexample.

The existing literature, however, cannot be brought in as evidence against our results for two reasons. First, it is likely that a publication selection bias exists in this literature. Because the null hypothesis before FHP [1988] was that financing constraints did not matter, only papers showing otherwise were likely to be written and published. (See De Long and Lang [1992].)

More importantly (and ignoring the possible publication bias), the existing evidence can be used to support the monotonicity assumption only if the theoretical priors used in those studies unequivocally identify those firms as more likely to be constrained. If this were the case, then the fact that most studies find a higher sensitivity for firms more likely to be constrained may be interpreted in favor of a monotonic relation between sensitivities and financing constraints. However, if the priors are ambiguous (and monotonicity cannot be taken for granted), then the argument is invalid, and the interpretation of many of the results in this literature becomes questionable: high sensitivities, per se, cannot be taken as evidence of financing constraints.

In our view, most of the sorting criteria used in this literature are, indeed, theoretically ambiguous. Consider, for example, one of the better known papers in this literature: Hoshi, Kashyap, and Scharfstein [1991], which divides Japanese firms on the basis of whether they belong to a keiretsu and, therefore, to a large extent of whether they have a main-bank relationship. Although it is easy to argue that such a relationship will have an effect on a firm's financing and investment policy, it is much less clear, on a priori grounds, what the sign of this effect should be. Some theories (e.g., Myers and Majluf [1984]) imply a positive role for a main-bank relationship in reducing informational asymmetries and, thus, in alleviating financing constraints. Hoshi, Kashyap, and Scharfstein find that Japanese firms with an exclusive bank relationship have a *lower* investment-cash flow sensitivity. By stressing these theories, Hoshi, Kashyap, and Scharfstein interpret their findings as evidence that a main-bank relationship makes firms *less* constrained.

In contrast, other theories (e.g., Sharpe [1990] and Rajan [1991]) imply that banks can exploit an exclusive main-bank relationship and charge client firms a higher cost of capital (i.e., make them more financially constrained). The finding in Hoshi, Kashyap, and Scharfstein [1993] that the healthiest Japanese firms (from their original sample) subsequently broke their exclusive bank relationships is consistent with this interpretation.

Houston and James [1995] find that U. S. firms with an exclusive bank relationship have a *higher* investment-cash flow sensitivity. By stressing these other theories, Houston and James interpret this as evidence that a main-bank relationship makes these firms *more, not less,* constrained.

The theoretical ambiguity is not unique to Hoshi, Kashyap, and Scharfstein [1991] and Houston and James [1995], but is shared by most of the splitting criteria used in this literature. Firms with a lower-than-average leverage are sometimes interpreted, a priori, as relatively unconstrained firms (e.g., Whited [1992]) because they retain a large debt capacity and can obtain external funds very easily. In other papers, firms with lower-than-average leverage are considered to be relatively constrained (e.g., Calomiris and Himmelberg [1995]) because they are assumed to maintain low leverage because the costs of being financially constrained or distressed would be extremely high.

Similarly, firms with unusually high cash holdings are sometimes classified, a priori, as relatively unconstrained [Kashyap, Lamont, and Stein 1994] because they can invest that cash. And sometimes firms with unusually high cash holdings are classified as relatively constrained [Calomiris, Himmelberg, and Wachtel 1995] because they are assumed to need to accumulate that cash as precautionary savings to avoid the high costs of being financially constrained or distressed in the future.

In sum, the theoretical priors are ambiguous. As a result, our findings are not a minor counterexample in a large literature that finds otherwise. Rather this is the first paper to test the very assumption upon which the literature is based.[19]

VII. Conclusion

Our analysis indicates that the investment-cash flow sensitivity criterion as a measure of financing constraints is not well-grounded in theory and is not supported by empirical evidence in the case we investigate. While we believe that the nonmonotonicity problem we have documented is pervasive and affects many of the results in this literature, future research will be needed to confirm this hypothesis.

19. Our methodology is not subject to the same criticisms for two reasons. First, we classify firm financing constraint status using direct observation rather than theoretical priors. Second, we confirm the quality of our financing constraint indicators using a test for which the theory is unequivocal.

If the nonmonotonicity result is general, then it will be important to understand its source. One explanation (implicitly assumed in our theoretical model) involves understanding the shape of the cost function of raising external finance where external finance is costly because of information or agency problems. Alternatively, it is possible that the nonmonotonic behavior of the investment-cash flow sensitivity is driven by a mischaracterization of the reasons why firms are reluctant to raise external finance. The most financially successful and least constrained firms in our sample appear to rely primarily on internal cash flow to invest despite the availability of additional low cost funds and, therefore, exhibit a high investment-cash flow sensitivity. The key question—that we do not answer—is why we observe this behavior. It seems important that future work attempt to distinguish among these explanations because of their disparate policy implications for institutional and incentive design.

The final implication of our paper is a methodological one. Our research design and results point out what we think is a weakness in existing research as well as an opportunity for future research. A great deal can be learned through more direct observation.

* Appendix follows references.

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Appendix: Financial Status by Firm-Year, by Subperiod, and by Entire Period

Distribution of financing constraints by year for 49 low-dividend firms from Fazzari, Hubbard, and Petersen [1988], from 1970 to 1984. Firm financing constraint status for each year is not financially constrained (NFC), likely not financially constrained (LNFC), possibly financially constrained (PFC), likely financially constrained (LFC), or financially constrained (FC). For subperiods and entire period: firms are NFC if firms are not financially constrained (NFC) every year; firms are NC if firms are not or likely not financially constrained (NFC or LNFC) every year; PFC if firms are possibly financially constrained (PFC) in some year; and FC if firms are likely or definitely financially constrained (LFC or FC) in some year.

Company	1970	1971	1972	1973	1974	1975	1976	1977
Barry	NFC	NFC	NFC	NFC	NFC	NFC	NFC	NFC
DWG	LNFC	LNFC	LNFC	LNFC	LNFC	LNFC	LNFC	LNFC
Digital Equipment	LNFC	LNFC	LNFC	LNFC	NFC	NFC	NFC	NFC
Fluke	LNFC	NFC	LNFC	LNFC	LNFC	LNFC	LNFC	LNFC
Forest Labs	NFC	NFC	LNFC	NFC	NFC	NFC	NFC	NFC
GCA	NFC	NFC	NFC	NFC	NFC	LNFC	NFC	NFC
Helene Curtis	LNFC	NFC	NFC	NFC	LNFC	NFC	NFC	NFC
Hewlett Packard	LNFC	LNFC	LNFC	LNFC	LNFC	NFC	NFC	NFC
Iroquois Brands	LNFC	NFC	NFC	NFC	NFC	LNFC	NFC	NFC
James River			NFC	NFC	NFC	LNFC	NFC	NFC
National Semi.	NFC	NFC	NFC	NFC	NFC	NFC	NFC	NFC
Scientific Atlanta	LNFC	LNFC	LNFC	LNFC	LNFC	NFC	LNFC	NFC
Southdown	NFC	NFC	NFC	NFC	NFC	LNFC	LNFC	LNFC
Thermo Electron	NFC	NFC	NFC	LNFC	LNFC	LNFC	NFC	NFC
Trico	LNFC	LNFC	LNFC	LNFC	LNFC	LNFC	NFC	NFC
Wang Labs	NFC	NFC	LNFC	NFC	NFC	LNFC	NFC	NFC
Winnebago	LNFC	NFC	NFC	LNFC	NFC	LNFC	LNFC	NFC
Cameron Iron Works	NFC	NFC	NFC	NFC	NFC	NFC	NFC	NFC
Data General	NFC	NFC	NFC	NFC	NFC	NFC	NFC	NFC
Coachmen	LNFC	LNFC	LNFC	LNFC	LNFC	NFC	NFC	NFC
Coherent	LNFC	LNFC	LNFC	LNFC	LNFC	PFC	LNFC	PFC
Commodore Intl					PFC	PFC	LNFC	LNFC
Nucor	PFC	PFC	NFC	NFC	NFC	NFC	NFC	LNFC
Plantronics	NFC	NFC	NFC	NFC	NFC	NFC	NFC	NFC
Teradyne	NFC	NFC	NFC	NFC	PFC	NFC	LNFC	LNFC
Vernitron	PFC	PFC	NFC	NFC	NFC	LNFC	NFC	NFC
Whitehall	NFC	NFC	NFC	NFC	NFC	LNFC	LNFC	LNFC
Adams Russell	LNFC	LNFC	PFC	LNFC	LNFC	LNFC	LNFC	NFC
Analog Devices	PFC	PFC	PFC	LNFC	LFC	PFC	LNFC	NFC
Applied Magnetics	LNFC	LNFC	LNFC	NFC	LFC	PFC	PFC	FC
Aydin	FC	LFC	LFC	PFC	LNFC	NFC	NFC	LNFC
Champion Home	NFC	LNFC	NFC	PFC	FC	PFC	FC	FC
Coleco	LNFC	LNFC	NFC	PFC	PFC	PFC	LNFC	FC
Compugraphic	LNFC	LNFC	LNFC	LNFC	LNFC	LNFC	NFC	NFC
Control Data	LNFC	LFC	LNFC	LNFC	LFC	LNFC	LNFC	NFC
Cordis	LNFC	PFC	LNFC	LNFC	LFC	FC	FC	LNFC
Galveston Houston	LNFC	PFC	LFC	LNFC	LNFC	LNFC	NFC	NFC
Gerber Scientific	PFC	NFC	LNFC	LNFC	FC	LFC	LNFC	NFC
Hesston	NFC	NFC	NFC	NFC	NFC	NFC	LFC	FC
Intl Rectifier	LNFC	PFC	PFC	LNFC	NFC	LNFC	NFC	NFC
Katy Inds	PFC	LNFC	NFC	NFC	PFC	FC	LFC	PFC
Mohawk Data Sciences	NFC	LNFC	PFC	FC	FC	LFC	LNFC	LNFC
Raychem	PFC	LNFC	LNFC	LNFC	LFC	LFC	LNFC	LNFC
Recognition Equipment	LNFC	LNFC	NFC	FC	LFC	LNFC	LNFC	LNFC
Rockcor	NFC	LFC	LFC	LNFC	LNFC	LNFC	LNFC	NFC
Rogers	PFC	PFC	PFC	LNFC	PFC	LFC	NFC	LNFC
SCI Systems	LFC	LFC	PFC	LFC	LFC	LNFC	LNFC	LNFC
Tyson Foods	LNFC	PFC	LNFC	LNFC	LFC	LNFC	NFC	NFC
US Surgical	FC	LFC	LFC	LFC	PFC	PFC	NFC	NFC

APPENDIX: CONTINUED

1978	1979	1980	1981	1982	1983	1984	Overall 1970–1977	Overall 1978–1984	Overall 1970–1984
NFC	NFC	NFC	LNFC	LNFC	LNFC	LNFC	NFC	NC	NC
NFC	NFC	NFC	NFC	NFC	NFC	NFC	NC	NFC	NC
NFC	NFC	NFC	NFC	NFC	NFC	NFC	NC	NFC	NC
NFC	NFC	LNFC	LNFC	NFC	NFC	NFC	NC	NC	NC
LNFC	LNFC	NFC	NFC	LNFC	NFC	NFC	NC	NC	NC
NFC	NFC	NFC	NFC	LNFC	LNFC	NFC	NC	NC	NC
NFC	NFC	NFC	NFC	LNFC	LNFC	LNFC	NC	NC	NC
NFC	NFC	NFC	NFC	NFC	NFC	NFC	NC	NFC	NC
NFC	NFC	NFC	LNFC	NFC	NFC	NFC	NC	NC	NC
NFC	NFC	NFC	NFC	NFC	NFC	NFC	NC	NFC	NC
NFC	NFC	LNFC	LNFC	LNFC	NFC	LNFC	NFC	NC	NC
NFC	NFC	NFC	NFC	NFC	NFC	NFC	NC	NFC	NC
NFC	NFC	NFC	LNFC	LNFC	NFC	NFC	NC	NC	NC
NFC	LNFC	NFC	NFC	NFC	NFC	NFC	NC	NC	NC
NFC	NFC	NFC	NFC	NFC	NFC	NFC	NC	NFC	NC
NFC	NFC	NFC	NFC	NFC	NFC	NFC	NC	NFC	NC
NFC	LNFC	NFC	NFC	NFC	NFC	NFC	NC	NC	NC
NFC	NFC	NFC	NFC	NFC	NFC	NFC	NFC	NFC	NFC
NFC	NFC	NFC	NFC	NFC	NFC	NFC	NFC	NFC	NFC
NFC	PFC	LNFC	NFC	NFC	NFC	NFC	NC	PFC	PFC
LNFC	LNFC	PFC	LNFC	LNFC	NFC	NFC	PFC	PFC	PFC
LNFC	LNFC	NFC	NFC	NFC	NFC	NFC	PFC	NC	PFC
LNFC	LNFC	NFC	NFC	NFC	NFC	NFC	PFC	NC	PFC
LNFC	LNFC	NFC	NFC	NFC	PFC	LNFC	NFC	PFC	PFC
LNFC	NFC	NFC	NFC	NFC	NFC	NFC	PFC	NC	PFC
NFC	NFC	NFC	NFC	NFC	NFC	NFC	PFC	NFC	PFC
NFC	PFC	LNFC	NFC	NFC	NFC	NFC	NC	PFC	PFC
NFC	NFC	NFC	NFC	NFC	LNFC	LFC	PFC	FC	FC
NFC	NFC	LNFC	NFC	NFC	NFC	NFC	FC	NC	FC
LNFC	LNFC	NFC	NFC	NFC	NFC	LNFC	FC	NC	FC
LNFC	NFC	NFC	NFC	NFC	NFC	NFC	FC	NC	FC
LFC	LFC	LFC	NFC	NFC	NFC	NFC	FC	FC	FC
FC	PFC	NFC	NFC	NFC	LFC	LFC	FC	FC	FC
NFC	NFC	PFC	FC	NFC	NFC	NFC	NC	FC	FC
NFC	NFC	NFC	NFC	NFC	NFC	LNFC	FC	NC	FC
LNFC	NFC	LNFC	LNFC	LNFC	LNFC	LNFC	FC	NC	FC
NFC	PFC	LNFC	NFC	LNFC	LNFC	LFC	FC	FC	FC
NFC	PFC	NFC	LNFC	NFC	NFC	NFC	FC	PFC	FC
NFC	NFC	NFC	NFC	LNFC	LNFC	LNFC	FC	NC	FC
NFC	NFC	NFC	LNFC	LFC	LNFC	NFC	PFC	FC	FC
PFC	LNFC	NFC	NFC	NFC	NFC	LNFC	FC	PFC	FC
NFC	NFC	NFC	PFC	PFC	LFC	FC	FC	FC	FC
NFC	NFC	NFC	NFC	LNFC	LNFC	LNFC	FC	NC	FC
LNFC	LNFC	NFC	PFC	FC	LNFC	LNFC	FC	FC	FC
NFC	NFC	NFC	NFC	NFC	LNFC	NFC	FC	NC	FC
NFC	LNFC	LNFC	PFC	LNFC	LNFC	NFC	FC	PFC	FC
LNFC	NFC	NFC	NFC	NFC	NFC	NFC	FC	NC	FC
LNFC	LNFC	LNFC	NFC	NFC	NFC	NFC	FC	NC	FC
LNFC	LNFC	LNFC	NFC	NFC	NFC	NFC	FC	NC	FC

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