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The Relationship between Firm Investment and Financial Status

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ABSTRACT

Firm investment decisions are shown to be directly related to financial factors. Investment decisions of firms with high creditworthiness (according to traditional financial ratios) are extremely sensitive to the availability of internal funds; less creditworthy firms are much less sensitive to internal fund availability. This large sample evidence is based on an objective sorting mechanism and supports the results of Kaplan and Zingales (1997), who also find that investment outlays of the least constrained firms are the most sensitive to internal cash flow.

A FIRM'S FINANCIAL STATUS IS IRRELEVANT for real investment decisions in a world of perfect and complete capital markets, as has been demonstrated by Modigliani and Miller (1958). However, financial structure may be relevant to the investment decisions of companies facing uncertain prospects that operate in imperfect or incomplete capital markets where the cost of external capital exceeds that of internal funds. For example, Greenwald, Stiglitz, and Weiss (1984), Myers and Majluf (1984), and Myers (1984) provide a foundation for these market imperfections by appealing to asymmetric information problems in capital markets. Alternatively, Bernanke and Gertler (1989, 1990) and Gertler (1992) demonstrate that agency costs can also cause a premium on external finance that increases as borrower net worth decreases. The investment decisions of firms operating in such environments are sensitive to the availability of internal funds because they possess a cost advantage over external funds.

Fazzari, Hubbard, and Petersen (1988) and a number of subsequent empirical studies provide strong support for the existence of this financing hierarchy, which is most prevalent among firms that have been identified as facing a high level of financial constraints.[1] These studies categorize firms according to characteristics (such as dividend payout, size, age, group membership, or debt ratings) that are designed to measure the level of financial

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[1] Other examples include studies by Hoshi, Kashyap, and Scharfstein (1991), Oliner and Rudebusch (1992), Whited (1992), Schaller (1993), and Gilchrest and Himmelberg (1995). Refer to Hubbard (1998) for an extensive summary of this literature.

constraints faced by firms. The results suggest that investment decisions of firms that are more financially constrained are more sensitive to firm liquidity than those of less constrained firms.

Debate over this matter has been fueled by the recent work of Kaplan and Zingales (1997) who challenge the generality of the conclusions summarized above. Kaplan and Zingales (hereafter KZ) classify firms according to their degree of financial constraint, based on quantitative and qualitative information obtained from company annual reports. Contrary to previous evidence, they find that investment decisions of the least financially constrained firms are the most sensitive to the availability of cash flow.

This study follows the approach of Kaplan and Zingales by classifying firms according to financial variables that are related to financial constraints. Firm financial status is determined using multiple discriminant analysis, similar to Altman's Z factor for predicting bankruptcy. This multivariate classification scheme effectively captures desired cross-sectional properties of firms. It also allows reclassification of firm financial status every period, and group composition is allowed to vary over time to reflect changing levels of financial constraints at the level of the firm. This differs from previous studies that do not allow group composition to vary, implicitly assuming that financial obstacles faced by firms do not change over time.

A major focus of this literature is the comparison of investment-liquidity sensitivities across different groups of firms. I employ a bootstrap methodology to determine significance levels of observed differences in coefficient estimates. This represents an improvement over previous studies whose conclusions are based primarily on the observed differences in magnitude and level of significance of the liquidity variable coefficient estimates.

Investment decisions of all firms are found to be very sensitive to firm liquidity, which is consistent with previous evidence. Similar to the KZ results, firms that are more creditworthy exhibit greater investment-liquidity sensitivity than those classified as less creditworthy. This provides strong support for the KZ conclusions using an objective classification scheme and a large, diversified sample of 1,317 U.S. firms.

The remainder of the paper is organized as follows. The next section reviews existing literature and discusses the motivation for the present study. Section II provides details of the data and methodology utilized, and Section III examines the regression results. Conclusions are offered in the final section.

I. Background

A. Evidence of Financing Hierarchies

An important empirical study of firm investment decisions in the presence of financial constraints was conducted by Fazzari, Hubbard, and Petersen (1988) (hereafter FHP88). They use *Value Line* data for 422 large U.S. man-

ufacturing firms over the 1970 to 1984 time period to analyze differences in investment behavior by firms classified according to earnings retention.[2] FHP88 argue that firms with higher retention ratios face higher informational asymmetry problems and are more likely to be liquidity constrained.

FHP88 run the following regression for several models of investment:

$$(I/K)_{it} = f(X/K)_{it} + g(CF/K)_{it} + u_{it}, \tag{1}$$

where I_{it} represents investment in plant and equipment for firm i during period t; K is the beginning-of-period book value for net property, plant, and equipment; $g(CF/K)$ is a function of current cash flow which measures firm liquidity; $f(X/K)$ is a function of variables related to investment opportunities; and u_{it} is an error term. Their analysis focuses on the q theory of investment, which suggests that $f(X/K)$ is represented by a firm's Tobin's q value. The investment of firms that exhaust all their internal finance is found to be much more sensitive to fluctuations in cash flow than that of mature, high dividend firms. FHP88 attribute these results to a financing hierarchy in which internal funds have a cost advantage over new equity and debt.

Subsequent studies have confirmed the central FHP88 result by dividing samples according to other a priori measures of financial constraint. For example, Hoshi et al. (1991) conclude that the investment outlays of 24 Japanese manufacturing firms that are not members of a keiretsu are much more sensitive to firm liquidity than that of 121 firms that are members of a keiretsu and are presumed to be less financially constrained. Oliner and Rudebusch (1992) examine 99 NYSE-listed firms and 21 over-the-counter firms during the 1977 to 1983 period. They find that investment is most closely related to cash flow for firms that are young, whose stocks are traded over-the-counter, and that exhibit insider trading behavior consistent with privately held information. Schaller (1993) studies 212 Canadian firms over the 1973 to 1986 period and concludes that investment for young, independent, manufacturing firms with dispersed ownership concentration is the most sensitive to cash flow.

Whited (1992) and Bond and Meghir (1994) employ an Euler equation approach to directly test the first-order condition of an intertemporal maximization problem, which does not require the measurement of Tobin's q. The strategy is implemented by imposing an exogenous constraint on external finance and testing whether that constraint is binding for a particular group of firms. Whited uses a sample of 325 U.S. manufacturing firms for the 1972 to 1986 period, and Bond and Meghir use an unbalanced panel of

[2] In particular, FHP88 classify firms into the following three groups based on their dividend behavior over the 1970 to 1984 period: (1) those that have a ratio of dividends to income of less than 0.10 for at least 10 years; (2) those that have a dividend-income ratio between 0.10 and 0.20 for at least 10 years; and (3) all other firms.

626 U.K. manufacturing companies for the 1974 to 1986 period. Both of these studies find the exogenous finance constraint to be particularly binding for the constrained groups of firms, which supports the basic FHP88 result. All of these results support FHP88's informational asymmetry argument.

A related study by Mayer (1990) examines the sources of industry finance of eight developed countries from 1970 to 1985 and reveals a number of stylized facts regarding global corporate financing behavior which also support the existence of financing hierarchies. He finds that: (i) retentions are the dominant source of financing in all countries; (ii) the average firm in any of these countries does not raise substantial amounts of financing from security markets in the form of short-term securities, bonds, or equities; and, (iii) the majority of external financing comes from bank loans in all countries.

B. Conflicting View

Kaplan and Zingales (1997) challenge the generality of the conclusions described above. They use a combination of qualitative and quantitative information extracted from company annual reports to rank firms in terms of their apparent degree of financial constraint. A firm is classified as financially constrained if the cost or availability of external funds precludes the company from making an investment it would have chosen to make had internal funds been available. Their classification scheme uses data from letters to shareholders, management discussions of operations and liquidity (when available), financial statements, notes to those statements for each firm-year, and financial ratios obtained from the COMPUSTAT database.[3]

The KZ sample consists of the 49 low-dividend paying firms identified by FHP88 as having extremely high investment–cash flow sensitivity. Contrary to FHP88's prediction that this entire group would face severe financial constraints, KZ 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 fact, almost 40 percent of the sample firms, including Hewlett-Packard (cited above), could have increased investment in every year of the sample period" (p. 171). Contrary to previous research, KZ find that the least financially constrained firms exhibit the greatest investment–cash flow sensitivity. They suggest these controversial results "capture general features of the relationship between corporate investment and cash flow" (p. 204), and are not specific to the sample or techniques utilized.

[3] KZ determine firm financial constraint status every year; however, they classify firms into one of three groups for the entire period for regression purposes. Firms are categorized as not financially constrained in a particular year if they "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." Firms were "more likely" to be classified as not constrained if they had a large cash position (relative to investment), or if the firm's lenders did not restrict the firm from making large dividend payments (relative to investment). This classification scheme suggests unconstrained firms tend to include financially healthy companies with low debt and high cash.

C. Motivation

KZ's finding that investment outlays of the least financially constrained firms are the most sensitive to cash flow contradicts a large body of empirical results, which implies the importance of examining the generality of their conclusions. The results are puzzling because they suggest that managers choose to rely primarily on internal cash flow for investment, despite the availability of additional low cost external funds. An important implication is that policies designed to make credit more available during recessions may not lead to an increase in investment by firms with high investment–cash flow sensitivities, which has been a policy implication of the existing literature.

The classification of firm financial constraint status according to traditional financial ratios has intuitive appeal because it represents a direct measure of the premium paid for bank loans by firms. The importance of this type of measure is highlighted by Mayer's (1990) evidence that bank loans are the primary source of external finance for firms in developed countries. However, a major limitation of the KZ study is the fact that their sample consists of only 49 manufacturing firms that could be considered fairly high quality firms, or they would not have been included in the *Value Line* database. They further subdivide this sample into groups of 22, 19, and 8, which leaves very few firms in the groups for comparison purposes. The use of such a small homogeneous sample implies the behavior of a very few firms could be driving their results, and it may be ambitious to make general conclusions based on these observations. Further, KZ are criticized by Fazzari, Hubbard, and Petersen (1996) and Schiantarelli (1995) because their sorting criteria are somewhat subjective and rely on possibly self-serving managerial statements.

II. Research Design

A. Sample Characteristics

The sample consists of 1,317 U.S. firms that have complete financial information available for the 1987 to 1994 period on the SEC Worldscope Disclosure data set.[4] Because the majority of firms have a December fiscal year-end, firms are included only if their last available financial statements were reported for fiscal year-ends occurring between July 1994 and June 1995. Banks, insurance companies, other financial companies, and utility companies were deleted from the sample. Details of the calculation of the financial variables are included in the Appendix. Included firms were required to have positive values for sales, total assets, net fixed assets, and market-to-book ratio.

[4] The requirement of complete information availability over the entire sample period is imposed to allow comparison of results with previous studies. The rationale underlying the use of this criterion is to focus attention on firms that have wealth to distribute.

A number of observations are "winsorized" (if the value of the variable exceeded cutoff values) according to the following rules: (i) assign a value of 100 percent (−100 percent) if growth in sales is greater (less) than 100 percent (−100 percent); (ii) assign a value of 2 (−2) if investment/net fixed assets is greater (less) than 2 (−2); (iii) assign a value of 5 (−5) if cash flow/net fixed assets is greater (less) than 5 (−5); (iv) assign a value of 10 if market-to-book is greater than 10; (v) assign a value of 10 if current ratio is greater than 10; (vi) assign a value of 100 percent (−100 percent) if net income margin is greater (less) than 100 percent (−100 percent); and (vii) assign a value of 100 (−0.1) if fixed charge coverage is greater (less) than 100 (0). This approach reduces the impact of extreme observations and allows the use of a larger number of observations than would be possible if these *extreme* observations were deleted (1,317 versus 1,080 firms).[5]

The sample includes 709 NYSE listed companies, 416 Nasdaq companies, and 192 companies listed on the AMEX or other U.S. exchanges. It is diversified across industries as measured by primary SIC code: 843 manufacturing firms (SIC codes 2000–3999); 99 agricultural, mining, forestry, fishing and construction firms (SIC codes 1–1999); 201 retail and wholesale trade firms (SIC codes 5000–5999); and 174 service firms (SIC codes 7000–8999). Summary statistics for the entire sample are included in Panel A of Table I.

B. Classification Methodology

Firms are classified into groups according to a beginning-of-period financial constraint index (Z_{FC}). Firm classification is allowed to change every period to reflect the fact that financial status changes continuously.[6] The index is determined using multiple discriminant analysis, similar to Altman's Z factor for predicting bankruptcy.[7] An advantage of this approach is that it considers an entire profile of characteristics shared by a particular firm and transforms them into a univariate statistic.

The first step in discriminant analysis is to establish two or more mutually exclusive groups according to some explicit group classification. For example, Altman's two groups consist of firms that went bankrupt and those that did not. It is difficult, if not impossible, to categorize explicitly which firms are financially constrained without making reference to a number of variables. However, it is still possible to establish two mutually exclusive groups by making use of the knowledge that firms do not like to cut dividends and are hesitant to increase them unless they can be maintained. This suggests dividing our sample into three categories: group 1 firms increase dividends and are likely not financially constrained; group 2 firms cut dividends and are likely financially constrained; and group 3 firms do not change

[5] I thank an anonymous referee for this suggestion.

[6] This point is acknowledged by Fazzari et al. (1996) who suggest that assuming firms are in one group for the entire period is an empirical convenience. Schiantarelli (1995) discusses the importance of accounting for this matter in detail.

[7] Refer to Altman (1968) or Altman, Haldeman, and Narayanan (1977).

Table I

Sample Summary Statistics (1988–1994)

Panel A reports financial variable means for the sample of 1,317 firms. All financial variables are for the beginning of the fiscal year, except for cash flow and investment which represent firm cash flow and capital expenditures during period t. K is the firm's beginning-of-period net fixed assets value. The discriminant score (Z) is calculated using discriminant analysis according to equation (2). A full description of the variables is included in the Appendix. Dividend Group 1 includes firms whose dividend per share (DPS) increased in year t, Dividend Group 2 includes firms whose DPS decreased in year t, and Dividend Group 3 includes firms that had no change in DPS in year t. Panel B shows the number (percentage) of firms falling into the these three dividend categories over the sample period.

Panel A: Selected Financial Ratio Means (1988–1994)

	Total Sample	Dividend Group 1 (increased DPS)	Dividend Group 2 (decreased DPS)	Dividend Group 3 (no change in DPS)
Net fixed assets (K)	\$650m	\$1076m	\$913m	\$360m
Current ratio	2.57	2.40	2.36	2.71
Debt ratio	0.22	0.20	0.26	0.23
Fixed charge coverage	12.1	16.8	7.4	9.9
Net income margin (%)	3.0	6.8	1.0	1.0
Market-to-book ratio	2.18	2.64	1.62	1.97
Sales growth (%)	10.1	11.4	1.6	10.3
Slack/K	1.71	1.42	1.45	1.92
Cash flow/K	0.47	0.58	0.27	0.42
Investment/K	0.26	0.26	0.19	0.24
Discriminant score (Z)	−0.31	0.17	−0.87	−0.61

Panel B: Number of Firms per Dividend Group

Dividend Group	Total Sample	1988	1989	1990	1991	1992	1993	1994
1 (increased DPS)	3241	547	543	478	408	411	420	434
	(35.1%)	(41.5%)	(41.2%)	(36.4%)	(31.0%)	(31.2%)	(31.9%)	(33.0%)
2 (decreased DPS)	634	53	68	94	127	110	91	91
	(6.9%)	(4.0%)	(5.2%)	(7.2%)	(9.6%)	(8.4%)	(6.9%)	(6.9%)
3 (no change in DPS)	5344	717	706	745	782	796	806	792
	(58.0%)	(54.5%)	(53.6%)	(56.6%)	(59.4%)	(60.4%)	(61.2%)	(60.1%)

dividend payments. Group 3 firms are not utilized for purposes of the discriminant analysis; however, they are assigned Z_{FC} scores and are used in the subsequent regression analyses.[8]

Panel A of Table I reports summary statistics for the 1988 to 1994 period which confirm that firms reducing dividends appear to be more financially constrained according to traditional financial ratios. Firms that cut dividends exhibit lower current ratios, higher debt ratios, lower fixed charge coverage, lower net income margins, lower market-to-book ratios, and lower sales growth, and have lower slack/net fixed assets values than firms that increased dividends.[9] Table I also shows the standard ratio performance for firms that did not increase or decrease dividend payments was between the other two groups.

Panel B of Table I indicates that the number of firms increasing (or decreasing) dividends changes through the years in response to changing economic conditions. The largest number of firms increasing dividends (547) occurred in the prerecessionary year of 1988; the largest number of firms cutting dividends (127) occurred in the recessionary year of 1991. This evidence supports the notion that firms face changing levels of financial constraints every year. Because the purpose of classifying firms is to examine the behavior of groups that face different levels of financial barriers, it is logical to allow group composition to change over time. Schiantarelli (1995) argues that studies which assign a firm to one group for the entire period are "neglecting the information that the financial constraints may be binding for the same firm in some years but not in others. It would be more advisable in these cases to allow firms to transit between different financial states" (p. 21).

Discriminant analysis uses a number of variables that are likely to influence characterization of a firm in one of the two mutually exclusive groups of interest. The present study uses the following beginning-of-period variables that are chosen to proxy for firm liquidity, leverage, profitability, and growth: current ratio, debt ratio, fixed charge coverage (FCCov), net income margin (NI%), sales growth, and slack/net fixed assets (SLACK/K).[10] The hypothesis is that these variables will enable us to predict if firms will in-

[8] This group of firms represents 58 percent of the sample (5,341 out of 9,219 firm-year observations) and can be categorized by reference to their Z_{FC} value (discussed below) as those that "fit the profile" of constrained or unconstrained firms. This enables the use of an increased sample size and requires less reliance on firm dividend policy for the purpose of a priori classification.

[9] Slack is calculated as: cash + short term investments + (0.50 $*$ inventory) + (0.70 $*$ accounts receivable) − short term loans. It is included as a proxy for cash + unused line of credit, which is a measure of liquidity used by Kaplan and Zingales (1997). The calculation is based on traditional credit line arrangements that enable firms to establish operating loans up to 50 percent of inventory and 70–75 percent of good accounts receivable. Net fixed assets is the net property, plant, and equipment figure obtained from the firm's balance sheet, and is used for scaling purposes.

[10] Alternative specifications, including the one used in Altman (1968), are also employed. They produce similar results but have a slightly lower success rate in predicting which firms will cut or increase dividends.

crease or decrease dividend payments in the subsequent period. Coefficient values are estimated that best distinguish each independent variable between the two groups according to the following Z_{FC} value:

$$Z_{FC} = \beta_1 Current + \beta_2 FCCov + \beta, SLACK/K + \beta_4 NI\% + \beta_5 Sales\ Growth + \beta_6 Debt. \quad (2)$$

Univariate significance levels indicate that net income margin, sales growth, debt ratio, and fixed charge coverage are all significant at the 1 percent significance level. Table II displays correlations among these variables, as well as those used in the subsequent regression analysis. The largest correlations between Z_{FC} and the independent variables are 0.80 with NI% and 0.55 with sales growth. These observations suggest that firms tend to increase dividends during periods of stable and increasing profits. Current ratio and SLACK/K both exhibit small, negative correlations with Z_{FC}, which accounts for their insignificance in classifying firms. This is somewhat surprising because one would expect dividend increases to be closely tied to a firm's liquidity status as measured by these variables.

Overall, the variables do a good job of successfully predicting which firms will cut or increase their dividends, with group 1 and group 2 firms being properly classified 74 percent of the time. Despite the practical importance of being able to accurately predict dividend changes, it is not the primary concern of this paper.[11] The focus here is to classify firms according to their financial status, and the summary statistics for the predicted group classification of firms presented in Table III indicate success in achieving this objective. In particular, firms that are classified as group 1 (likely to increase dividends) appear more solid in terms of the reported financial variables.

Firms are classified every year according to their Z_{FC} value to reflect the fact that their financial constraint status is changing continuously. The top one-third of the firms each year are categorized as not financially constrained (NFC), the next one-third as partially financially constrained (PFC), and the bottom one-third as financially constrained (FC). Summary statistics for these groups presented in Table III indicate the classification scheme has successfully captured the desired cross-sectional properties. The financial ratios are superior for the NFC group, inferior for the FC group, with the PFC group lying somewhere in between.[12] The importance of classifying firm financial status every year is highlighted by the observed turnover rates for the NFC, PFC, and FC groups which average 40.9, 52.3, and 37.3 percent per year. Further, 75 percent (or 986) of the total 1,317 firms are clas-

[11] In fact, if the purpose was to predict changes in dividend behavior, it would be incorrect to use *in-sample* observations for the discriminant analysis.

[12] This trend persists for similarly formed subgroups within dividend payout categories, exchange groups, and industry classifications, although the results are not reported here.

Table II

Correlations among Variables

All financial variables are for the beginning of the fiscal year, except cash flow and investment, which represent firm cash flow and capital expenditures during period t. Cash flow, investment, and slack are all scaled by net fixed assets at the beginning of fiscal year t. The discriminant score (Z) is calculated using discriminant analysis according to equation (2). A full description of the variables is included in the Appendix.

	Cash Flow/ Fixed Assets	Current Ratio	Debt Ratio	Fixed Charge Coverage	Investment/ Fixed assets	Market-to-Book Ratio	Net Income Margin (%)	Sales Growth (%)	Slack/ Fixed Assets	Discriminant Score (Z)
Cash flow/Fixed assets	1.00									
Current ratio	0.11*	1.00								
Debt ratio	−0.18*	−0.33*	1.00							
Fixed charge coverage	0.21*	0.19*	−0.43*	1.00						
Investment/Fixed assets	0.37*	0.17*	−0.23*	0.18*	1.00					
Market-to-book ratio	0.21*	0.02	−0.12*	0.21*	0.24*	1.00				
Net income margin (%)	0.34*	0.08*	−0.14*	0.24*	0.13*	0.10*	1.00			
Sales growth (%)	0.19*	0.02	−0.01	0.11*	0.24*	0.20*	0.21*	1.00		
Slack/Fixed assets	0.38*	0.47*	−0.33*	0.13*	0.40*	0.08*	0.02	0.05*	1.00	
Discriminant score (Z)	0.32*	−0.07*	−0.29*	0.32*	0.18*	0.19*	0.80*	0.55*	−0.08*	1.00

*Significant at the 1 percent level.

Table III

Selected Financial Ratio Means for Financially Constrained Groups (1988–1994)

All financial variables are for the beginning of the fiscal year, except cash flow and investment, which represent firm cash flow and capital expenditures during period t. K is the firm's beginning-of-period net fixed assets value. The discriminant score (Z) is calculated using discriminant analysis according to equation (2). A full description of the variables is included in the Appendix. Predicted Group 1 includes firms that are classified as likely to increase dividends in year t according to discriminant analysis, Predicted Group 2 includes firms that are classified as likely to decrease dividends per share (DPS) in year t. The FC, PFC, and NFC groups are formed by sorting all firms according to their discriminant scores. Every year, the firms with the lowest discriminant scores (the bottom one-third) are categorized as financially constrained (FC); the next one-third are categorized as partially financially constrained (PFC); and the top one-third are categorized as not financially constrained (NFC).

	Predicted Group 1 (likely to increase DPS)	Predicted Group 2 (likely to decrease DPS)	FC firms (financially constrained)	PFC firms (partially financially constrained)	NFC firms (not financially constrained)
Net fixed assets (K)	\$803m	\$591m	\$507m	\$787m	\$656m
Current ratio	2.37	2.54	2.74	2.37	2.62
Debt ratio	0.18	0.28	0.31	0.22	0.14
Fixed charge coverage	18.3	4.8	3.0	8.8	24.6
Net income margin (%)	7.2	−1.2	−4.8	4.2	9.6
Market-to-book ratio	2.58	1.50	1.65	1.91	2.99
Sales growth (%)	15.1	−0.6	−2.3	9.0	23.5
Slack/K	1.30	1.30	1.93	1.46	1.75
Cash flow/K	0.52	0.24	0.23	0.42	0.75
Investment/K	0.27	0.19	0.21	0.24	0.33
Discriminant score (Z)	0.51	−1.45	−1.77	−0.21	1.05

sified as NFC in at least one year, with figures of 83 and 74 percent for the PFC and FC groups. This indicates that individual firm financial status does change significantly from one year to the next. In fact, only 17 firms are classified as PFC for all seven years, and only 49 and 80 are classified as NFC and FC for the entire period.

C. Regression Estimation

The following variation of the FHP88 regression equation is estimated using fixed firm and year effects:

$$I/K_{it} = \beta_{M/B}(M/B)_{it} + \beta_{CF/K}(CF/K)_{it} + u_{it}. \tag{3}$$

I represents investment in plant and equipment during period t; K is the beginning-of-period book value for net property, plant, and equipment; CF represents current period cash flow to the firm as measured by net income plus depreciation plus the change in deferred taxes; and M/B represents the firm's common equity market-to-book ratio based on the previous year's actual market value at year-end. Fixed effects estimation maintains separate

intercepts for each firm and for each year in order to account for unobserved relationships between investment and the independent variables, and to capture business-cycle influences.[13]

The use of market-to-book ratio to proxy for growth opportunities follows the approach of KZ. This differs from FHP88 who calculate Tobin's q based on replacement costs and the average market value over the last quarter of the previous year; however, Perfect and Wiles (1994) indicate that improvements obtained from the more involved computation of Tobin's q are limited. Further, KZ point out that using year-end market values can only be regarded as a methodological improvement because "the FHP88 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" (p. 179). Current period cash flow (CF), scaled by K, is used to measure the liquidity variable. This follows the specification of most previous studies including FHP88 and KZ, and facilitates comparison of results with previous evidence.

D. Determination of Significance Levels

A major focus of this literature is the comparison of investment-liquidity sensitivities across different groups of firms. However, traditional tests designed to detect differences in coefficients are not appropriate because the error terms likely violate the required assumptions.[14] As a result, conclusions regarding the existence of differences in investment-liquidity sensitivity across groups have been largely based on observing differences in magnitude and level of significance of the coefficient on the liquidity variable in regression estimates. This paper uses simulation evidence to determine the significance of observed differences in coefficient estimates.[15]

A bootstrapping procedure is used to calculate empirical p-values that estimate the likelihood of obtaining the observed differences in coefficient estimates if the true coefficients are, in fact, equal. Observations are pooled

[13] Regression estimates are obtained using OLS and using fixed firm and year effects. The fixed effects estimates are obtained using two standard approaches that transform the actual observations before running regressions using the transformed values. The first approach involves subtracting firm means and year means from the actual observations; the second approach transforms the actual observations by taking first differences and using time dummy variables. The reported results are the *demeaned* or *within* fixed firm and year estimates, which coincide with estimates presented by FHP88 and KZ. The coefficients estimated using OLS and *first differences* are not reported here, however they are consistent with the reported estimates in terms of magnitude and observed patterns across groups. Hsiao (1986), Griliches and Hausman (1986), and Schaller (1993) suggest that obtaining consistent estimates from alternative panel data estimation techniques provides evidence of no serious errors in variables problems.

[14] Traditional tests are generally designed for testing changes in parameters across time series data, where it may sometimes be reasonable to assume no heteroscedasticity in the resulting residuals. Panel data, with emphasis on cross-sectional data, likely violate the required assumptions. For example, the Chow test requires that the disturbance variance be the same for both regressions, while the standard Wald test requires independence of the error terms. These conditions are unlikely to be satisfied by panel data residuals.

[15] I thank Raymond Kan for this suggestion.

from the two groups whose coefficient estimates are to be compared. Using n_1 and n_2 to denote the number of annual observations available from each group, we end up with a total of $n_1 + n_2$ observations every year. Each simulation randomly selects n_1 and n_2 observations each year from the pooled distribution and assigns them to group 1 and group 2, respectively. Coefficient estimates are then determined for each group using these observations, and this procedure is repeated 5000 times. The empirical p-value is the percentage of simulations where the difference between coefficient estimates (d_i) exceeds the actual observed difference in coefficient estimates (d_{Sample}). This p-value tests against the one-tailed alternative hypothesis that the coefficient of one group is greater than that of the other group ($H_1 : d > 0$). For example, a p-value of 0.01 indicates that only 50 out of 5000 simulated outcomes exceeded the sample result, which implies the sample difference is significant, and supports the notion that $d > 0$.

III. Discussion of Results

A. Results

Regression estimates for the entire sample are presented in Table IV and indicate that firms' investment decisions are sensitive to investment opportunities as proxied by market-to-book, but are even more sensitive to liquidity variables. This is consistent with evidence from previous studies. Regression results for the FC, PFC, and NFC groups are also presented in Table IV. They indicate that liquidity and market-to-book are significant determinants of investment (at the 1 percent significance level) for all three groups. The adjusted R^2 values range from 7.78 percent to 18.24 percent, which is consistent with previous studies. The coefficients for market-to-book ratios are not significantly different across the three groups.

Coefficients for liquidity variables are all positive and significant, which suggests firm investment decisions are sensitive to the availability of internal funds. More important, the investment outlays of the NFC firms are significantly more sensitive to liquidity than that of PFC and FC firms, and PFC firms are more liquidity sensitive than FC firms. The estimated cash flow coefficients for the NFC, PFC, and FC groups are 0.153, 0.090, and 0.064. The observed differences between the NFC coefficient estimates and those for the other two groups are significant at the 1 percent significance level, and the difference between the PFC estimate and the FC estimate is significant at the 8.30 percent level. These results provide strong support for the KZ conclusions, using a much larger, broader sample and an objective classification scheme.

It is important to ensure that this is a general result across different categories of firms. In order to obtain more homogeneous groups and reduce the potential impact of dividend policy, the entire sample is divided into dividend payout groups, similar to the original FHP88 approach. In particular, firm-year observations are delegated to three groups: (i) those with zero dividend payout (Pay0); (ii) those with greater than zero but less than

Table IV

Regression Results for the Total Sample (1317 firms)

Reported coefficients are the *within* fixed firm and year estimates over the 1988–1994 sample period (t-statistics are in parentheses). Capital expenditures divided by net fixed assets is the dependent variable. The firm's market-to-book ratio and cash flow/net fixed assets are the independent variables. The FC, PFC, and NFC groups are formed by sorting all firms according to their discriminant scores. Every year, the firms with the lowest discriminant scores (the bottom one-third) are categorized as financially constrained (FC); the next one-third are categorized as partially financially constrained (PFC); and the top one-third are categorized as not financially constrained (NFC). The empirical p-values are determined using the simulation procedure described in Section II. They are estimated based on the null hypothesis that the coefficients are equal for the two groups under consideration. The alternative hypothesis is that the coefficient for the first group is greater than that of the second group. For example, the p-value of 0.9168 in the market-to-book column for NFC versus PFC suggests that the market-to-book coefficient for the NFC group is greater than that for the PFC group at the 91.68 percent significance level. The 0.0046 p-value in the next column suggests that the coefficient estimate for Cash Flow/Net Fixed Assets is greater for the NFC group than for the PFC group (at the 0.46 percent level of significance).

	Market-to-Book	Cash Flow/Net Fixed Assets	Adjusted R^2	Number of Observations
Regression estimates				
Total sample	0.024 (12.3)	0.096 (29.7)	11.76%	9219
FC firms (financially constrained)	0.020 (5.8)	0.064 (14.0)	7.78%	3073
PFC firms (partially financially constrained)	0.028 (7.7)	0.090 (14.1)	9.28%	3073
NFC firms (not financially constrained)	0.018 (5.8)	0.153 (23.5)	18.24%	3073
Empirical p-values				
PFC versus FC	0.1344	0.0830		
NFC versus FC	0.5890	0.0000		
NFC versus PFC	0.9168	0.0046		

30 percent payout (Pay<30); and (iii) those with 30 to 100 percent payout (Pay>30).[16] These dividend payout groups are then sub-divided according to discriminant scores every year as above to determine the FC, PFC, and NFC groups within each dividend payout category. Table V presents regression results for these subgroups that confirm the general conclusions above—namely, that investments of the NFC firms are the most sensitive to liquidity, followed by the PFC firms, and finally by the FC firms. This result is strongest for the zero payout group, which is similar to the group analyzed by KZ, lending additional support to their conclusions. I also examine the generality of these results by dividing the sample into groups based on exchange listing and industry classification. These groups are then subdivided according to discriminant scores as above to determine the FC, PFC, and NFC groups within each category. Regression results for these subgroups, which are not reported here, confirm the general results above.[17]

An additional test is performed to examine the robustness of results to the influence of firm leverage. The importance of controlling for firm leverage is demonstrated by Lang, Ofek, and Stulz (1996), who find that future growth and investment are negatively related to leverage, particularly for firms with low Tobin's q values and high debt ratios. This implies the significance of examining whether the pattern of investment-liquidity sensitivities detected in this study could be attributed to a systematic tendency of the classification scheme to assign firms to a group whose investment decisions are more sensitive to firm leverage than those of other groups. This hypothesis is tested by running regressions that include debt to total assets as an independent variable in the regression specification, in addition to market-to-book and CF/K. The results are not reported here; however, the coefficient on the debt to total assets variable is found to be negative and significant for all three groups, which confirms the results of Lang et al. Despite the relevance of firm leverage, the cash flow coefficients remain virtually identical for all of the groups, which is the primary concern of the present study.[18] This evidence suggests that the observed pattern of investment liquidity-sensitivities is not attributable to a *leverage effect*.

[16] This approach differs slightly from the FHP88 classification scheme, which divides firms based on payout ratios over the entire sample period and does not allow group composition to vary through time. The FHP88 approach is also used, with no resulting change in conclusions.

[17] The result that the least constrained firms are most sensitive to liquidity is robust to a number of alternative sorting arrangements whose results are not reported, including: (i) whether the sample is divided into two or three groups; (ii) groups formed using absolute discriminant score cutoff points for the entire period to create the NFC, PFC, and FC groups, rather than dividing the sample into thirds each year; (iii) groups formed based on the dividend groups (as defined in Table I); and (iv) groups formed on predicted dividend groups (as defined in Table III).

[18] In particular, the coefficients on CF/K for the FC, PFC, and NFC groups changed from 0.064, 0.090, and 0.153 to 0.064, 0.086, and 0.149, and the adjusted R^2 values increased from 7.78, 9.28, and 18.24 percent to 10.17, 11.43, and 19.63 percent.

Table V

Regression Results for Dividend Payout Groups

Reported coefficients are the *within* fixed firm and year estimates over the 1988–1994 sample period (t-statistics are in parentheses). Capital expenditures divided by net fixed assets is the dependent variable. The firm's market-to-book ratio and cash flow/net fixed assets are the independent variables. Pay0 represents the group formed using firm year observations where the firm's dividend payout was zero; Pay<30 represents payouts greater than zero but less than 30 percent; and Pay>30 represents payouts of 30 to 100 percent. The FC, PFC, and NFC groups are formed by sorting firms within a given payout group according to their discriminant scores. Every year, the firms in the group with the lowest discriminant scores (the bottom one-third) are categorized as financially constrained (FC); the next one-third are categorized as partially financially constrained (PFC); and the top one-third are categorized as not financially constrained (NFC). The number of observations for the PFC group may be larger than the other two because the leftover firms are assigned to the PFC group when the total number of firms in a payout group during a given year is not a multiple of three. The empirical p-values are determined using the simulation procedure described in Section II. They are estimated based on the null hypothesis that the coefficients are equal for the two groups under consideration. The alternative hypothesis is that the coefficient for the first group is greater than that of the second group. For example, the p-value of 0.6114 in the market-to-book column for NFC versus PFC in the Pay0 group suggests that the market-to-book coefficient for the NFC group is greater than that for the PFC group at the 61.14 percent significance level. The 0.0002 p-value in the next column suggests that the coefficient estimate for Cash Flow/Net Fixed Assets is greater for the NFC group than for the PFC group in the Pay0 group (at the 0.02 percent level of significance).

	Market-to-Book	Cash Flow/ Net Fixed Assets	Adjusted R^2	Number of Observations
Panel A: Pay0 Group				
Regression estimates				
FC firms	0.021 (4.8)	0.057 (9.9)	8.23%	1520
PFC firms	0.028 (5.3)	0.080 (11.5)	11.03%	1529
NFC firms	0.024 (4.7)	0.159 (18.7)	22.47%	1520
Empirical p-values				
PFC versus FC	0.2694	0.1378		
NFC versus FC	0.3834	0.0000		
NFC versus PFC	0.6114	0.0002		
Panel B: Pay<30 Group				
Regression estimates				
FC firms	0.035 (3.7)	0.054 (3.6)	4.06%	709
PFC firms	0.017 (2.4)	0.133 (6.1)	6.66%	712
NFC firms	0.005 (0.9)	0.147 (8.4)	10.67%	709
Empirical p-values				
PFC versus FC	0.9008	0.1826		
NFC versus FC	0.9878	0.0788		
NFC versus PFC	0.8584	0.3974		

Table V—*Continued*

	Market-to-Book	Cash Flow/ Net Fixed Assets	Adjusted R^2	Number of Observations
		Panel C: Pay>30 Group		
Regression estimates				
FC firms	0.018 (2.6)	0.051 (2.6)	1.80%	839
PFC firms	0.010 (2.0)	0.105 (6.3)	5.91%	842
NFC firms	0.023 (4.5)	0.119 (10.0)	13.40%	839
Empirical *p*-values				
PFC versus FC	0.8008	0.1640		
NFC versus FC	0.3008	0.1738		
NFC versus PFC	0.1026	0.4382		

B. Interpretation

The high investment liquidity sensitivity of the unconstrained firms appears puzzling at first glance. However, it is consistent with Mayer's (1990) empirical evidence that internal financing is the dominant source of financing for all firms, which implies that investment decisions of the majority of firms are sensitive to current liquidity. It also concurs with the results of Lamont (1997) who documents a large decrease in the capital expenditures of non-oil subsidiaries of oil conglomerates in reaction to the 1986 drop in oil prices. Lamont concludes that large reductions in cash flow and collateral value lead to decreased investment, independent of changes in available investment opportunities.

This behavior supports the free cash flow argument presented by Jensen (1986) that firms increase investment in response to the availability of cash flows. Jensen argues that "managers have incentives to cause firms to grow beyond optimal size" since "growth increases managers' power by increasing the resources under their control" (p. 323). It is also consistent with the conclusion of Bernanke and Gertler (1990) that "both the quantity of investment spending and its expected return will be sensitive to the *creditworthiness* of borrowers (as reflected in their net worth positions)" (p. 89). Alternatively, KZ suggest that "managerial risk aversion" may contribute to the correlation between investment and liquidity. Given the size and changing group composition of the approach used in this study, the observed sensitivities are not likely to be driven by overly risk-averse managers in a particular group, and this may in fact, be a general behavioral characteristic of most firm managers.

IV. Conclusions

The sensitivity of firm investment decisions to liquidity status is examined using data for 1,317 U.S. firms over the 1988 to 1994 period. Following the basic approach of Kaplan and Zingales (1997), firms are classified according to financial statement variables that are related to their ability to raise external finance. An objective multivariate classification index, similar to Altman's Z factor, is used to determine firm financial status and this status is allowed to vary from one period to the next. The approach captures desired cross-sectional properties of a large number of firms and successfully classifies firms that increase or decrease dividends 74 percent of the time. Additionally, a bootstrap methodology is used to determine significance levels of observed differences in coefficient estimates across different firm categories.

Large sample evidence demonstrates that the investment decisions of firms with high creditworthiness are significantly more sensitive to the availability of internal funds than are firms that are less creditworthy. This strongly supports the small-sample evidence of Kaplan and Zingales (1997), who also find that the least constrained firms are the most sensitive to cash flow availability, contrary to the conclusions of several previous studies.

Appendix

The financial variables utilized are calculated as follows:

(1) $$\text{Current ratio} = \frac{\text{current assets}}{\text{current liabilities}};$$

(2) $$\text{Debt ratio} = \frac{\text{current portion of long-term debt} + \text{long-term debt}}{\text{total assets}};$$

(3) Fixed charge coverage ratio

$$= \frac{\text{earnings before interest and taxes}}{\text{interest expense} + \text{preferred dividend payments} \times \left(\dfrac{1}{1 - \text{tax rate}}\right)};$$

(4) Net income = net income before extraordinary items ± extraordinary items and discontinued operations;

(5) $$\text{Net income margin} = \frac{\text{net income}}{\text{net sales}};$$

(6) Cashflow = net income + depreciation and/or amortization expense + change in deferred taxes;

(7) Investment = net capital expenditures

$$(8)\ \text{Net sales growth} = \frac{\text{net sales}_t - \text{net sales}_{t-1}}{\text{net sales}_{t-1}};$$

$$(9)\ \text{Dividend payout} = \frac{\text{total dividends paid}}{\text{net income}};$$

$$(10)\ \text{Slack} = \text{cash} + \text{short term investments} + (0.50 \times \text{inventory}) + (0.70 \times \text{accounts receivable}) - \text{short term loans};$$

$$(11)\ \text{Net fixed assets} = \text{net property, plant and equipment};$$

$$(12)\ \text{Market-to-book} = \frac{\text{market value of common equity}}{\text{book value of common equity}}.$$

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