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Paula R. Worthington

Abstract

This paper's analysis of U.S. manufacturing industries confirms previous research showing that cash flow and investment spending are positively correlated, even after controlling for investment demand, and it makes two new points as well. First, I find that cash flow's impact is larger for durable goods industries than for nondurable goods industries. Second, I find that cash flow's impact is significantly larger in industries with high sunk costs than in those with low sunk costs. The latter finding suggests that external financing of capital investment is more difficult when the assets being financed are highly specific or are "sunk."

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I. Introduction

Much recent research has been devoted to analyzing the sources and consequences of imperfections in factor, product, and financial markets. For example, some researchers have argued that financial capital market imperfections contribute to excessive investment volatility and to suboptimal investment levels by certain classes of firms. Other researchers have analyzed the influence of sunk costs on product market competition, developing models of contestability, precommitment, and predation, while still others have focused on the importance of asset specificity on firms' financial structure. Yet another group of papers investigates the effects of particular financial capital structures on input choices and the intensity of subsequent product market competition.

This paper contributes to the literatures on capital market imperfections, investment, and asset specificity (sunk costs) by analyzing the effects of two sunk cost proxies on an industry's investment sensitivity to movements in internal funds. Although many previous researchers have documented and interpreted the positive correlation between cash flow and investment, this paper differs by focusing on the role played by the assets whose purchase is being financed, whether by internal or external funds. The idea is quite simple: if financial capital markets are imperfect, then access to external funds to finance investment spending should in part depend on the degree of asset specificity of the assets being purchased. In turn, this implies that the sensitivity of investment spending to movements in internal funds, or cash flow, will depend on the degree of sunk costs.

To test this hypothesis, I examined data for 270 four-digit Standard Industrial Classification (SIC) manufacturing industries from 1963-1989 and found that the impact of cash flow on investment spending was significantly larger in industries in which capital expenditures were more likely to be sunk. I also found larger cash flow effects for durable goods industries than for nondurable goods industries.

Section II briefly summarizes previous work on this topic, and Section III describes the data and empirical approach used here. Estimation results are in Section IV, and discussion and conclusions are in the final section.

II. Capital market imperfections

A number of recent theoretical and empirical papers have analyzed the consequences of imperfect capital markets for investment behavior.[1] When capital markets are perfect, firms undertake any investment project with a positive net present value, and the choice of financing mix is indeterminate.[2] That is, a firm's cost of capital is the same whether that capital is raised internally through retained earnings, or externally through the issuance of debt or equity. Market imperfections potentially arise from several sources, including corporate tax deductibility of interest, scale economies in underwriting, and informational asymmetries.

Many researchers have focused on capital market frictions due to informational asymmetries, which arise when a firm's credit worthiness is unobservable.[3] In this situation,

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[1]See Fazzari, Hubbard, and Petersen (FHP; [1988]) for a review of the theoretical literature and some empirical evidence. Hubbard [1990] also contains several papers on this topic.

[2]I ignore considerations based on an options-value approach to investment and the value to waiting; see Pindyck [1991] for a discussion of that approach.

[3]Any observable firm characteristic which increases the riskiness of the firm will be reflected in an increase in the firm's cost of capital; perfect capital markets do not imply that all firms have the same cost of capital.

lenders cannot distinguish between low risk and high risk firms. To compensate for increased average default risk due to pooling of high and low risk firms, lenders raise rates, causing some or all of the better firms to leave the market. In extreme cases the lending market disappears entirely, and firms cannot obtain external financing at all. As a result, these information-driven imperfections can decrease the cost of internal funds relative to external funds, so that a "financing hierarchy" can develop that favors retained earnings, followed by debt, and, in turn, equity. Under these conditions, fixed investment spending will vary with the availability of internal funds, not just the availability of positive net present value projects.

Researchers have explored these issues by identifying a priori those firms for which informational problems are likely to be severe (and hence, the external funds premium is likely to be large) and examining whether the investment-internal finance link is stronger for those firms than for firms judged to suffer less from information-based problems.[4] Previous studies have grouped firms by size, age, dividend payout behavior, bond rating, and, for Japanese firms, membership in keiretsu, or large industrial groups. These studies have generally found support for the hypothesis of limited capital market access for certain groups of firms. Although some researchers have expressed concerns about methodological difficulties with interpreting the investment-cash flow relationship, several recent papers indicate that the cash flow-investment correlation is truly robust and can be interpreted, at least in part, as evidence that capital markets are imperfect and that internal funds are cheaper

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[4]One recent paper (Oliner and Rudebusch [1992]) has actually studied the sources of the external financing premium.

than external funds.[5]

There is much theoretical and empirical evidence that firms differ in their access to external funds. For example, if lenders incur fixed costs when monitoring borrower behavior or gathering information about potential or actual borrowers, then small firms may face higher external funds premia than large firms, and in extreme cases they may be unable to obtain external finance at all. Furthermore, small firms may face disadvantages since they tend to be less diversified and younger than large firms. Young firms have not yet acquired reputations as good credit risks and may be unable to issue external debt or equity. Some empirical evidence supports these arguments, although firm size and age tend to decrease in importance once other firm characteristics are taken into account.[6]

Other studies have used dividend payout behavior to group firms, arguing that firms paying zero or low dividends are effectively revealing themselves to researchers as those who suffer from information liquidity problems (FHP [1988], Fazzari and Petersen [1990], Gilchrist and Himmelberg [1993], Mackie-Mason [1990]). Each study found that the investment-cash flow connection is stronger for low or zero dividend payout firms than for others.

One study (Whited [1991]) classifies firms according to whether their debt has been

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[5]The problem is that a positive correlation between investment spending and cash flow need not be interpreted as evidence that capital markets are imperfect; movements in current cash flow may signal future movements in the marginal productivity of capital, so that investment and cash flow would move together even in a Modigliani-Miller world. Two recent papers addressing this issue (Gilchrist and Himmelberg [1993] and Fazzari and Petersen [1990]) find the robustness result mentioned in the text.

[6]See Whited [1991, 1992] and Gertler and Gilchrist [1993]. One study finds the reverse size relationship (Devereux and Schiantarelli [1990]).

rated by Moodys or not. Firms with credit ratings are "known quantities," and any differences across firms in riskiness are known and presumably reflected in the rating and, in turn, in the cost of capital. Firms with no ratings are essentially unknown, and informational asymmetries are likely to be severe. Consistent with this argument, Whited finds that, for firms in the latter category, investment spending is more sensitive to several balance sheet items than it is for firms in the former group.

Hoshi, Kashyap, and Scharfstein [1990, 1991] studied the investment-financing relationship for nonfinancial corporations in Japan, where a firm may be a member of a keiretsu (industrial group) with strong ties to a "main bank." The authors found that the investment spending of keiretsu members was less sensitive to movements in cash flow than that of nonmembers. The authors infer that member firms do not face the information problems of nonmembers, since members rely on a main bank for most of their financing needs.

In this paper, I use a classification scheme based on the idea that the degree to which capital expenditures are "sunk," hence unrecoverable in case of borrower financial distress, will affect the informational asymmetries, hence capital market constraints, that face firms. Industries in which sunk costs are high (relative to total capital or fixed costs) should thus display greater investment sensitivity to internal finance movements than industries with low sunk costs. Mayer [1990] makes the first point quite clearly when he argues that lenders will be reluctant to finance acquisition of assets that are highly specific to their current employment. Shleifer and Vishny [1992] develop a formal model showing that the acquisition of sunk assets is likely to be hard to finance using debt. Empirical evidence on this issue appears to be somewhat limited, although Zeckhauser and Pound [1990] present some estimates of asset specificity for selected U.S. industries and argue that low asset specificity makes an industry's firms easy to monitor, thus less likely to face informational problems than others.[7]

This paper uses two measures of the degree of asset specificity to group industries.[8] First, I compute the share of used capital expenditures in total capital expenditures. A high share implies that there is an active second-hand market for capital in that industry. It also insures either that potential lenders have valuable collateral should borrowing firms default, or that indebted firms in financial distress can sell assets relatively easily to other firms in the industry. Second, I compute the ratio of total capital rental payments to the gross capital stock.[9] A high share indicates an active rental market, which implies that assets are easily transferred between firms; this suggests that asset specificity, i.e., the extent of sunk capital costs, is low. For both measures, I expect that in industries with high values, investment spending will be less sensitive to cash flow movements than it is in industries with low values.

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[7]Petersen and Himmelberg [1990] exploited this argument as well in their study of the effects of internal finance on R&D spending. Since R&D spending is really investment in a noncollateralizable asset, information problems are likely to be severe, and internal funds availability should explain much of the variation in R&D spending. See also Mackie-Mason [1990] and Hall [1992] for related evidence on R&D and investment financing choices.

[8]Both are suggested by work of Kessides [1990], who used these two measures, along with depreciation rates and other measures, to estimate the share of sunk costs in capital costs at the industry level. See also Tirole's [1988] discussion of resale and rental considerations and sunk capital costs.

[9]Kessides [1990] defines the denominator to be the product of the interest rate and the gross stock; since I do not have data on industry-specific interest rates, an aggregate interest rate would alter only the level of this variable, not its cross-sectional variance.

Finally, I emphasize that the measures of asset specificity computed in this paper are at the industry level, not firm level. While it is true that an industry-wide demand or cost shock could eliminate overnight the second-hand and rental markets for an industry's capital (see especially Shleifer and Vishny [1992]), it is also true that industry-level risk is fairly easily observable by lenders. Thus, potential creditors take into account the prospects of a borrowing firm's industry. It is unobservable firm-specific risk that can cause external funding markets to demand premia or to collapse entirely. A lender's ability to take possession of a defaulting firm's capital stock and to sell or rent it to others lessens the "lemons" premium it will require of borrowing firms in that industry.

III. Empirical Approach and Data Description

I model investment as a function of investment opportunities and cash flow.[10] Previous researchers analyzing firm-level data have used Tobin's q for the former, while using various retained earnings measures for the latter. The Census data I use here cannot be used to construct q-based measures, since q measures depend on firm-level valuations of equity and debt, while the Census data pertain to manufacturing plants aggregated up to the four-digit SIC industry. Studies using more aggregate data, e.g., two-digit SIC data, have used sales or output measures in accelerator models to capture the impact of investment opportunities on investment spending (Abel and Blanchard [1988]). One problem with using sales (shipments) or output data in the present study is that these output measures are highly

[10]For example, FHP [1988] and Whited [1992] use this approach in their papers.

correlated with the cash flow measure I use.[11] Consequently, I use alternative measures of investment opportunities, or investment demand, as described below.

Let IK denote the gross investment rate, S the measure of investment opportunities and CFK the ratio of cash flow to capital. Then the gross investment rate is written as:

$$(1) \quad IK_{it} = \alpha + S_{it}\beta + CFK_{it}\gamma + \varepsilon_{it} ,$$

where i and t refer to industry i and time t, respectively.[12] I try two alternative measures for S to control for differences in industry investment opportunities. The first, denoted CU, is a proxy for capacity utilization and is measured as hours per production worker.[13] The idea is that increases in this value denote intensive use of labor and signal increased demand for the products sold by the industry. Short run increases in CU should be followed by increases in investment spending. The second measure, denoted CUAGG, is the Federal Reserve Board series on capacity utilization for the manufacturing sector. Both CU and CUAGG are highly cyclical and strongly positively correlated with investment spending in the data.

The cash flow measure used in the numerator of the cash flow/capital ratio (CFK) is defined as the difference between the value of shipments and all plant-level non-capital input

[11]Cantor [1990] notes this problem as well in his study of investment and leverage in U.S. manufacturing firms.

[12]As is standard in the literature, both investment and cash flow are scaled by the beginning of period capital stock.

[13]Abbott, Griliches, and Hausman use this measure as a capacity utilization proxy in their [1989] paper. Alternative industry-based measures, such as the ratio of production worker wages to total payroll, suggested by Lichtenberg [1988], performed similarly.

costs.[14] This measure, then, overstates true cash flow by omitting capital and overhead expenses. The capital stock measure is real total stock at the beginning of the period. I expect the coefficient on CFK to be positive if capital markets are not perfect and the coefficient's size to vary systematically across different groups of industries, as explained elsewhere in this paper.

I estimate Equation (1) over several subsamples of industries. First, I divide the sample into durable goods and nondurable goods producing industries.[15] Next, I divide the sample into groups based on the two sunk cost proxies: the intensities of rental and second hand capital markets. Each of these proxies is computed using 1977 cross-sectional data. Intensity of the rental market (SHRRENT) is measured as the ratio of industry rental payments to the gross capital stock, and intensity of the market for used capital (SHRUSED) is measured by the ratio of used capital expenditures to total capital expenditures. I present estimates using both the median and the 75th percentile of the SHRRENT and SHRUSED distributions to divide industries into groups.

The empirical approach is to measure all variables in logs so that the coefficients may be interpreted as elasticities, and the right-hand side variables are lagged one period to limit endogeneity problems. This paper uses fixed effects (FE) estimation procedures to estimate

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[14]Petersen and Strauss [1991] use this measure and find that its correlation with investment spending is quite strong. However, they do not control for other determinants of investment spending in their analysis.

[15]Previous research has shown that durable and nondurable goods industries differ significantly in their output and investment behavior; see Petersen and Strongin [1992].

(1), so that the intercept, α, is permitted to vary across industries.[16] Preliminary analysis suggested that serial correlation was a serious problem, so this paper presents estimates correcting for first-order serial correlation. The first set of estimates (method 1) is based on Kiefer's [1980] suggestion of estimating the AR(1) parameter from the OLS residuals on the mean-differenced data, using the estimate to quasi-difference the mean-differenced data, and estimating the resulting equation using least squares. An alternative set of estimates (method 2) is derived by first-differencing the data, estimating the AR(1) parameter from the first-differenced data, and using least squares techniques on the quasi-differenced first-differenced data.

The data used in the paper are derived from the Census of Manufactures and the Annual Survey of Manufactures; a list of variables and definitions appears in Table I. The final data set contains annual observations on 270 industries over the 1963-1989 period; forty-two industries were eliminated from the original data set because of missing or poor quality data. Lagging the right-hand side variables in Equation (1) led to a sample period of 1964-1989. Summary statistics for the full sample as well as the durable goods and nondurable goods subsamples are presented in Table II.[17]

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[16]An alternative approach, the random effects (RE) or error components technique, would be appropriate if the effects are uncorrelated with other right-hand side variables. Preliminary analysis indicated that a fixed effects approach was justified. Hausman tests soundly rejected the null of no correlation between the industry effects and other explanatory variables.

[17]Table II indicates that the CFK measures are much larger than the IK measures; the CFK measure overstates true cash flow, since it fails to deduct interest expenses and central office (above the plant level) expenses.

[Tables I and II about here]

IV. Results

Tables III and IV, which contain the coefficient estimates obtained by estimating Equation (1) for the full sample as well as for several subsamples, presents the principal results of the paper. The demand measure in both Tables is CU, with Table III reporting the results using AR(1) method 1 and Table IV those using AR(1) method 2. In each specification, F-tests on the industry effects strongly rejected the null hypothesis of zero effects. While the results of the two Tables are qualitatively similar, the statistical significance is more pronounced with Table IV's method 2 results. To streamline the discussion, however, I will explicitly discuss only Table III.

[Tables III and IV about here]

Consider first the performance of the capacity utilization proxy, CU. The first row of Table III reports an elasticity estimate of .640 for the full sample; CU enters positively and significantly in most of the subsamples, with its fit for durables industries a bit better than that for nondurables industries. Overall, the CU variable seems to perform reasonably well.[18]

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[18]Tables AII and AIII in the Appendix present estimates using the aggregate capacity variable, CUAGG, in lieu of the industry-based CU measure, and Table AIV contains the associated t statistics. The results are qualitatively similar to those of Tables III-V and will not be discussed further.

Now turn to the cash flow elasticities presented in Table III. For the full sample, the elasticity estimate is .121, positive and significant as other researchers have found, and consistent with the hypothesis of imperfect capital markets. Following arguments similar to FHP [1988] and others, however, I wish to emphasize the differences in coefficient estimates across groups of industries rather than the levels of those coefficient estimates. The elasticities for durable goods industries are higher than those for nondurable goods industries, consistent with previous research (Petersen and Strauss [1991], Petersen and Strongin [1992]); F-tests strongly reject pooling of durables and nondurables industries. Shleifer and Vishny's [1992] model provides some explanation of this finding: in the model, firms in highly cyclical industries are more likely to find that their physical assets cannot be easily sold to other firms in the industry, since all firms are likely to face financial distress and limited capital availability simultaneously. Thus, internal funds will be more important to firms in cyclical industries than in noncyclical industries.

Now consider the results when industries are grouped according to their rental and second-hand capital markets. As predicted, industries with active second-hand markets (high values of SHRUSED) and rental markets (high values of SHRRENT) have lower cash flow elasticities; many of the differences are statistically significant (see Table V, which contains the t-statistics on the sunk cost dummies-cash flow coefficients), and many are sizeable as well, with the differences exceeding 50% or more. For example, when the full sample is divided (using the 75th percentile) into "high rent" and "low rent" industries, Table III indicates that investment's elasticity with respect to cash flow is .154 for the low rent sample and only .063 for the high rent sample; the difference is significant at the 1% level.

Similarly, industries with SHRUSED values above the median have smaller cash flow elasticities than those with lower SHRUSED values; the difference is significant at the 5% level for the full sample.[19] In general, these results hold up when the sample is split between durable and nondurable goods industries, with the results for durable goods industries being somewhat stronger than those for nondurable goods industries.

[Table V about here]

V. Discussion and Conclusions

This paper has found that cash flow measures enter industry level investment equations positively and significantly, even after investment opportunities are taken into account. The effect of cash flow is greater in durable goods industries than in nondurable goods industries. Furthermore, the impact of cash flow on investment is larger in industries whose capital expenditures are likely to be highly "sunk" than in low sunk-cost industries. I interpret this last finding as evidence that external financing of capital investment is more difficult when the assets being financed have low recovery (resale) values or are sunk.

These results suggest that sunk costs, or asset specificity, can affect the severity and impact of financial capital market imperfections. Future empirical work using both industry and firm level data is needed to sort out the relative importance of firm, industry, and asset characteristics on firms' investment and financing choices. Furthermore, more research is

[19] There is no reason a priori to expect that the threshold percentiles of the SHRRENT and SHRUSED distributions are the same. The results indicate that the 75th percentile cut-off works well for the rental variable, while the median works well for the used variable.

needed to identify potential spillovers between financial capital market and other market imperfections. For example, ample theoretical and empirical evidence suggests that sunk costs influence the intensity of product market competition; combining this insight with the one relating sunk costs to financial market imperfections leaves one with a rich variety of explanations for firm behavior.

One example of the possible connections between the sunk costs-product market competition literature and the sunk costs-financial markets literature is the following. Industrial organization economists have shown that precommitment has value to "first-movers" in noncooperative settings, where firms precommit to physical capacity, financial capital structure, or some other irreversible item. Yet this paper and others suggest that sunk or precommitted physical capital is exactly the sort of asset that would be difficult to finance using external funds (debt). Thus, committing to a high debt level may not be that effective or credible, since the asset or activity being financed is not sunk and has value to others should the borrowing firm face financial distress. In conclusion, more study is needed to explore fully the nature of "sunkenness" and its implications for the workings of input, output, and financial markets.

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Table I List of Variable Definitions

Name	Label	Definition
Panel variables		
gross investment rate	IK	total investment in current year/capital stock at end of previous year
industry demand	CU	production worker hours/production workers
capacity utilization	CUAGG	capacity utilization rate, manufacturing sector [from Federal Reserve Board]
cash flow/capital ratio	CFK	((value of shipments - total payroll - cost of materials)/shipments price deflator)/real capital stock
Cross-sectional variables		
rental payments relative to capital stock	SHRRENT	rental payments for capital/gross book value of capital stock
share of used capital expenditures	SHRUSED	spending on used capital plant and equipment/(spending on new + spending on used plant and equipment)

Table II Summary Statistics

		Total	Durables	Nondurables
Panel variables 1963-1989		Mean (Std)	Mean (Std)	Mean (Std)
IK		.082 (.040)	.084 (.041)	.080 (.039)
CU		.922 (.054)	.926 (.047)	.918 (.062)
CUAGG		.824 (.046)	.824 (.046)	.824 (.046)
CFK		1.242 (1.014)	1.116 (.720)	1.387 (1.256)
Cross-sectional variables, 1977		Total	Durables	Nondurables
SHRRENT	mean	.034	.028	.040
	median	.024	.024	.024
	75th perc.	.038	.034	.048
SHRUSED	mean	.091	.090	.091
	median	.074	.075	.072
	75th perc.	.124	.074	.124

Table III Regression Results: AR(1) method 1 specification

Dependent Variable IK, 1964-1989

		all	high rent (median)	low rent (median)	high used (median)	low used (median)
all industries	CU	.640[a] (.097)	.625[a] (.138)	.631[a] (.135)	.549[a] (.139)	.707[a] (.134)
	CFK	.121[a] (.016)	.100[a] (.023)	.147[a] (.023)	.089[a] (.023)	.153[a] (.023)
durables industries	CU	.925[a] (.142)	.832[a] (.189)	1.041[a] (.212)	.775[a] (.186)	1.088[a] (.217)
	CFK	.144[a] (.023)	.135[a] (.032)	.144[a] (.032)	.102[a] (.032)	.183[a] (.032)
nondurables industries	CU	.414[a] (.133)	.454[b] (.201)	.368[b] (.174)	.289 (.210)	.486[a] (.174)
	CFK	.099[a] (.023)	.073[b] (.031)	.139[a] (.033)	.076[b] (.033)	.127[a] (.032)
		all	**high rent (75th percentile)**	**low rent (75th percentile)**	**high used (75th percentile)**	**low used (75th percentile)**
all industries	CU	.640[a] (.097)	.641[a] (.202)	.586[a] (.108)	.735[a] (.206)	.613[a] (.109)
	CFK	.121[a] (.016)	.063[b] (.029)	.154[a] (.019)	.087[b] (.034)	.131[a] (.018)
durables industries	CU	.925[a] (.142)	.545[b] (.262)	.994[a] (.166)	.950[a] (.274)	.913[a] (.166)
	CFK	.144[a] (.023)	.062 (.039)	.175[a] (.027)	.104[b] (.049)	.156[a] (.025)
nondurables industries	CU	.414[a] (.133)	.726[b] (.296)	.275[c] (.141)	.430 (.313)	.412[a] (.148)
	CFK	.099[a] (.023)	.064 (.042)	.126[a] (.027)	.070 (.047)	.108[a] (.026)

Notes: Standard errors are in parentheses under coefficient estimates, and all regressions include industry dummies (not reported). All variables are in logs, and the right hand side variables are lagged once. Coefficients marked with superscripts a, b, or c are statistically significant at the 1%, 5%, or 10% level, respectively.

Table IV Regression Results: AR(1) method 2 specification

Dependent Variable IK, 1964-1989

		all	high rent (median)	low rent (median)	high used (median)	low used (median)
all industries	CU	.418[a] (.095)	.377[a] (.137)	.452[a] (.133)	.287[b] (.140)	.529[a] (.131)
	CF	.328[a] (.022)	.236[a] (.034)	.394[a] (.029)	.270[a] (.032)	.381[a] (.031)
durables industries	CU	.616[a] (.143)	.624[a] (.191)	.539[b] (.213)	.445[b] (.188)	.824[a] (.218)
	CFK	.400[a] (.030)	.272[a] (.045)	.495[a] (.041)	.287[a] (.043)	.504[a] (.043)
nondurables industries	CU	.240[c] (.130)	.158 (.196)	.311[c] (.171)	.105 (.208)	.304[c] (.167)
	CFK	.247[a] (.033)	.188[a] (.052)	.288[a] (.042)	.250[a] (.048)	.249[a] (.045)
		all	high rent (75th percentile)	low rent (75th percentile)	high used (75th percentile)	low used (75th percentile)
all industries	CU	.418[a] (.095)	.376[c] (.203)	.419[a] (.107)	.261 (.205)	.463[a] (.108)
	CFK	.328[a] (.022)	.193[a] (.053)	.364[a] (.024)	.283[a] (.044)	.344[a] (.026)
durables industries	CU	.616[a] (.143)	.481[c] (.272)	.639[a] (.168)	.439 (.273)	.695[a] (.168)
	CFK	.400[a] (.030)	.191[a] (.072)	.442[a] (.034)	.344[a] (.064)	.417[a] (.034)
nondurables industries	CU	.240[c] (.130)	.297 (.290)	.212 (.139)	-.019 (.312)	.286[b] (.144)
	CFK	.247[a] (.033)	.190[b] (.074)	.265[a] (.035)	.225[a] (.061)	.257[a] (.039)

Notes: Standard errors are in parentheses under coefficient estimates, and all regressions include industry dummies (not reported). All variables are in logs, and the right hand side variables are lagged once. Coefficients marked with superscripts a, b, or c are statistically significant at the 1%, 5%, or 10% level, respectively.

Table V T-statistics on the Cash Flow-Sunk Cost Interaction Variables

Specification:	Table III	Rent	Used
medians	all industries	-1.42	-2.06[b]
	durables	-.28	-1.85[c]
	nondurables	-1.50	-1.13
75th percentile	all industries	-2.85[a]	-1.18
	durables	-2.34[b]	-.98
	nondurables	-1.56	-.71
Specification:	**Table IV**	**Rent**	**Used**
medians	all industries	-3.36[a]	-2.29[b]
	durables	-2.79[a]	-3.58[a]
	nondurables	-1.91[c]	.25
75th percentile	all industries	-3.43[a]	-1.46
	durables	-3.10[a]	-1.43
	nondurables	-1.29	-.50

Superscripts a, b, or c denote statistical significance at the 1%, 5%, or 10% level, respectively.

Appendix

The industry data used in this paper are from various years of the Census of Manufactures (CM) and the Annual Survey of Manufactures (ASM), both conducted by the Commerce Department's Bureau of the Census. The CM is conducted every several years and is based on information collected from every manufacturing establishment in SIC industries 2000-3999. The ASM is conducted annually and is based on only a sample of these establishments. The ASM data is then "scaled up" to give the total data for each industry. This paper's data are compiled from a version of this data prepared by Domowitz, Hubbard, and Petersen [1987] and later updated by William Strauss at the Federal Reserve Bank of Chicago. This dataset uses the 1958 industry definitions. The price deflators and capital stocks were provided by Wayne Gray, and the rest of the variables are from CM and ASM, unless otherwise noted.

Table AI Sample Sizes

	Total	Durables	Nondurables
All	270	145	125
High rent	68	29	39
Low rent	202	116	86
High used	67	36	31
Low used	203	109	94

Table AII Regression Results: AR(1) method 1 specification

Dependent Variable IK, 1964-1989

		all	high rent (median)	low rent (median)	high used (median)	low used (median)
all industries	CUAGG	1.370[a] (.087)	1.200[a] (.123)	1.524[a] (.124)	1.397[a] (.120)	1.341[a] (.126)
	CF	.146[a] (.016)	.132[a] (.022)	.161[a] (.022)	.112[a] (.022)	.180[a] (.022)
durables industries	CUAGG	1.698[a] (.114)	1.461[a] (.156)	1.956[a] (.166)	1.665[a] (.157)	1.730[a] (.166)
	CFK	.161[a] (.022)	.154[a] (.031)	.157[a] (.030)	.116[a] (.031)	.203[a] (.030)
nondurables industries	CUAGG	.973[a] (.135)	.901[a] (.194)	1.039[a] (.185)	1.052[a] (.187)	.896[a] (.193)
	CFK	.125[a] (.023)	.106[a] (.031)	.154[a] (.032)	.100[a] (.032)	.151[a] (.032)

		all	high rent (75th percentile)	low rent (75th percentile)	high used (75th percentile)	low used (75th percentile)
all industries	CUAGG	1.370[a] (.087)	.866[a] (.189)	1.502[a] (.098)	1.450[a] (.173)	1.341[a] (.101)
	CFK	.146[a] (.016)	.092[a] (.030)	.169[a] (.018)	.107[a] (.033)	.158[a] (.018)
durables industries	CUAGG	1.698[a] (.114)	.946[a] (.247)	1.855[a] (.128)	1.817[a] (.241)	1.664[a] (.130)
	CFK	.161[a] (.022)	.088[b] (.039)	.184[a] (.025)	.108[b] (.047)	.176[a] (.024)
nondurables industries	CUAGG	.973[a] (.135)	.810[a] (.273)	1.011[a] (.150)	1.037[a] (.249)	.949[a] (.159)
	CFK	.125[a] (.023)	.093[b] (.043)	.144[a] (.026)	.095[b] (.045)	.134[a] (.026)

Notes: Standard errors are in parentheses under coefficient estimates, and all regressions include industry dummies (not reported). All variables are in logs, and the right hand side variables are lagged once. Coefficients marked with superscripts a, b, or c are statistically significant at the 1%, 5%, or 10% level, respectively.

Table AIII Regression Results: AR(1) method 2 specification

Dependent Variable IK, 1964-1989

		all	high rent (median)	low rent (median)	high used (median)	low used (median)
all industries	CUAGG	1.028[a] (.079)	.947[a] (.111)	1.099[a] (.113)	1.119[a] (.110)	.944[a] (.114)
	CF	.291[a] (.022)	.208[a] (.034)	.350[a] (.029)	.224[a] (.032)	.351[a] (.031)
durables industries	CUAGG	1.369[a] (.106)	1.318[a] (.146)	1.400[a] (.154)	1.514[a] (.144)	1.221[a] (.155)
	CFK	.322[a] (.030)	.204[a] (.045)	.408[a] (.041)	.195[a] (.043)	.445[a] (.043)
nondurables industries	CUAGG	.611[a] (.120)	.509[a] (.170)	.716[a] (.169)	.664[a] (.170)	.556[a] (.169)
	CFK	.239[a] (.033)	.185[a] (.052)	.274[a] (.042)	.238[a] (.048)	.242[a] (.045)
		all	high rent (75th percentile)	low rent (75th percentile)	high used (75th percentile)	low used (75th percentile)
all industries	CUAGG	1.028[a] (.079)	.618[a] (.172)	1.160[a] (.089)	1.135[a] (.154)	.996[a] (.092)
	CFK	.291[a] (.022)	.178[a] (.053)	.318[a] (.024)	.237[a] (.044)	.308[a] (.026)
durables industries	CUAGG	1.369[a] (.106)	.888[a] (.236)	1.490[a] (.118)	1.564[a] (.220)	1.313[a] (.121)
	CFK	.322[a] (.030)	.136[c] (.073)	.359[a] (.033)	.225[a] (.065)	.351[a] (.034)
nondurables industries	CUAGG	.611[a] (.120)	.435[c] (.245)	.690[a] (.134)	.657[a] (.219)	.598[a] (.142)
	CFK	.239[a] (.033)	.192[a] (.074)	.253[a] (.035)	.218[a] (.060)	.246[a] (.039)

Notes: Standard errors are in parentheses under coefficient estimates, and all regressions include industry dummies (not reported). All variables are in logs, and the right hand side variables are lagged once. Coefficients marked with superscripts a, b, or c are statistically significant at the 1%, 5%, or 10% level, respectively.

Table AIV T-statistics on the Cash Flow-Sunk Cost Interaction Variables

Specification:	Table AII	Rent	Used
medians	all industries	-1.05	-2.04[b]
	durables	.13	-1.89[c]
	nondurables	-1.41	-1.03
75th percentile	all industries	-2.92[a]	-1.28
	durables	-2.36[b]	-1.23
	nondurables	-1.59	-.67
Specification:	**Table AIII**	**Rent**	**Used**
medians	all industries	-2.99[a]	-2.76[a]
	durables	-2.46[b]	-4.27[a]
	nondurables	-1.77[c]	.14
75th percentile	all industries	-2.83[a]	-1.74[c]
	durables	-2.69[a]	-2.17[b]
	nondurables	-1.11	-.49

Superscripts a, b, or c denote statistical significance at the 1%, 5%, or 10% level, respectively.

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