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FINANCING CONSTRAINTS AND CORPORATE INVESTMENT

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Financing Constraints and Corporate Investment

ABSTRACT

Most empirical models of investment rely on the assumption that firms are able to respond to prices set in centralized securities markets (through the "cost of capital" or "q"). An alternative approach emphasizes the importance of cash flow as a determinant of investment spending, because of a "financing hierarchy," in which internal finance has important cost advantages over external finance. We build on recent research concerning imperfections in markets for equity and debt. This work suggests that some firms do not have sufficient access to external capital markets to enable them to respond to changes in the cost of capital, asset prices, or tax-based investment incentives. To the extent that firms are constrained in their ability to raise funds externally, investment spending may be sensitive to the availability of internal finance. That is, investment may display "excess sensitivity" to movements in cash flow.

In this paper, we work within the q theory of investment, and examine the importance of a financing hierarchy created by capital-market imperfections. Using panel data on individual manufacturing firms, we compare the investment behavior of rapidly growing firms that exhaust all of their internal finance with that of mature firms paying dividends. We find that q values remain very high for significant periods of time for firms paying no dividends, relative to those for mature firms. We also find that investment is more sensitive to cash flow for the group of firms that our model implies is most likely to face external finance constraints. These results are consistent with the augmented model we propose, which takes into account different financing regimes for different groups of firms. Some extensions and implications for public policy are discussed at the end.

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I. INTRODUCTION

Studies of business investment and the impact of public policy on investment have figured prominently in economic research since the Keynesian revolution.[1] Empirical models of investment generally rely on the assumption that all firms respond similarly to prices set in centralized securities markets (through the cost of capital or q). Another line of inquiry, however, emphasizes the importance of cash flow as a determinant of investment spending,[2] because of a "financing hierarchy" in which internal finance has cost advantages over external finance.[3] Recent research on imperfections in markets for equity and debt emphasizes that all firms do not have the same access to external capital markets. Thus, firms will not respond to changes in the cost of capital, asset prices, or tax-based investment incentives in the same way. For firms that face constraints in their ability to raise funds externally, movements in cash flow may be important determinants of capital spending.

In this paper, we work within the q theory of investment, which has been used extensively in empirical studies and for tax policy evaluation. Empirical implementation of the model relies on the cost-of-adjustment approach;[4] previous results have not been uniformly convincing.[5] Recently, Abel and Blanchard (1986) find important roles for profits and output in aggregate investment equations relying on q, suggesting problems of aggregation or that firms do not face perfect capital markets. We address both of these points. Our emphasis is on the importance of using micro data to consider issues of firm heterogeneity in capital markets; the model developed here shows that capital-market imperfections can limit the availability of external finance to particular types of firms.

To test the effects of financing constraints on q and investment, careful attention must be paid to sectoral detail and firm heterogeneity (see, for example, Calomiris, Hubbard, and Stock, 1986). Thus, we use data on manufacturing firms from the Value Line data base. Our strategy is to identify differences in q, financing behavior, and investment across firms classified by their retention behavior. We are particularly interested in rapidly growing firms with current investment demands that exceed their current cash flow. If the cost disadvantage of external finance is slight, then retention behavior should contain little or no information about q or investment--firms will simply use external finance to smooth investment when internal finance fluctuates. On the other hand, if there is a pronounced financing hierarchy, then firms retaining all of their income may effectively be at a corner solution, where investment is limited by available internal cash flow. In this case, there are two predictions of our theoretical model that are the focus of our empirical work. First, firms with high retention ratios may have no low-cost marginal source of finance for investment to drive q down to its conventional equilibrium level. Second, the investment behavior of firms paying no dividends should be driven by fluctuations in cash flow; in the limit, contractions in cash flow will reduce their investment dollar for dollar.[6]

The paper is organized as follows. Section II reviews models based on imperfect information that explain why some firms face restrictions on issuing new shares or borrowing. In section III, we develop a model of investment and financial decisions for firms in different financing regimes. Theoretical equilibrium values of marginal q can differ markedly between firms exhausting all internal finance and mature firms with high payout rates. In section IV, we present evidence on the differences in Tobin's q for dividend-paying and non-dividend-paying firms. We also estimate an augmented q investment equation that incorporates the effect of cash flow. As our model predicts, the investment of constrained firms is more sensitive to fluctuations in cash flow than that of mature firms, and fluctuations in cash flow account for economically important movements in investment for constrained firms. The last section of the paper considers some of the cyclical and policy implications of our findings.

II. CAPITAL-MARKET IMPERFECTIONS, FINANCIAL CONSTRAINTS, AND INVESTMENT

Asymmetric Information and External Finance

Under perfect capital markets and no taxes, there is no cost differential between internal and external finance. The existence of transaction costs gives some advantage to internal finance, but these costs appear to be small. When firms and potential investors have asymmetric information about firms' prospects, however, it is possible that some sources of external finance may have higher costs or even be completely unavailable to certain categories of firms.

We consider first the case of tradeoffs between internal and external equity finance. Important recent papers by Myers and Majluf (1984) and Greenwald, Stiglitz, and Weiss (1984) explain why asymmetric information either eliminates any reliance on external equity finance in the market or causes suppliers of new equity to demand a large premium.[7] These results are referred to as either "pecking order" theories of finance (Myers, 1984) or as "financing hierarchy" theories.

Myers and Majluf consider a situation in which managers (or current owners) are better informed than potential shareholders about the true value of both the firm's investment opportunities and the existing assets in place. The true value of the firm will eventually be revealed, but new shares must be issued before this date, or the investment opportunity is lost--a realistic assumption for new firms in industries experiencing rapid technological advancement. In addition, managers are assumed to act in the interest of existing shareholders, and potential new investors are aware of this.

Myers and Majluf show that firms will turn down some investment projects with positive net present values rather than issue new shares under the circumstances. The basic argument applies Akerlof's (1970) market for "lemons" model, but with a more complicated structure. Appendix A illustrates the lemons discount demanded by potential new shareholders (see also Petersen, 1987); we summarize the argument below.

Suppose there are two types of firms in a new industry, "good" firms and "lemons." The value of assets in place is higher for good firms, and only good firms have positive net-present-value investment opportunities. Under these conditions, "lemons" are overvalued, and they will always try to issue new shares--they can always invest the funds in a zero net-present-value investment such as treasury bills. As a result, new shareholders will demand a higher return from good firms to cover the losses incurred from inadvertently funding lemons (we work this out in Appendix A). If this premium exceeds the share of the value of a new project going to existing shareholders, new shares will not be issued. For young firms with short track records, the probability of purchasing shares of a lemon is undoubtedly high. As firms mature, information asymmetries diminish and the lemons discount falls.

Debt considerations can be easily incorporated. In general, the cost of debt will increase with the extent of borrowing.[8] The precise relationship between the quantity and shadow price of credit is likely to vary across firms according to information imperfections. For example, asymmetric information between borrowers and lenders can lead to "credit rationing" to some categories of borrowers. In the model of Stiglitz and Weiss (1981), borrowers have private information about the riskiness of their project returns, and lenders cannot necessarily distinguish "good borrowers" from "bad borrowers." Under these circumstances, higher loan interest rates lead to adverse selection of borrowers with a high probability of default. Lenders may maximize their profits by quantity rationing in competitive equilibrium. Calomiris and Hubbard (1986) also show that when multiple credit markets exist side by side--with some borrowers able to obtain funds in bond and commercial paper markets and others restricted to bank markets--aggregate shocks to collateral value or cash flow (e.g., because of business cycle downturns) make credit restrictions more likely to borrowers that rely only on bank markets. In addition, the importance of borrower net worth for obtaining external finance is stressed in Leland and Pyle (1977), Myers and Majluf (1984), Calomiris and Hubbard (1986), and Bernanke and Gertler (1987).

These results imply that firms constrained by asymmetric information in equity markets cannot easily substitute debt for new share issues, absent substantial available internal finance and current assets. The more severe the information asymmetry, the more likely that external finance will be either very costly or unavailable.[9] Information asymmetries are more pronounced for new firms and for small firms whose stock is traded (if it is traded at all) in markets far less organized than, say, the New York Stock Exchange. For mature corporations, analysts specialize in gathering information for potential investors about their prospects. Such information is expensive and is provided only for firms with a large clientele of investors.

Empirical Evidence on Cost Differentials Between Internal and External Finance

Many case studies have suggested that small firms have more limited access to external finance than large firms (see for example the literature beginning with Butters and Lintner, 1945).[10] Using data from a variety of sources, Srini Vasan (1986, Chapter 3) has examined differences in corporate financing behavior across firms of various sizes. He finds striking differences in the reliance on internal and external finance across firms. Small and medium-sized manufacturing corporations (those with assets less than $100 million) are very dependent on internal finance;[11] this source accounted for over 85 percent of their total finance over the period from 1960 to 1980. These corporations raised only about 3 percent of their total finance from bonds and 2 percent from new share issues, with the balance coming from bank loans. While large firms account for 74 percent of total manufacturing assets over the period, they issue 99 percent of all new shares and 92 percent of all new corporate bonds. In addition, retention ratios are substantially higher in the small and medium-sized categories; many firms pay no dividends at all for substantial periods of time.

This evidence indicates that most large firms, when faced with a reduction in current earnings, can substitute either external finance or reduce dividends. For smaller firms, however, any contraction in earnings reduces their total finance. Srini Vasan also finds that internal finance exhibits greater volatility over the business cycle in small and medium-sized corporations than in large corporations. Moreover, during downturns, large firms have greater relative access to short-term and long-term debt markets. Hence, business recessions and changes in corporate tax policy that affect internal finance will likely have a much greater effect on the growth rates and investment behavior of small, immature enterprises.

Some recent studies have tested for implied cost differences between internal and external equity finance. McDonald and Soderstrom (1986) examined financing behavior in a panel of 423 corporations listed in the Compustat Industrial data file. Their results support the existence of a financing hierarchy--where new equity issues are undertaken only as a last resort. They also find evidence that dividends provide marginal finance for firms when cash flow is high relative to investment, while equity issues serve as the marginal source of finance for firms that retain all of their earnings. Related work by Kalay and Shimrat (1985) finds that almost one-third of unregulated firms issuing new shares were paying no dividends, while the remainder had, on average, very low payout ratios. Finally, Kalay and Shimrat (1986) study the movement of stock and bond prices following the announcement of a new share issue. Their evidence of a significant drop in both bond and stock prices supports the "market-for-lemons" argument.

III. FINANCIAL CONSTRAINTS, FINANCING DECISIONS, AND INVESTMENT

Investment and Financing Decisions of the Firm

The central feature of our argument is that for firms facing asymmetric information in capital markets, q can fluctuate over a substantial range in excess of unity with little or no response of investment, while investment can be "excessively sensitive" to cash flow fluctuations. We demonstrate this result by modifying a simple model of firm financial and investment decisions developed in the public finance literature (see for example, Auerbach, 1984; Poterba and Summers, 1983, 1985). In tax-based models, there are differences in the costs of internal and external finance because of the differential taxation of capital gains and dividends at the personal level.[12] We first consider decisions about corporate finance and investment in "full-information" firms, that do not face financing constraints due to asymmetric information. We then model the financing and investment decisions of constrained firms.

In any period t, an existing shareholder's after-tax return R_t is the sum of a dividend return (taxed at rate θ) and a capital gain (taxed at rate c). The capital gain tax rate is an accrual-equivalent effective tax rate, as in King (1977). That is,

(1) $$R_t = \frac{(1-\theta)D_t + (1-c)({}_tV_{t+1} - V_t)}{V_t},$$

where D_t represents the dividend payment by the firm, V_t is the value of the firm's equity, and ${}_tV_{t+1}$ is the value in period t+1 of shares outstanding in period t, which we assume is known with certainty. In period t+1, the total value of the firm is

(2) $$V_{t+1} = {}_tV_{t+1} + V_t^N,$$

where V_t^N represents net new share issues.

In equilibrium, owners of equity earn their required return ρ, so that

(3) $$R_t = \rho .$$

Therefore,

(4) $$\rho V_t = (1-\theta)D_t - (1-c)V_t^N + (1-c)V_{t+1} - (1-c)V_t,$$

and the value of the firm evolves according to

(5) $$V_{t+1} = \left(1 + \frac{\rho}{1-c}\right) V_t + V_t^N - \left(\frac{1-\theta}{1-c}\right) D_t,$$

so that

(6) $$V_t = \sum_{i=0}^{\infty} \left(1 + \frac{\rho}{1-c}\right)^{-i} \left[\left(\frac{1-\theta}{1-c}\right) D_{t+i} - V_{t+i}^N\right].$$

That is, the total value of the firm is the present value of the post-tax dividend stream adjusted for the present value of new share issues which would have to be bought by current equity holders to maintain their proportional claim on the firm. The firm maximizes its market value, subject to a set of constraints.

The capital accumulation constraint is

$$(7) \qquad K_t = (1-\delta)K_{t-1} + I_t,$$

where K_t is the capital stock at the beginning of period t, I represents investment, and δ represents a constant rate of depreciation. Sources of funds for the firm include post-tax profits, $(1-\tau)\pi(K_t)$, where τ is the corporate income tax rate, new share issues (V_t^N), and net borrowing. The firm issues one-period debt B_t at the beginning of each period, paying an interest rate of i_t at the end of the period, where $i = i(B/K)$, $i' > 0$.[13] Uses of funds include dividend payments, debt service, and investment. In general, the effective price of investment will depend on the value of investment tax credits and the current value of depreciation tax deductions. We ignore these considerations for the moment, though we incorporate them in our empirical work. Thus, the constraint that sources equal uses of funds yields

$$(8) \qquad (1-\tau)\pi(K_t) + V_t^N + B_t - B_{t-1} = D_t + (1-\tau)\, i_{t-1}B_{t-1} + I_t.$$

There are also implicit constraints on dividend payments and new share issues. First, dividends cannot be negative, so that

(9) $D_t \geq 0.$

Second, new share issues are assumed to be bounded from below by some minimal (negative) level, V_{-}^N :[14]

(10) $V_t^N \geq V_{-}^N$.

In summary, the firm chooses I_t, K_t, V_t^N, and D_t to maximize V_t subject to the constraints described above. That is, the firm acts to

$$(11) \quad \max \sum_{t=0}^{\infty} \left(1 + \frac{\rho}{1-c}\right)^{-t} \{[(\frac{1-\theta}{1-c})D_t - V_t^N] - \lambda_t[K_t - (1-\delta)K_{t-1} - I_t]\}$$

$$- \alpha_t[(1-\tau)\pi(K_t) + V_t^N + B_t - B_{t-1} - D_t - I_t - (1-\tau)i_{t-1}B_{t-1}]$$

$$- \beta_t(V_t^N - V_{-}^N) - \gamma_t D_t,$$

where λ_t, α_t, β_t, and γ_t are the Lagrange multipliers associated with the constraints.

The solution to this full-information problem is familiar (see Auerbach, 1979, for example), and we do not repeat it here. We first consider the case analyzed by Auerbach, in which firms are mature—cash flow exceeds investment—and they pay dividends. Two basic results emerge. First, if the dividend tax rate exceeds the capital gains tax rate ($\theta > c$), it is never optimal to issue new shares and pay dividends at the same time: V_t can be increased by an equal decrease in D_t and V_t^N. Second, abstracting for the moment from corporate tax and debt considerations, for firms paying dividends, the equilibrium shadow value of an additional unit of capital--marginal q--is equal to $(1-\theta)/(1-c)$. This is the q value at which shareholders are indifferent between a dollar of retentions reinvested in the firm and taxed at rate c, and a dollar of dividends taxed at rate θ. Thus, firms neither pay dividends nor issue new shares over a range-- $\frac{1-\theta}{1-c} < q < 1$. If marginal q is below one it is not optimal to issue new shares, but firms will reinvest earnings rather than pay dividends as long as $q > (1-\theta)/(1-c)$, because of favorable capital gains taxation.

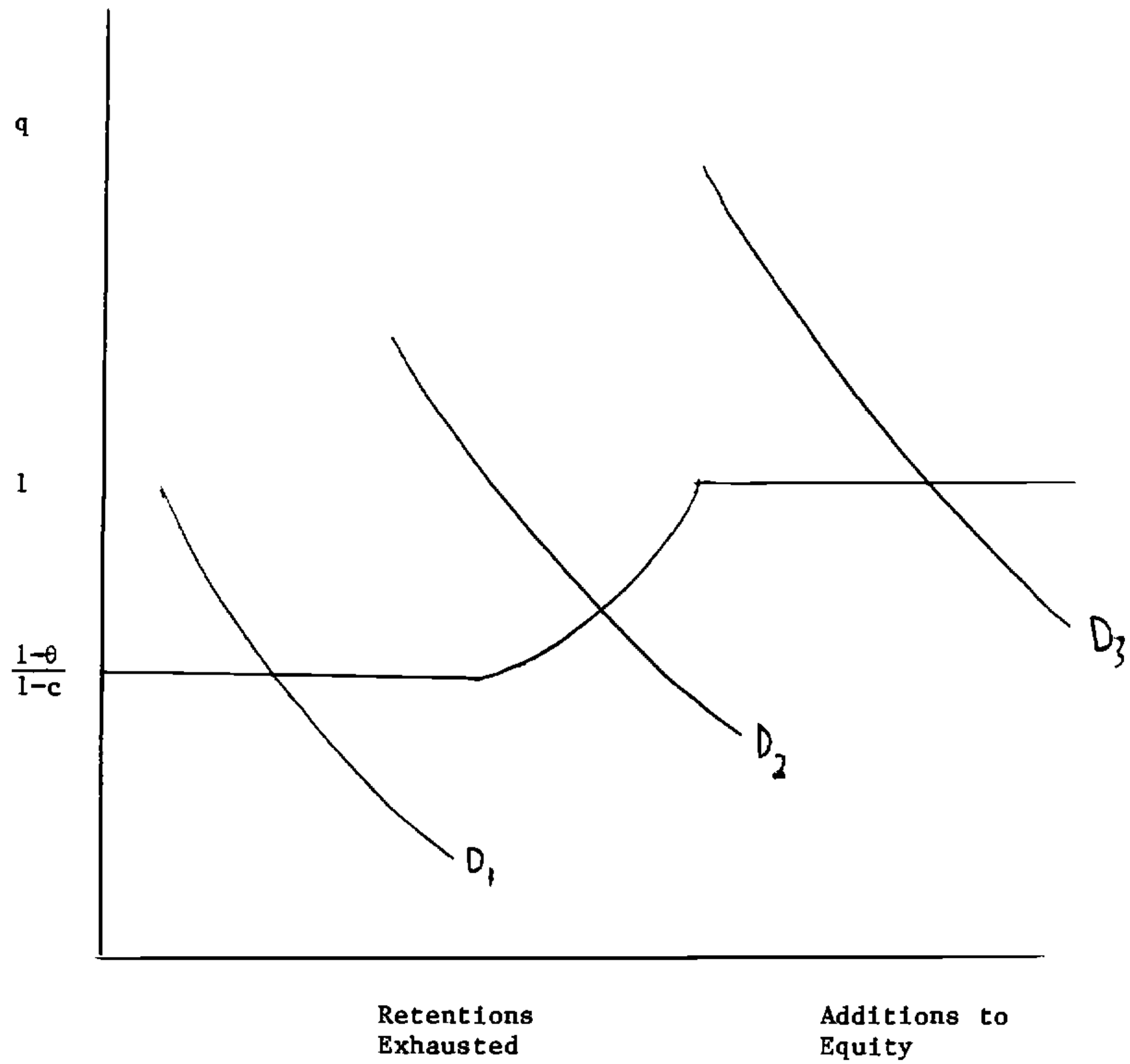
Thus, taxation alone leads to a financing hierarchy with a discontinuity between the effective costs of internal and external finance. Such a hierarchy is shown in Figure 1 (see also Auerbach, 1983b, 1984). When investment demand is low (as in the D_1 schedule in the figure), capital spending can be financed from internally generated funds, at the expense of extra dividends, and marginal q is still equal to $(1-\theta)/(1-c)$ in equilibrium. When marginal q exceeds unity and the demand for investment is very high (as in the D_3 schedule), firms will issue new shares to restore marginal q to its equilibrium value of unity. For intermediate levels of investment demand (as in the D_2 schedule), debt finance will be used to bridge the gap between internal and external equity finance. If $\theta = 0.30$ and $c = 0.05$, these bounds would be 0.74 and 1; the tax-induced range of q values over which firms pay no dividends and issue no shares is, thus, probably small.

Capital-Market Imperfections, Corporate Finance, and Investment

We now consider rapidly growing firms that have investment demand that exceeds internal finance and that face restrictions on their

FIGURE 1

q AND FINANCING DECISIONS IN MATURE FIRMS



ability to raise funds externally.[15] Two features of financing constraints are incorporated in a simple modification of the model. First, we assume that firms face a maximum debt to capital ratio of b dictated by lenders, as in the models discussed in section II; that is, increases in debt can be obtained only with an increase in internal equity.[16] Second, to take into account the "lemons premium" (see Appendix A), we reduce V_t in equation (6) by an amount Ω_t per dollar of new equity issued.

The discount Ω represents the additional value that new investors demand from "good" firms to compensate them for losses they incur from inadvertently funding lemons.[17] The discount Ω can be readily connected to the previous literature on new share issues and the "lemons premium." Let the q value of good firms and lemons be denoted by q^G and q^L, respectively, and the percentage of good firms be p. Because of asymmetric information, all firms are initially valued at a weighted-average value, $\bar{q} = pq^G + (1-p)q^L$. It is shown in Appendix A that the breakeven q value of a dollar of new investment financed by share issues is given by $q = q^G/\bar{q} = 1 + \Omega$.

Under perfect information, good firms are valued at q^G, and the threshold q value for new share issues is unity. When good firms cannot initially be distinguished from lemons, marginal q will exceed unity by an amount that depends on the percentage of lemons and the difference between the value of good firms and lemons. The ratio $q^G/\bar{q}$ indicates how much dilution occurs when good firms issue new shares; the lemons premium, Ω, is equal to $(q^G/\bar{q}) - 1$. For example, suppose $q^G = 5$ and $\bar{q} = 2$, then Ω is 1.5, and a new project must have a q of at least 2.5 before managers will seek external equity finance.

Incorporating the lemons premium, equation (6) becomes:

$$(12) \qquad V_t = \sum_{i=0}^{\infty} (1 + \frac{\rho}{1-c})^{-i} \left[(\frac{1-\theta}{1-c}) D_{t+i} - (1+\Omega_t) V_{t+i}^N \right] .$$

We can now express the value maximization problem in equation (11) as:

$$(13) \qquad \max \sum_{t=0}^{\infty} (1+ \frac{\rho}{1-c})^{-t} \{ [(\frac{1-\theta}{1-c}) D_t - (1+\Omega_t) V_t^N] - \lambda_t [K_t - (1-\delta)K_{t-1} - I_t]$$

$$-\alpha_t [(1-\tau)\pi(K_t) + V_t^N - D_t - (1-b_t)I_t - (1-\tau)i_{t-1}B_{t-1}]$$

$$-\beta_t (V_t^N - V_-^N) - \gamma_t D_t .$$

The first-order necessary conditions for the optimal investment program include:

$$(14a) \qquad I_t : \lambda_t + \alpha_t (1-b_t) = 0$$

$$(14b) \qquad K_t : -\lambda_t + (1+ \frac{\rho}{1-c})^{-1} (1-\delta) \lambda_{t+1} - \alpha_t (1-\tau)\pi'(K_t) + \alpha_{t+1} (1 + \frac{\rho}{1-c})^{-1} (1-\tau) i_t b_t^2 = 0$$

$$(14c) \qquad V_t^N : -1 - \Omega_t - \alpha_t - \beta_t = 0.$$

$$(14d) \qquad D_t : (\frac{1-\theta}{1-c}) + \alpha_t - \gamma_t = 0.$$

The range of q values for which firms neither pay dividends nor issue new shares can be derived as follows. When firms are not paying dividends and internal finance is exhausted, we know that $\beta = 0$ and

(15) $\alpha_t = -1 - \Omega_t$.

With the lemons discount present, constrained firms will choose to issue shares only when

(16) $\lambda_t > (1 + \Omega_t)(1 - b_t)$,

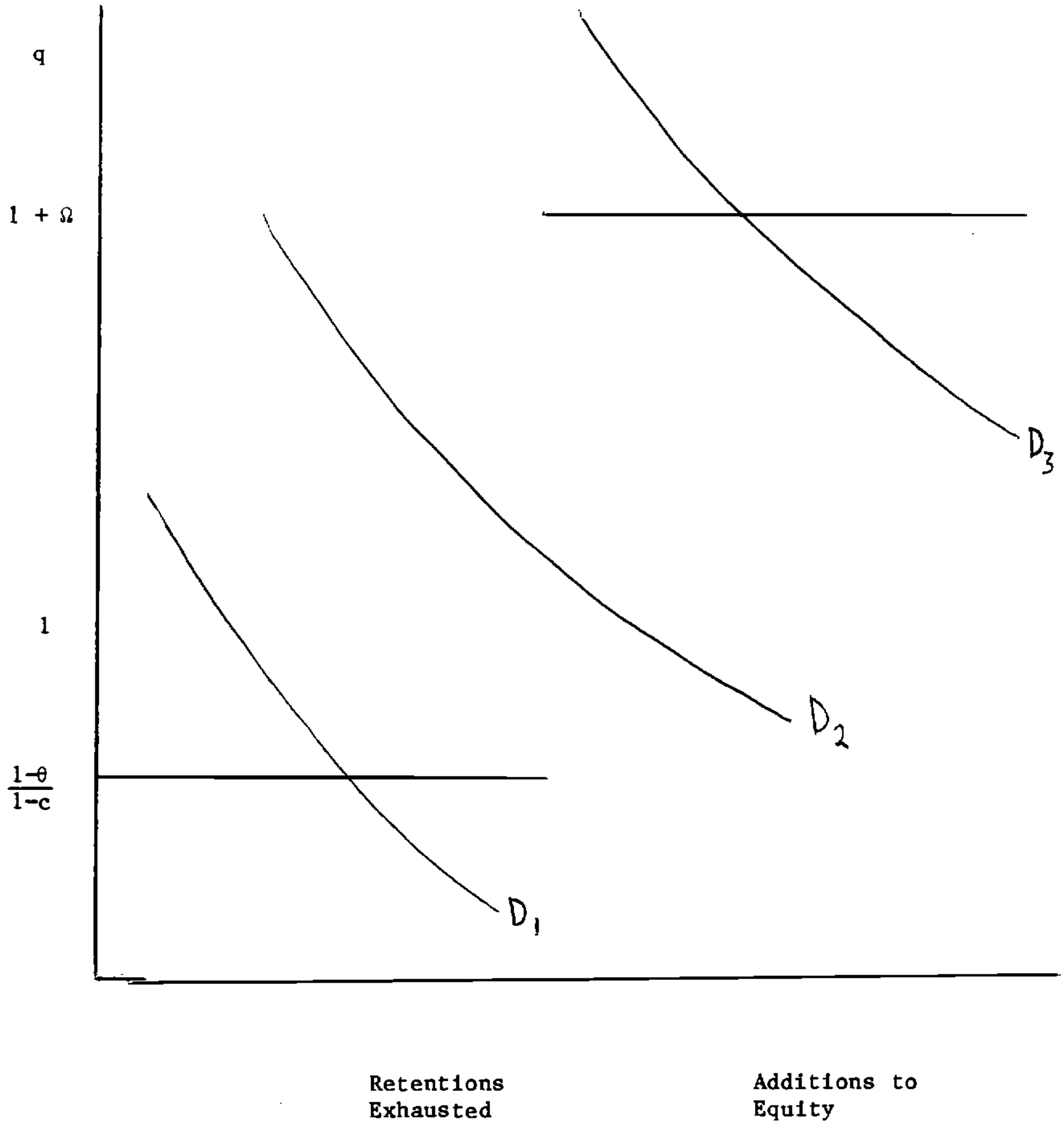
so that the supply-of-funds schedule facing the firm has a discontinuity at the point where retentions are exhausted, as depicted in Figure 2.

New shares are issued only when internal finance is exhausted and the marginal q on additional projects exceeds $1 + \Omega_t(1 - b_t)$, as illustrated by the D_3 demand schedule in the figure. (The last term accounts for the fact that new equity capital can be leveraged.) The higher the value of Ω, the greater the likelihood that a firm's investment will be constrained by internal finance, as illustrated by the D_2 demand schedule in Figure 2. Of course, Ω can vary both across firms and over time for the same firm. If information asymmetries become less severe over time, the top horizontal schedule in Figure 2 will shift downward toward unity.

The model has several direct empirical implications. First, observed q values will differ across firms with different information characteristics. For firms facing asymmetric information, the observed q value will be the weighted average $\bar{q}$ discussed above. This may be well above one because these firms have no low-cost marginal source of finance to undertake the investment necessary to push q to its full-information equilibrium. The model also predicts that q must be

FIGURE 2

q AND FINANCING DECISION IN CONSTRAINED FIRMS



substantially higher to induce a new share issue for limited-information firms, than for full-information firms, but the true marginal q is unobservable. We can, however, observe $\bar{q}$ and its relationship to new share issues. For "good" full-information firms, q^G and $\bar{q}$ are the same, so we expect no systematic link between observable q values and new share issues. On the other hand, $\bar{q}$ can move independently from q^G for limited-information firms. For example, the market may reappraise the underlying probability that a firm is a lemon. If the asymmetric information problem is important empirically, observed q values should rise prior to new share issues for limited-information firms.

Finally, internal finance constrains investment spending for firms that do not pay dividends and face an investment demand schedule like D_2 in Figure 2. When q is sufficiently high, new shares are issued, and movements in q will lead to movements in investment. Otherwise, movements in investment are limited by changes in internal finance (supplemented by allowed leverage of collateral). That is, variations in the length of the retention segment in Figure 2 should cause matching variation in investment. More specifically, investment—$I_t(\hat{\lambda}_t)$— would be determined according to

$$(17) \qquad \hat{\lambda}_t = \max[(1+\Omega_t)(1-b_t), \frac{\partial V_t}{\partial K_t}(\hat{I}_t)] \ ,$$

where $\hat{I}_t = (1-\tau)\,\pi(K_t)(1+b_t)$. That is, investment is sometimes restricted by the availability of internal finance. We test these implications in our empirical work.

In this formulation, the required rate of return does not depend on the payout ratio. The basic model is in the spirit of the "new view" of dividends (see e.g. Auerbach, 1979; Bradford, 1981; and King, 1977). Given our emphasis on a financing hierarchy generated primarily by capital-market imperfections, we can be agnostic as to motivations for paying dividends. Cash flow would be an even more important determinant of investment than our theoretical results suggest if firms face signalling consequences of cutting dividends (see, for example, Bhattacharya, 1979).[18]

To make the derivations presented above operational, we work within the q-theory approach to investment (see Brainard and Tobin, 1968; Tobin, 1969; and the subsequent advances in Mussa, 1977; Abel, 1979; Hayashi, 1982; and Abel and Blanchard, 1986). In the basic version of the model, the ratio of investment to the capital stock is a function of q. We follow Summers (1981) in specifying a cost of adjustment per unit of investment, $\emptyset(I/K)$, where adjustment costs are assumed to be expensed for tax purposes. We can then rewrite equation (14a) for a firm i in period t (ignoring time subscripts on the tax variables) as

$$(18) \qquad \lambda_{it} + \alpha_{it}(1-b_{it} + \emptyset(1-\tau) + \emptyset'(1-\tau)\frac{I_{it}}{K_{it}}) = 0 \ .$$

In the absence of the financing constraints addressed here, Hayashi (1982) and Summers (1981) link the shadow price to the market value of existing capital.[19] In that approach, under quadratic adjustment costs (assumed to be constant across firms),[20] equation (18) can be written as

$$(19) \qquad \left(\frac{I}{K}\right)_{it} = \mu_i + \mu_1 Q_{it} + u_{it},$$

where I represents investment during the period, K is the replacement value of the capital stock at the beginning of the period, μ_i is the normal value of $(I/K)_i$, and u_{it} is white noise. Q represents the value of Tobin's q at the beginning of the period (defined as the sum of the value of equity and debt less the value of inventories divided by the replacement cost of the capital stock), adjusted for corporate and personal tax considerations (see Appendix B).

An alternative model is required to describe the investment behavior of constrained firms, who are unable to respond to variations in Q. In the simplest alternative, investment is constrained by available cash flow (CF) in firms that retain all earnings, but which have little or no access to external finance (beyond that obtained by allowed leverage of internal finance), so that

$$(20) \qquad \left(\frac{I}{K}\right)_{it} = f\left(\frac{CF}{K}\right)_{it} \quad .$$

In practice, in any group of firms across time, financing constraints will be binding for some of the firms and not for others. We estimate a model that combines equations (19) and (20) so that both Q and cash flow influence investment:

$$(21) \qquad \left(\frac{I}{K}\right)_{it} = \mu_i + \mu_1 Q_{it} + \mu_2\left(\frac{CF}{K}\right)_{it} + \mu_3\left(\frac{CF}{K}\right)_{it-1} + u_{it} \quad .$$

We expect, however, that the estimated coefficients on cash flow will be larger in classes of firms that are more likely to face financing constraints, a priori. The inclusion of cash flow measures in investment equations is not novel; we integrate them formally here.

IV. ECONOMETRIC EVIDENCE ON FINANCIAL CONSTRAINTS AND INVESTMENT

The Data

We use Value Line data to examine the importance of financing constraints in explaining investment. The detailed definitions of our empirical measures are discussed in Appendix B. The firms in this data base are typically large, and their stock is publicly traded. Evidence that some of these firms face financing constraints should indicate that the phenomenon is widespread.

We limit our attention to firms within the manufacturing sector (SIC codes between 2000 and 3999). The selection of the time period is very important to our study. We need enough years to obtain adequate time-series variation; however, we also need to identify a set of firms that may face financing constraints. Too long a time period would permit constrained firms to mature, reducing the importance of information-related financing constraints. With the above considerations in mind, and taking into account the data availability, we selected the period from 1970 to 1984.[21] We also analyze subintervals within this period.

The sample of firms was obtained as follows. We deleted observations from the sample that had missing or inconsistent data. We also deleted firms with major mergers because mergers could cause inconsistencies when constructing lags. This paper studies financial constraints resulting from asymmetric information in capital markets, not financial distress due to poor market performance. Therefore, only those firms that had positive sales growth from 1969 to 1984 were included in the sample. These restrictions still left us with a substantial sample of 421 manufacturing firms.

We use a single criterion to identify firms that may face financing constraints—firms' retention behavior over the sample period.[22] The model in section III implies that if information problems in capital markets lead to financing constraints, they should bind on firms that retain most of their income. If, on the other hand, the cost disadvantage of external finance is slight (e.g., only issue costs), then retention behavior should contain little or no information about investment behavior of the firm or its q value. Firms would simply use external finance to smooth investment when internal finance fluctuates.

The classification scheme divides firms into four groups as follows:

Class 1: $\frac{\text{Dividends}}{\text{Income}} < 0.1$ for at least 10 years;

Class 2: $\frac{\text{Dividends}}{\text{Income}} < 0.2$ for at least 10 years, but not in class 1;

Class 3: $\frac{\text{Dividends}}{\text{Income}} < 0.4$ for at least 10 years, but not in class 1 or 2;

Class 4: All others.

This approach limits the sensitivity of the classification to outliers of the dividend-income ratio. In a particular year, this ratio could be very high due to abnormally low income, even though the firm generally retains most of its earnings. Thus, our approach is more robust than classifying firms according to their average retention ratio.

Several summary statistics for the firms in each class are presented in Table 1. Our class 1 firms--those that we hypothesize will generally face binding financial constraints--retained an average of 95 percent of their income, and paid a dividend on average in only 35 percent of the years. The typical class 1 firm paid no dividends for the first seven to ten years and a small dividend in the remaining years. In fact, 21 firms in class 1 never paid a dividend over the entire time period, although these firms are profitable, as the average rate of return figures indicate. Going across classes, there is a pronounced increase in the percentage of time that a positive dividend is paid and a corresponding decrease in the retention ratio.

The classes are effectively sorted by firm size as well, as the capital stock figures show. Class 1 firms experienced much more rapid growth in the fixed capital stock than the mature firms in class 4. Mean values of the capital stock are, of course, influenced by extreme values. The pattern across the four classes for the median values of the capital stock is similarly striking. While class 1 firms are small relative to firms in class 4, they are still large relative to U.S. manufacturing corporations in general; 85 percent of manufacturing corporations had smaller capital stocks in 1970 than the average class 1 firm--the beginning of our sample period (based on information provided

TABLE 1

Summary Statistics: Sample of Manufacturing Firms, 1969-1984

	Category of Firm			
	Class 1	Class 2	Class 3	Class 4
Number of firms	51	39	188	143
Average retention ratio	0.95	0.85	0.68	0.34
Percent of years with positive dividends	35%	83%	98%	99%
Average capital stock-1970 (millions of 1982 dollars)	97.3	314.6	648.4	2094.4
Median capital stock-1970 (millions of 1982 dollars)	27.1	54.2	148.1	655.1
Average capital stock-1984 (millions of 1982 dollars)	347.4	577.3	934.3	2778.4
Median capital stock-1984 (millions of 1982 dollars)	94.9	192.5	266.8	694.7
Average real sales growth	13.5%	9.0%	5.7%	3.4%
Average rate of return on market value of common stock	14.6%	16.3%	14.3%	11.8%

Source: Authors' calculations based on samples selected from the Value Line database.

by the Quarterly Financial Reports of the Securities and Exchange Commission).

Though we deal with fairly large firms even in class 1, we note that for the manufacturing sector as a whole, firms with assets of less than $50 million in 1970 (or a little over $100 million in 1982 dollars) accounted for almost 20 percent of the assets of manufacturing firms. We show later that class 1 firms have both a higher mean rate of investment and higher volatility of capital spending, so that potential financial constraints on this kind of firm will be important for aggregate manufacturing investment.

The data in Table 2 present information on new share issues, debt finance, and Tobin's q for firms in the various classes.[23] *Ceteris paribus*, one would expect firms in class 1 to rely more heavily on new share issues than firms in the remaining classes. The typical firm in class 1 has an investment demand schedule like D_2 or D_3 in Figure 2. The typical firm in classes 3 or 4 has a demand schedule like D_1 and should not simultaneously pay dividends and issue new shares--given the taxation of corporate income. As the model in section III predicts, firms in class 1 issue new shares more frequently--approximately one year in every four--than do firms in the other three classes. Firms in the first class also raise a greater proportion of total finance from new shares. Even for class 1, however, the amount of finance raised from new share issues is small compared to funds generated from internal cash flows.

The last two lines of Table 2 provide information on debt utilization. Although one would expect the mature firms in classes 3

TABLE 2

New Share Issues and Tobin's q in Manufacturing Firms

	Class 1	Class 2	Class 3	Class 4
Average percent of years with new share issues	26%	19%	12%	8%
Average value of share issue as a percentage of cash flow	23%	9%	5%	4%
Average q values for all years	3.9 (0.4)	2.5 (0.2)	1.8 (0.1)	1.6 (0.1)
Median q values for all years	1.6	1.4	1.0	0.7
Average difference in q values between periods of new share issues and periods of no new share issues	1.6 (0.8)	0.9 (0.4)	0.4 (0.2)	0.0 (0.1)
Average ratio of debt to capital stock	0.59 (0.05)	0.52 (0.05)	0.39 (0.02)	0.28 (0.02)
Average ratio of interest payments to (interest payments plus cash flows)	0.23 (0.14)	0.18 (0.09)	0.16 (0.10)	0.15 (0.09)

Source: Authors' calculations based on samples selected from the Value Line database. The standard error of the mean appears in parentheses below the average q values.

and 4 to have higher debt capacities, the debt-to-capital ratios are much higher for classes 1 and 2. These results are consistent with the existence of a financing hierarchy and support the assumption in our model that constrained firms borrow up to their debt capacity.[24] It is also noteworthy that the correlation between net borrowing and cash flow is positive and more than three times greater in class 1 than class 4, suggesting that class 1 firms are unable to smooth fluctuations in internal finance with debt.

Table 2 also reports conventional Tobin's q measures for all four classes of firms.[25] The averages for classes 1 and 2 are significantly greater than the averages for classes 3 and 4. The asymptotic t statistic for the null hypothesis that the class 1 mean equals the class 4 mean is 5.8.[26] This result also holds for every year in the sample individually. Similar patterns hold for median q values.

One might interpret the high q values observed in class 1 as the result of high expected growth rates for these rapidly expanding firms. As Table 1 shows, the class 1 firms did indeed grow very quickly over our sample period. Their high q values, however, beg the question of why these firms did not invest even more. As an alternative to financing constraints, high adjustment costs could slow convergence of q to a full-information equilibrium. Then, one would expect no systematic relation between q and new share issues. Firms would invest at an optimal pace to push q uniformly toward equilibrium, and new shares would be issued as necessary to finance capital spending.[27]

The statistics in Table 2, however, strongly contradict this view. We calculate the differences in q values in years with and without new share issues on a firm by firm basis and then compute an average of differences.[28] As noted in the table, for classes 1 through 4, this procedure yields differences of, respectively, 1.6, 0.9, 0.4 and 0.0. These results are consistent with the existence of a financing hierarchy arising because of a "lemons premium." As already noted (see Appendix A), firms will issue only if marginal $q > q^G/\bar{q}$, where q^G is the true q value for good firms and $\bar{q}$ is the observable weighted-average value of q for good firms and lemons. When asymmetric information problems are severe and the percentage of lemons is large, however, the ratio of q^G to $\bar{q}$ can be very large; that is, good firms may be considerably undervalued. Observed $\bar{q}$ can vary independently of the true q^G for good firms. As lemons are revealed, $\bar{q}$ rises, and the lemons premium falls. At some point, at sufficiently high stock prices, good firms will issue new shares. Our sample, of course, consists of companies that *ex post* are good firms.

Financing Constraints, Cash Flow, and Investment

The evidence on financing patterns presented to this point is consistent with the view that information asymmetries generate significant financial constraints. One implication of the model in section III is that firms facing these financial constraints will exhaust their cash flow to finance desired capital spending. The summary statistics presented in Table 3 confirm this prediction for the firms in our sample. The cash-flow-to-capital and investment-to-capital ratios are roughly equivalent in class 1. Firms in classes 3 and 4 spend a much lower proportion of their cash flow on investment. The

TABLE 3

Cash Flow and Investment in Manufacturing Firms

	Class 1	Class 2	Class 3	Class 4
I/K	0.26	0.20	0.14	0.09
CF/K	0.29	0.28	0.23	0.18
Correlation of CF with I (deviations from trend)	0.92	0.82	0.38	0.20
Average of firm standard deviations of I/K	0.18	0.10	0.06	0.04
Average of firm standard deviations of CF/K	0.20	0.10	0.07	0.05

Source: Authors' calculations based on samples selected from the Value Line database.

last two rows of Table 3 demonstrate the pronounced differences in the volatility of both cash flow and investment in class 1 firms relative to mature, dividend-paying firms.

The correlation results in Table 3 are especially striking. Both investment and cash flow have pronounced upward trends in all classes. The theory predicts, however, that the deviations from trend for cash flow should be more closely linked with deviations of investment from trend in classes 1 and 2 than in classes 3 and 4. Table 3 presents the correlations of deviations in cash flow and investment from exponential trends estimated from aggregate time-series data for each class from 1970 to 1984. For classes 1 and 2, aggregate deviations from the investment trend are highly correlated with aggregate deviations from the cash flow trend. The correlation drops off substantially, however, for classes 3 and 4. Again, these results are consistent with the view that capital-market imperfections prevent some groups of firms from smoothing fluctuations in internal finance with external funds.

Our strategy is to estimate the contribution of cash flow toward explaining investment (over and above movements in tax-adjusted Q). In Table 4, we begin by reporting coefficient estimates for the basic Q model described in equation (19), and estimates for the cash flow model from equation (20) with only current and lagged CF/K included as explanatory variables. In both cases, fixed firm[29] and year effects are included, and the equations are estimated for each of the four classes. We report results using tax-adjusted Q only; results using the unadjusted measure are very similar.

TABLE 4

Effects of Q or Cash Flow Individually on Investment

Dependent Variable: $(I/K)_{it}$

	Class 1		Class 2		Class 3		Class 4	
Q_{it}	0.0046 (0.0004)	—	0.0073 (0.0009)	—	0.0055 (0.0004)	—	0.0031 (0.0003)	—
$(CF/K)_{it}$	—	0.412 (0.032)	—	0.346 (0.041)	—	0.166 (0.015)	—	0.136 (0.022)
$(CF/K)_{it-1}$	—	0.108 (0.027)	—	0.133 (0.036)	—	0.157 (0.015)	—	0.213 (0.022)
$\bar{R}^2$	0.18	0.38	0.18	0.29	0.13	0.22	0.11	0.23

Note: The models estimated include fixed firm and year effects (not reported). Standard errors are in parentheses.

Three findings in Table 4 are of interest. First, positive and precisely estimated coefficients of tax-adjusted Q are obtained in all classes. The cash flow model, however, explains more of the variation in investment in all classes than does Q. In addition, the pattern of coefficients on current cash flow suggests a much greater sensitivity of investment to contemporaneous fluctuations in cash flow for firms in class 1 than for firms in the other classes.

The most convincing results come from estimates of the model in which both Q and cash flow variables are included. We report these results in Table 5. The fifteen years covered by our sample may be too long a period over which to classify firms; that is, some firms may have "matured" over the period. To address this possibility, we report estimates over two time periods--1970-1977 and the full sample, 1970-1984.

The estimate of positive coefficients on the cash flow variables (i.e., an apparent "excess sensitivity" of investment to cash flow) need not imply that capital-market imperfections are important. Our data measure average Q, and the theory pertains, of course, to marginal Q. Cash flow could contain information about movements in marginal Q not captured in average Q.[30] Indeed, estimated coefficients on lagged cash flow are positive, statistically significant, and of comparable magnitude for all classes, suggesting that, for whatever reason, cash flow contributes to explaining investment over and above Q.[31] This is not surprising, given the estimates for aggregate time-series in manufacturing from Abel and Blanchard (1986).

TABLE 5

Effects of Q and Cash Flow on Investment

Dependent Variable: $(I/K)_{it}$

	Class 1		Class 2		Class 3		Class 4	
	1970-77	1970-84	1970-77	1970-84	1970-77	1970-84	1970-77	1970-84
Q_{it}	-0.0002 (0.0004)	0.0004 (0.0006)	0.0053 (0.0013)	0.0040 (0.0009)	0.0022 (0.0005)	0.0019 (0.0004)	0.0001 (0.0005)	-0.0004 (0.0003)
$(CF/K)_{it}$	0.554 (0.036)	0.418 (0.034)	0.288 (0.064)	0.317 (0.041)	0.130 (0.020)	0.153 (0.015)	0.137 (0.032)	0.142 (0.023)
$(CF/K)_{it-1}$	0.166 (0.032)	0.122 (0.033)	0.055 (0.048)	0.089 (0.037)	0.110 (0.021)	0.135 (0.015)	0.168 (0.031)	0.220 (0.023)
$\bar{R}^2$	0.56	0.38	0.20	0.31	0.15	0.23	0.14	0.23

Note: The models were estimated using fixed firm and year effects (not reported). Standard errors are in parentheses.

The theory presented here does suggest, however, that there should be economically important differences in the effects of cash flow on investment across our classes of firms. In this respect, we focus on the coefficient on current cash flow. With quarterly data, lagged cash flow would not be a bad proxy for a constrained firm's ability to undertake investment, but a year is a substantial period of time.[32] The pattern of the coefficients on current cash flow across classes is quite striking. For the early period, they range from about 0.54 in class 1 to 0.18 in class 4. Again, it is the differences in the magnitudes of the estimated coefficients that we stress; that all of the coefficients are different from zero is not surprising given the limitations of the Q model. The fact that the addition of cash flow reduces the estimated coefficient on Q to zero in class 4 suggests the collinearity of cash flow and Q for those firms.

The economic importance of these results is reinforced by the higher variability of cash flow in class 1. The results in Tables 3 and 5 imply that investment is roughly three times more sensitive to cash flow variations in class 1 relative to classes 3 and 4, while the underlying cash flow variations are about four times larger in class 1.[33] As an example of the implications of these observations, consider the predictions of the model for the investment expansion that occurred between 1975 and 1979. The average cash flow to investment ratio for class 4 rose by 0.005 over this period. The model estimated over the full sample predicts that this would cause an increase of 0.001 in the class 4 investment to capital ratio, a small change equal to only one percent of the class 4 sample average. For class 1, however, the cash flow to capital ratio increased by 0.082 over the same period. The model implies that this would cause an increase in the investment to capital ratio of 0.035. This is **35 times larger** than the change predicted for class 4; it is over 13 times larger as a percentage of the sample average investment to capital ratio. Similar differences can be obtained for other periods.[34] Effects of this size have clear economic consequences for constrained firms. Moreover, even if constrained firms do not undertake the majority of aggregate investment, their potential investment variation is so large that it is likely significant for the explanation of aggregate investment cycles.

We also considered two alternative models in which cash flow might appear important for investment, even given the inclusion of the beginning-of-period Q in the model--(i) movements in cash flow reflect news about market fundamentals not captured in the beginning-of-period Q; or (ii) cash flow and sales are highly correlated, and "accelerator" mechanisms are responsible for the results.[35]

We pursued two tests of the first alternative. First, we estimated the models reported in Table 5 using only Q and current cash flow and an instrumental-variables procedure (with firm dummies, time dummies, and lagged values of Q and CF/K as instrumental variables). Those results are similarly striking; for the early subperiod, the coefficient on CF/K in class 1 is not significantly different from unity, while the estimated coefficient for class 4 is roughly the same as the sum of the coefficients on current and lagged CF/K in the OLS regressions. Second, adding Q dated at the end of the current period, that includes all news arriving in the current period, produced no important difference in the cash-flow coefficients.

With respect to the second alternative explanation, we added current and lagged sales (deflated by K) to the investment equation. Estimated coefficients on sales differed little across classes. The coefficients on contemporaneous cash flow across the four classes for the full sample fell to 0.289, 0.091, -0.004, and 0.027, respectively. Only the estimate for class 1 is significantly different from zero at the five-percent level. These results extend those presented in Table 5. That is, given potential problems with the Q model, there may be reasons for variables other than Q to influence investment. Important effects of cash flow on investment appear, however, only in firms identified *a priori* as facing financing constraints.

In summary, the results in Table 5 suggest important impacts of fluctuations in the availability of internal finance on investment. These effects are magnified by the fact that cash flow is highly variable for the rapidly growing firms in class 1, while mature firms in class 4 experience very small variation in cash flow. Internal funds contribute to explaining investment in all classes—even for firms that have much more cash flow than investment—most likely indicating the pitfalls in using average Q in empirical studies. For our purposes, however, the fundamental result is the substantial **difference across classes** in the impact of cash flow on investment. These differences are consistent with the cost differential between internal and external equity finance predicted by our model, and the differences in q values across classes.

Finally, it is important to stress that the firms we examine--even the rapidly growing smaller firms in class 1--are manufacturing corporations which are large by economy-wide standards. The significance of capital-market imperfections in dictating the importance of internal finance for capital spending is no doubt of still greater concern for smaller companies, which have more difficult access (or no access) to centralized securities markets.

V. CONCLUSIONS AND POLICY IMPLICATIONS

Standard models of business fixed investment--working either from the price effects of changes in the cost of capital or induced effects of changes in asset valuations--typically rely on perfect capital markets. To the extent that firms do not face a cost of capital on the margin set in centralized securities markets, or there are constraints on firms' ability to participate in particular markets for external finance, standard models may yield misleading predictions about the impact of public policies on investment. In this paper, we work within the framework of the q-theory of investment, and show that imperfect information can create "financing hierarchies" over the use of internal and external finance which accentuate hierarchies created solely from tax considerations.[36] The clear implication is that for many firms--particularly developing firms in rapidly growing industries--there may be a significant range of q values over which no dividends are paid and external finance is very costly to obtain. Large variations in q may have little effect on investment. Rather, investment is constrained by current cash flow. Our empirical evidence for U.S. manufacturing firms in the Value Line data base suggests that such patterns are important.

These results suggest several areas for future research. First, the presence of constrained firms complicates the analysis of the effects of tax reform on investment. The most obvious example relates to changes in the corporate profit tax rate. For example, Summers (1981) concludes that the short-run impact on investment of an increase in the corporate tax rate is ambiguous--because benefits from expensing investment adjustment costs and the increased value of the tax deduction for depreciation may offset the effect of increased taxes in reducing dividends. For firms that face financing constraints, increases in corporate taxes can crowd out investment significantly through the additional channel of reduced internal cash flow (see also Greenwald and Stiglitz, 1987).[37] The Tax Reform Act of 1986, for example, is widely believed to have increased the marginal corporate cost of capital. On the other hand, tax reform substantially reduced the tax rate on marginal as well as inframarginal corporate profit. For financially constrained firms, this latter effect may be much more important for investment than the increased cost of capital. Because constrained firms probably constitute the most dynamic, progressive sector of the economy, the effect of public policy on their investment and growth deserves particular emphasis.[38,39]

The result that financial constraints are important even for relatively large manufacturing firms also suggests some empirical promise for recent information-based models of procyclical investment (see, for example, Bernanke and Gertler, 1987; Greenwald and Stiglitz, 1986; and Calomiris and Hubbard, 1986). In these models, aggregate shocks can have strong effects on the allocation of external finance for investment across different categories of firms. Such models present a challenge to conventional analyses of the effects of fiscal and monetary policies on investment that focus primarily on price effects through the cost of capital.

Finally, the existence of financing constraints has many implications for research in industrial organization. Many mergers appear to match corporations that face different costs of capital on the margin because of different earnings and growth prospects. Such combinations would permit reallocations of capital that bypass external capital markets. Large differentials in the cost of internal and external finance can also rationalize such strategies as predatory pricing and limit pricing. For example, Judd and Petersen (1986) show that dynamic limit pricing is a profit-maximizing strategy for a dominant firm facing a financially constrained fringe, while Petersen (1987) argues that an "absolute capital requirement" entry barrier is a logical outcome of a financing hierarchy. The results presented in this paper provide empirical support for the existence of imperfect capital markets and financing constraints that underlie these theoretical results.

NOTES

[1]Much debate has centered on the effects of tax policy on capital spending in "flexible accelerator" models (e.g., Eisner, 1978), "neoclassical" investment models (e.g., Hall and Jorgenson, 1967; Eisner and Nadiri, 1968; and Bischoff, 1971), and "q" models (e.g., Summers, 1981; Salinger and Summers, 1983). Also see the review in Clark (1979).

[2]Meyer and Kuh (1957, chapter 10) emphasized the importance of internal liquidity for investment in general, and for small firms, in particular. Another early statement of this view can be found in Duesenberry (1958); it has been extended by Minsky (1975) and tested empirically by Fazzari and Mott (1986). Kuh and Meyer (1963) examined the influence of internal liquidity on investment, finding that the timing of investment spending is linked closely to the availability of funds over most of the business cycle. Similar results are obtained in Coen (1971) using aggregate data. Eisner (1978) found that the timing of investment in small firms is more responsive to profits than in large firms for some specifications. Chirinko (1987) finds an important role for liquidity in explaining investment in aggregate data, though the effect is not robust to changes in estimation technique. Fazzari and Athey (1987) present supporting evidence for the role of cash flow in investment functions estimated from micro data.

In a careful study of Japanese firms, Hayashi and Inoue (1987) find that profits enter importantly in a Q model of investment. They point out, however, that when shocks to firm cash flow are correlated with shocks to the adjustment cost function, a positive coefficient on cash flow could just reflect a bias in the estimate of the Q coefficient.

[3]The notion of a hierarchy, in which internal funds are cheaper than external funds, has been explained in the absence of financing constraints in the public finance literature (e.g., Auerbach, 1979, 1984), because of the differential tax treatment of dividends and capital gains. Earlier studies emphasized a hierarchy arising from transactions costs; see for example Baumol, Heim, Malkiel, and Quandt (1970).

[4]The q theory linked to the cost-of-adjustment paradigm permits segregation of expectation lags (captured in q) and delivery or adjustment lags (captured in the adjustment cost function). See Eisner and Strotz (1963), Lucas (1967a, 1967b), Gould (1968), and Treadway (1969).

[5]Empirical investment studies relying on q have not always been found a significant role for q. In addition, the unexplained movement in investment displays serial correlation, which is inconsistent with the theory. See for example von Furstenberg (1977), Clark (1979), Blanchard and Wyplosz (1981), and Summers (1981).

[6]Firms have relied heavily on internal finance for growth and development in U.S. manufacturing since at least the end of the nineteenth century (see the discussion in Hansen, 1941). It is quite striking that the automobile industry--today a classic mature industry--developed largely from retentions. Even by the 1920s, only three of the eight major automobile manufacturers (General Motors, Packard, and Studebaker) maintained any noticeable reliance on external equity capital. By 1926, retained earings were more than fifty percent of net worth even in these large companies (Seltzer, 1928).

[7]Other general discussions of the negative effects of external financing on the value of claims of existing shareholders can be found in Huberman (1984) and Miller and Rock (1985).

[8]Several studies have found that the capacity to use debt may be limited, in the sense that the required rates of return on debt and equity increase with leverage (see, for example, Baumol and Malkiel, 1967; Auerbach, 1979; and Feldstein, Green, and Sheshinski, 1978; Gordon, 1982). See also Kim (1978) and Hayashi (1985a) for a derivation of the optimal debt-capital ratio in the presence of bankruptcy costs.

[9]A natural question, of course, is why financially constrained firms are not acquired by mature, cash-rich firms. At least three factors limit such a process: (i) managerial diseconomies in conglomerates, (ii) asymmetric information—an acquiring firm finds itself in a situation qualitatively similar to the providers of external finance in the models discussed in the text, and (iii) some degree of individual specificity of project endowments.

[10]Butters and Lintner (1945) cite numerous studies reporting constraints on external finance during the Depression for otherwise profitable small, growing firms. Small firms actually increased their average retention ratios during the early 1930s, while the largest firms paid out more than their current earnings in some periods.

[11]Similar patterns were noted in early studies for the 1930s; that is, profitable small firms maintained consistently higher retention ratios than did large corporations (see for example Crum, 1939).

[12]Poterba and Summers (1985) note that under the "tax irrelevance" view of dividend taxation advanced by Miller and Scholes (1978, 1982), share prices are determined by investors for whom the marginal tax rates on dividends and capital gains are equal, so that marginal q will be unity in either case. The "new view" assumes that dividends are the primary vehicle for transferring money out of the corporate sector. To the extent that corporate takeovers or share repurchases are important, (see Shoven, 1987), the approach may have limitations for explaining financing behavior, even in mature firms.

[13]We have in mind "full-information" firms here, so that i'> 0 reflects the market's assessment of marginal changes in the probability of default.

[14]While share repurchases are not prohibited in the U.S., they may be treated as dividends by the IRS. See the discussion in Auerbach (1979).

[15]Hayashi (1985a) also develops a model within the q-theory framework in which there are three financing regimes--internal finance, debt finance, and external equity finance.

[16]The debt capacity constraint is assumed to binding; a proportion (1-b) of funds required for investment must be financed from cash flow and new share issues. This approach follows Summers (1981).

[17]It will certainly be the case that Ω will vary across firms; we address this in our empirical work in section IV.

[18]"Signalling" explanations of dividend payments fail to explain why small developing firms (presumably facing substantially imperfect markets for external finance) generally pay little or none of their earnings in dividends, while mature companies have relatively high payout ratios. The agency explanation suggested by Easterbrook (1984) and Jensen (1986)--that shareholders prefer managers to face the discipline of and monitoring provided by external capital markets for debt and equity--is probably more promising for mature firms. Within the framework suggested here, one can imagine that firms face a tradeoff, as they develop, between the shadow value of the "agency benefit" from paying a dividend of one dollar and shadow value of a dollar's worth of investment. If the latter is very high for firms facing severe external capital constraints, developing firms in rapidly growing markets will pay no dividends initially. The "traditional" view of dividends (see the discussion in Poterba and Summers, 1985) may well be correct for large mature firms, but empirical work must be careful to distinguish firms according to their financial hierarchies.

[19]It is important, of course, to specify conditions under which the stock market provides a proxy for marginal q (see for example Hayashi, 1982). The following restrictive assumptions are required: (i) capital is homogeneous and malleable; and (ii) firms produce with constant returns to scale (Lindenberg and Ross, 1981, and Salinger, 1984, derive an expression for q in the presence of monopoly rents.). While these assumptions may call into question the general applicability of the q approach, they apply as well to most versions of the standard flexible accelerator approach. Wildasin (1984) notes also that average q may be a poor proxy when there are many types of capital goods. In any event, our interest lies principally in comparing the performance of the model across various groups of firms.

It is not obvious that distinctions between marginal and average q lie at the heart of empirical difficulties. Abel and Blanchard (1986) estimate a series for marginal q for aggregate U.S. manufacturing. They note (p. 250): "Since our findings are so similar to the results obtained relating investment to average q, we find little support for the view that the low explanatory power of average q is due to the fact that average q is a poor proxy for the theoretically more appealing marginal q."

[20]That is, we assume that adjustment costs A follow

$$A_{it} = \frac{1}{2\mu_1}\left(\frac{I_{it}}{K_{it}} - \mu_i - u_{it}\right)^2 K_{it-1}, \text{ if } \left(\frac{I_{it}}{K_{it}} - \mu_i\right) > 0;$$

$$A_{it} = 0, \text{ otherwise.}$$

Hence,

$$\phi\left(\frac{I_{it}}{K_{it}}\right) I_{it} = \frac{1}{2\mu_1}\left(\frac{I_{it}}{K_{it}} - \mu_i - u_{it}\right)^2 K_{it}$$

[21]Manufacturing firms were included in the sample only if they had data observations from 1969 to 1984. The 1969 data were used for constructing lags. We choose 1969 as the starting point because the number of firms and data items available on Value Line increased substantially in 1969. The number of firms that had observations on the necessary variables dropped significantly after 1984. We found 675 firms with some data from 1969 to 1984. The sample was reduced to 421 firms for reasons discussed in the text.

[22]Under perfect capital markets, of course, dividend and investment decisions are independent (the Modigliani-Miller theorem). Previous studies have attempted to estimate dividend and investment functions jointly (see, for example, Dhrymes and Kurz, 1967; and the criticism in Fama, 1974), but none has tried to group firms so as to permit a test of financing hierarchies applying to some firms and not others.

Our scheme for grouping firms according to differences in dividend behavior is similar to tests for the presence of liquidity constraints on consumption, in which households were grouped into "high-wealth" and "low-wealth" categories (see for example Hayashi, 1985b; and Zeldes, 1985).

[23]Some firms reported frequent, but very small new share issues that were probably associated with executive stock option plans. We counted positive common finance as a substantive new share issue only if the funds raised exceeded 10 percent of the firm's cash flow in the same year.

[24]The pattern of debt leverage across classes also holds for debt-equity ratios measured as the book value of debt divided by the book value of common equity. The effect on investment of debt service measures that emphasize interest expense relative to cash flow are discussed by Minsky (1975), Eckstein and Sinai (1986), and Fazzari and Athey (1987).

[25]We also performed a similar exercise for two measures of tax-adjusted Q (see the definition in Appendix B), and the patterns were even more dramatic.

[26]The t test for equality of means is valid only asymptotically because the variances of the q measures are clearly different across classes.

[27]An alternative explanation of the high Tobin's q values in class 1 is the relative importance of "intangibles" for such firms. It is difficult, however, to link that story to the large differences in q values between periods in which new shares are issued and periods in which no new shares are issued.

[28]The average difference reported in Table 2 is computed as follows. We first compute the average difference on a firm-by-firm basis for all firms that issued shares in at least one of our sample years. These statistics are then averaged across firms in each class to obtain the results in Table 2. Thus, differences in average q levels between firms that issue shares and firms that do not issue would not affect the reported statistics.

[29]Problems of high values of average Q stemming from monopoly rents not captured in our formulation (see the discussion in Lindenberg and Ross, 1981, and Salinger, 1984) will be eliminated by using fixed-effects methods as long as the markup of price over marginal cost is constant over the period.

[30]Another explanation is that the stock market is excessively volatile, so that information about fundamentals is better conveyed through cash flow than q. To be consistent with the pattern of results in Table 5, an "excess volatility" story would have to explain why q is a poorer signal in growing firms paying out little or none of their profits as dividends.

[31]Hayashi (1985a) notes that it is possible that an increase in current cash flow (with no expected effect on future cash flows) could increase current investment just by placing the firm in different financing regimes.

[32]Abel and Blanchard (1986) consider three (quarterly) lags of profits in a q model for investment using aggregate data for the manufacturing sector. This time period would fit within our contemporaneous annual observation; Abel and Blanchard found only the coefficient on the first lag of profits to be statistically different from zero.

[33]For the period 1970-1984, the total sum of squares for the four classes are, respectively, 37.84, 5.80, 14.06 and 5.29, while the number of observations are 725, 560, 2788, and 2140, respectively.

[34]These differences would be even larger if the model estimates for the first half of the sample were used (when the constraints on class 1 firms were likely the most severe. Larger quantitative effects could also be obtained if the variation explained by cyclical effects captured in the annual intercepts were included.

[35]Results are not reported here, but are available from the authors upon request.

[36]Indeed, as a result of recent tax reform, the wedge between taxes on dividends and capital gains that leads to a financing hierarchy has been virtually eliminated.

[37]A related concern is that to the extent that small, immature firms are probably more likely to have negative earnings in a given year, they are less likely to realize the benefits of the investment tax credit. Our point is that, even with positive earnings, the tax rate relevant for a firm constrained in both equity and debt markets is the **average** tax rate.

[38]Analogously, Hubbard and Judd (1986, 1987) demonstrate the importance of the distribution of tax changes for consumption in the presence of borrowing restrictions ("internal finance constraints").

[39]Calomiris and Hubbard (1986) suggest a role for differential taxation of corporate income according to information imperfections faced in credit markets. One possibility here is a reduction in the corporate tax financed by an increase in the dividend tax. If the Auerbach (1979)-Bradford (1981)-King (1977) view of dividends (as a residual) is correct, such a policy might well raise investment substantially. Such a reform would be more costly if dividend payments were important as a signal of the firm's health (as in Bhattacharya, 1979) or to restrict managerial discretion (as in Jensen and Meckling, 1976; or Jensen, 1986).

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APPENDIX A

Asymmetric Information and the Differential Cost of Internal and External Equity Finance

To motivate the lemons discount described in the text, consider the following example adapted from Myers and Majluf (1984). Suppose a new industry has two types of firms, "good" firms (type G) and "lemons" (type L). Let good firms account for a fraction p of the firms, with the fraction 1-p being lemons. Gross returns from assets in place are given by Y_G and Y_L, respectively, while gross returns from new investment opportunities are given by Y'_G and Y'_L, respectively. The net return on new investment by lemons must clearly be bounded from below by the risk-free return, because managers of lemons can always invest new funds in riskless assets.

Managers of lemons will always attempt to issue new shares. Managers of good firms, however, will issue shares and undertake the new investment project only under certain conditions. Provided that the market for new share issues does not collapse completely because of the lemons problem, the market value of either firm type would equal

$$V = p(Y_G + Y'_G) + (1-p)(Y_L + Y'_L).$$

Good firms are undervalued here, because V is less than $Y_G + Y'_G$, their ultimate value if they make the new investment. However, managers know that Y'_G will be lost unless new shares are issued.

When will good firms issue new shares? The division of market value between old (V^0) and new (V^N) shareholders can be expressed as

$$V^0 = (V/(V+I))\ (Y_G + Y_G'), \text{ and}$$

$$V^N = (I/(V+I))\ (Y_G + Y_G'),$$

respectively, where I is the dollar value contributed by new equity holders to finance the new project.

While undertaking the project raises the market value of the **firm** *ex post*, the division of market value will be in the interest of **existing shareholders**, only if

$$\text{(A1)} \qquad (V/(V+I))(Y_G + Y_G') > Y_G \text{ , or } (I/(V+I))\ Y_G < (V/(V+I))\ Y_G' \text{ .}$$

That is, making the new investment is in the interest of existing shareholders only if the share of existing assets going to new shareholders is less than or equal to the share of the value of the new investment going to existing shareholders.

Expression (A1) can be rewritten as the "breakeven" marginal q value required by new projects. Algebraic manipulation of (A1) yields:

$$\text{(A2)} \qquad Y_G'/I > Y_G/V \text{ .}$$

The left-hand side of (A2) is the firm's marginal q on a new investment. If I is small relative to V, the right-hand side of (A2) is approximately:

$$Y_G/V \cong q^G/\bar{q} \quad ,$$

where q^G is the true value of good firms and $\bar{q}$ is the weighted average value of good firms and lemons. The lemons premium--Ω--is equal to $(q^G/\bar{q}\ ) - 1$.

A simple example may help to clarify the issues. Suppose that p = 1/4, $(1 - p)$ = 3/4, Y_G = \$500, Y_L = \$50 and the replacement cost of the capital stock equals \$100. (This implies a Tobin's q of 5 for good firms and 1/2 for lemons.) In addition, suppose that a new investment opportunity will yield Y_G' = \$100 and Y_L' = \$50 and that I = \$50; that is, for good firms, marginal q is 2.

If good firms undertake the new investment opportunity, V will increase from \$500 to \$600. However, this will not be in the best interest of existing shareholders, because V^O = \$490 and V^N = \$110. That is, new investors demand a lemons premium of (\$110-\$50)/\$50 = 1.2 This is the value denoted by Ω in the text. The investment will not be undertaken because its marginal q is less than $1+\Omega$.

APPENDIX B

Variables Used in Empirical Work

We use annual data from Value Line sources covering the period from 1969 to 1984.

Market Value of Equity (V). The value of common stock at the beginning of the year is the average price over the last fiscal quarter of the previous year times the number of shares outstanding at the end of the previous fiscal year. For the preferred stock, we compute the market value by dividing preferred dividends by the preferred stock yield from Standard and Poor's.

Market Value of Debt (B). We use the book value of debt. For discussion of conversions of book value to market value, see Brainard, Shoven, and Weiss (1980) and Salinger and Summers (1983).

Replacement Value of the Capital Stock (K). K_t represents the capital stock at the beginning of period t. The replacement value of property, plant, and equipment is estimated from book values using a method similar to Salinger and Summers (1983). We set the initial value of K to the book value of gross plant for the first year the firm appers on the Value Line database. The capital stock is then defined iteratively as

$$K_t = [I_t + (P_t/P_{t-1})\ K_{t-1}] \times (1-1/LIFE).$$

where P_t is the implicit price deflator for fixed non-residential investment, I_t is the firm's capital spending, and LIFE is the average service life implicit in the firm's book depreciation costs (see Salinger and Summers, 1983). The final term is based on the assumption that economic depreciation is single-declining balance. Our results were not changed substantially when we assumed double-declining balance economic depreciation or when the initial value of K was set equal too the firm's net plant. For mature firms, the starting point for this procedure generally stretched back to the late 1950s. For newer firms, the initial book value of their capital stock probably is a good estimate of its replacement cost. Thus, the capital stock estimates should exhibit little inflationary bias for our sample that begins in 1969.

Tax Parameters for Q. As in Salinger and Summers (1983), we estimate values for X_t and z, assuming that (i) tax policy parameters are assumed to remain constant, and (ii) the sum of the required rates of return on investment and expected inflation is equivalent to the nominal BAA bond rate plus 0.06.

That is,

$$X_t = \tau\ z\ \left(\frac{1-\theta}{1-c}\right)\ K_t,$$

where π represents inflation and K_t is the nominal replacement value of the capital stock, and

$$\tau z = \tau\left(\frac{\delta}{\delta + \frac{\rho+\pi}{1-c}}\right).$$

Tax depreciation is assumed to be double-declining balance at rate $\delta = 2/LIFE$. The average effective tax rate on dividends (θ) is taken from Feldstein and Jun (1986). We assume that the effective tax rate applicable to non-dividend cash flows over the period was 5 percent (see Protopapadakis, 1983; and Shoven, 1986). The corporate tax rate τ was set at the statutory maximum marginal rate.

Market value of inventories (N). Since inventories are included in the market valuation of the firm, but not in the replacement cost of the fixed capital stock, we subtract N from the market value of the firm. There was no substantial difference in the results when N was instead added to the replacement cost of the firm's capital stock. Inventories for each firm are converted from book value to market value using the procedure outlined in Salinger and Summers (1983) and Value Line data concerning whether the firm uses LIFO or FIFO methods of inventory accounting.

Investment Tax Credit (k). Information on legislated values of the investment tax credit was taken from the Washington University Macro Model. Information on the mix between equipment and structures was taken from aggregate data.

Cash Flow (CF). Our cash flow variable is taken from the Value Line database.

Q Definitions. Using these components, we have constructed three Q measures:

Tobin's q = (V+B-N)/K;

Tax-Adjusted Q (No Dividends) $= (1-\tau)^{-1} \left[\frac{V + B - X - N}{K} - (1-k-\tau z)\right]$; and

Tax-Adjusted Q (Dividends Paid) $= (1-\tau)^{-1} \left[\frac{1-c}{1-\theta} \left(\frac{V-X}{K}\right) + \frac{B-N}{K} - (1-k-\tau z)\right]$.