Capital market imperfections and investment fluctuations

Bruce Petersen

It is well known that investment is a very volatile and procyclical component of Gross National Product. Recent studies indicate that in the United States, investment fluctuations have been approximately four to five times greater than fluctuations in output over the post-war period.[1] For example, between 1973 and 1975, the peak-to-trough change in the investment-to-capital ratio was approximately -20 percent. A change of similar magnitude, but of opposite sign, occurred between 1975 and 1979. These changes were much larger than output deviations over this time period. Investment is also more volatile than output in other countries, such as Japan, the United Kingdom, and West Germany, although the difference is less pronounced.[2]

Because the volatility of investment is a key aspect of the business cycle, economists have become increasingly interested in providing a sound microeconomic explanation for this aggregate phenomenon. That is, an attempt is being made to understand why business enterprises find it in their best interest to invest in such a pronounced procyclical pattern over time. One of the most promising theories is based on the premise that there are serious imperfections in capital markets.[3]

The logic of this theory can be briefly summarized. As a consequence of capital market imperfections, external finance (debt and new share issues) costs the firm considerably more than internally generated finance from earnings and depreciation allowances. Thus, firms may be either unable or unwilling to offset reductions in available internal finance with external finance. As a result, a firm's optimal response to a reduction in its internal finance may be to reduce its investment. Because fluctuations in internal finance are highly correlated with fluctuations in aggregate output, imperfections in capital markets may explain why aggregate investment is so volatile.

Capital market imperfections should not, however, have a uniform impact on the investment behavior of all firms. This point has not been emphasized in the models employing capital market imperfections to explain aggregate fluctuations in investment. Many corporations generate quantities of internal finance well in excess of their demand for finance—that is, they do not depend on external finance at the margin. The existence of capital market imperfections may be of little consequence for the investment behavior of these firms. On the other hand, a large fraction of the firms in the United States do exhaust all, or nearly all, of their internal finance. Investment of these firms should be the most sensitive to fluctuations in internal finance if capital markets are imperfect. This is the basic idea behind the test described in this paper.

A panel of publicly listed manufacturing firms is grouped according to what fraction of their earnings they retain in the firm. If the cost disadvantage of external finance is slight, then corporate retention behavior should contain little or no information about investment behavior—firms can simply use external finance to smooth investment when internal finance fluctuates. If, however, there is a pronounced difference between the cost of internal and external finance, the investment of firms retaining all of their income may be driven by fluctuations in their internal finance.

The first section of the paper describes possible sources of capital market imperfections and the resulting cost-of-capital schedule. Implications for investment behavior are developed and related to a standard model of investment. The next two sections of the paper present the test results, which indicate that investment is much more sensitive to fluctuations in internal finance for firms which retain all of their income.[4] In addition, these firms, as an aggregate, exhibit an extremely pronounced procyclical pattern of investment. This is not the case for firms in the sample with a high dividend-payout ratio.

Capital market imperfections

Early investment research often emphasized the importance of financial factors such as liquidity and access to internal finance as determinants of investment spending.[5] Indeed, financial effects on many aspects of real economic activity received considerable attention during the early post-war period. Over the last twenty years, however, most research on investment behavior has proceeded under the assumption that the investment decision of the firm can be separated from purely financial decisions. The theoretical basis for this approach was provided by Modigliani and Miller (1958) who demonstrated the irrelevance of financial policy for real investment under certain (very restrictive) conditions.

More recently, some economists and corporate finance specialists have seriously questioned how closely the predictions of the Miller-Modigliani Theorem match the actual stylized facts about corporate financing. Myers (1984) has proposed an alternative framework which he refers to as a "pecking order" theory: There is a financing hierarchy, with internal finance dominating external finance.

There are several explanations for a cost advantage of internal finance over external finance, including issue costs, the taxation of capital income, and asymmetric information between managers and potential investors. In this paper, we will limit our examination to taxation and asymmetric information.

Many countries tax income from capital gains at much lower effective rates than the rate on dividends. Such was the case in the United States until quite recently.[6] A large number of studies have examined the cost of equity finance in light of the above provisions. A thorough review of this literature can be found in Auerbach (1983). The central conclusion of these studies is that internal finance has a tax advantage over new share issues. The basic intuition is that no tax savings occur from the issue of new shares, while tax savings do occur when earnings are retained, because a dividend tax is avoided for a lower tax on capital gains.

A measure of the cost advantage of internal finance can be readily calculated. Using the "q" model of investment (utilized and explained in the next section of the paper), consider how the favorable taxation of internal

finance alters the breakeven q value. (Tobin's q is the ratio of the stock market value of the firm to its replacement cost.) The essential insight underlying Tobin's q theory of investment is that, in a taxless world, firms should invest as long as each additional dollar spent purchasing capital raises the market value of the firm by at least one dollar; that is, as long as marginal q is at least equal to unity. This breakeven condition of q = 1 changes when the tax rate on dividends (d) exceeds the tax rate on capital gains (c). Consider what q value will make shareholders indifferent to $1 of retained earnings or $1 of dividends. The after-tax return on $1 of dividends is $1(1 − d) while the after-tax return on $1 of capital gains is $1q(1 − c). These returns will be equated only if: q = (1 − d)/(1 − c), which is a value clearly less than unity if c < d.

Thus, the breakeven q value on internal finance is q = (1 − d)/(1 − c) while firms should issue new shares only if q ≥ 1. The breakeven q value on retentions is shown on the vertical axis of the cost-of-capital schedule appearing in Figure 1. Internal finance is exhausted at R on the horizontal axis, the point of discontinuity on the cost-of-capital schedule.

A second reason for financing hierarchies is asymmetric information. This is a situation in which potential suppliers of finance have less complete or less accurate information about a firm's prospects than the firm itself. Important recent papers by Myers and Majluf (1984) and Greenwald, Stiglitz, and Weiss (1984) explain why asymmetric information either eliminates

Figure 1
Investments and financing decisions
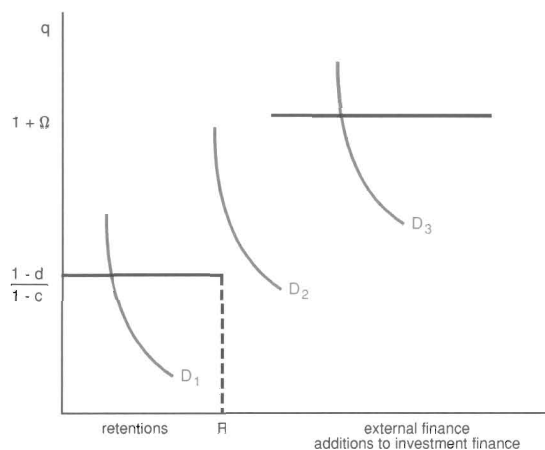
any reliance on external equity finance or causes suppliers to demand a large premium.[7]

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. In addition, managers are assumed to act in the interest of existing shareholders, and potential new investors are aware of this. Since external investors cannot distinguish the quality of firms, they value them all at the population average. Consequently, new shareholders implicitly demand a premium to purchase the shares of relatively good firms to offset the losses that will arise from inadvertently funding below-average firms, sometimes referred to as "lemons".

The intuition behind the "lemons" premium also can be described in terms of the q model of investment. Following the example in Myers and Majluf, let the true q value of "good" firms be q^G and the true q value of "lemons" be q^L and the percentage of good firms be p. Because of asymmetric information, all firms are initially valued at a weighted-average value, $q^A = pq^G + (1 - p)q^L$. It can be shown that if the market does not collapse because good firms drop out, the breakeven q value for good firms is approximately: $q = q^G/q^A$. The breakeven 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/q^A indicates how much dilution occurs when good firms issue new shares; the lemons premium, Ω, is equal to $q^G/q^A - 1$.[8]

A financing hierarchy depicting the combined effects of taxation and asymmetric information is shown in Figure 1. Firms exhaust internal finance first and issue new shares only if the marginal project has a q of at least $1 + \Omega$. Also appearing in Figure 1 are three possible demand schedules for new investment, where projects are ranked according to their Tobin's q value. If a firm has available an amount of internal finance R and an investment schedule depicted by demand curve D_1, it would finance all desired investment internally and pay out some dividends. If its investment demand schedule was D_2 instead of D_1, it would exhaust all internal finance but not issue new shares. Finally, only if a firm's investment demand schedule intersects the ex-

ternal finance portion of the financing hierarchy, as depicted by investment demand D_3, will it issue new shares.

Debt considerations can be incorporated into the cost schedules depicted in Figure 1. It is often assumed that firms have some "debt capacity" which is determined by the cost of financial distress and by agency costs.[9] It is well known that debt finance creates agency problems and that the greater the debt-equity ratio, the more distorted are the firm's investment incentives. Additionally, managers have incentives to issue new debt, which will raise the riskiness and lower the value of existing debt. Debt-holders understand these conflicts of interest and rationally demand covenants which restrict the behavior of managers, particularly with respect to new debt issues.

In addition, recent work by Stiglitz and Weiss (1981) and others emphasize how asymmetric information between borrowers and lenders can cause distortions similar to those discussed above for new share issues. Asymmetric information may increase the cost of new debt, or even result in "credit rationing".

One simple way to include debt finance in the cost-of-capital schedule is to allow firms to leverage every dollar of equity finance by some fraction of a dollar of debt finance. In this case, a dollar contraction in internal finance would cause R to decline by more than one dollar. A second, more general way to introduce debt finance is to include an upward sloping schedule which connects the internal and external finance segments (see for example Auerbach, 1983). The position of this schedule shifts in tandem with shifts in the quantity of internal finance. The slope of the debt supply schedule determines the extent to which firms can offset reductions in internal finance with greater leverage.

The financing patterns of most corporations are consistent with the predictions of a financing hierarchy. Most corporations rely very heavily on internal finance, particularly small corporations where asymmetric information problems are likely to be most pronounced. New share issues account for only a small fraction of new equity finance in the United States.

Srini Vasan (1986) examines the financing behavior of corporations engaged in manufacturing over the period 1960-80. He finds that corporations with assets of under $100 million raised 85 percent of their finance from

internal sources. The balance came from bank debt (10%), corporate bonds (3%) and new share issues (2%). In addition, Srini Vasan finds that the average retention ratio of small corporations is very high and that many corporations pay no dividends at all for long periods of time. This evidence indicates that it may be very common for corporations to operate at or near point R in Figure 1.

Fluctuations in investment at the firm level

Consider a firm which has an investment demand schedule like D_2 in Figure 1. It is important to note that D_2 does not intersect either the internal finance segment or the new share issues segment. Ignoring debt finance, the firm's optimal position is R; that is, it exhausts all internal finance but does not issue new shares. If the cost differential between internal and external finance is large enough, the investment demand schedule can shift a considerable distance without any investment response.

Now consider what happens if internal finance expands or contracts. This amounts to an increase or a decrease in the length (OR) of the internal finance segment in Figure 1. Because the firm is exhausting all internal finance, changes in earnings can cause a dollar-for-dollar change in investment. For example, if internal finance declines, the firm will contract investment by moving up its investment demand schedule. External finance will not be used to smooth investment until the marginal project has a return of at least $1 + \Omega$.

Such a prediction is quite contrary to standard neoclassical models of firm investment behavior. In these models, capital markets are assumed to be perfect, thus firms' cost-of-capital schedules are not discontinuous as shown in Figure 1. A firm's optimal level of investment is determined by the cost of capital; vertical shifts in the cost-of-capital schedule will change the optimal capital stock and the rate of investment.

The investment model that will be considered in the remainder of the paper is the q theory of investment. The intuition of the model is that, absent considerations of taxes or capital-market imperfections, a firm will invest so long as the value of an additional unit of capital—marginal q—exceeds unity. In equi-librium, the value of an extra unit of capital is just its replacement cost, so that marginal q is unity. The conceptual advantage of this framework is that it is forward looking; that is, investment is driven by the stock market's evaluation of the firm as measured by q. This has become a standard model of investment behavior and it has been estimated by many researchers, usually for highly aggregated data.

Empirical implementation of the q theory of investment requires rather strong assumptions about technology and adjustment costs. Following Summers (1981) and several subsequent papers, adjustment costs are assumed to be zero until some normal level of investment is reached, after which marginal adjustment costs rise linearly with investment.[10] This can be shown to produce the following equation:

$$(1) \quad (I/K)_{it} = \alpha_i + \alpha_1 \, Q_{it} + \mu_{it}$$

where I is investment, K is the replacement value of the capital stock, i and t denote the firm and time period, respectively, α_i is the normal value of $(I/K)_i$ and μ_{it} is an error term. Q represents the value of q at the beginning of the period adjusted for corporate and personal tax considerations. (The tax adjustments are calculated following the procedures outlined by Summers [1981].)

An alternative model is required to describe the investment behavior of firms who may not be able to respond to fluctuations in Q because of capital market imperfections. In the simplest alternative, investment is constrained by available cash flow (CF). The basic model estimated in the paper is:

$$(2) \quad (I/K)_{it} = \alpha_i + \alpha_1 \, Q_{it} + \alpha_2 \, (CF/K)_{it} + \mu_{it}$$

Tax-adjusted q is included in the model to control for variation over time in investment opportunities. Tests of robustness of this basic model are discussed in the next section.

To summarize, in a world of no capital market imperfections, variations in Tobin's q should lead to variations in investment. However, for firms exhausting all internal finance and facing a high shadow price on external finance, q could vary over a considerable range with no investment response. Thus, variations in cash flow, not q, may drive investment for some firms.

The data and test results

Value Line data is used to implement the test described above. (The detailed definitions of the empirical measures can be found in Fazzari, Hubbard, and Petersen [1988].) Attention here is limited to firms within the manufacturing sector. The selection of the time period over which to conduct the test is very important. Enough years are needed to obtain adequate time-series variation. However, too long a time period would permit firms that may initially be constrained by capital market imperfections to mature. With these considerations in mind, and taking into account the data availability, the time period 1970 to 1984 was selected.[11] Subintervals within this period are also analyzed.

The sample of firms was obtained as follows. Firms with missing or inconsistent data were deleted. In addition, firms with major mergers were deleted because mergers can cause inconsistencies when constructing lags. Finally, firms with negative growth rates in sales were excluded.[12] The resulting sample consisted of 422 manufacturing firms.

The tests described above require that the sample be partitioned into groups of firms; the obvious selection criteria is retention behavior. If capital market imperfections lead to financing constraints on investment, they should be most evident for firms that retain all of their income. If, however, internal and external finance are nearly perfect substitutes, then retention behavior should contain little or no information about investment behavior, including fluctuations in investment. The classification scheme chosen divides the sample into three groups as follows.[13]

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

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

Class 3: All others.

Several summary statistics for the firms in each class are reported in Table 1. Class 1 firms—those that are most likely to be affected by capital market imperfections—retained an average of 94 percent of their income, and paid a dividend on average in only 33 percent of the

Table 1
Summary statistics: Sample of manufacturing firms, 1970-1984

	Category of firm		
	Class 1	Class 2	Class 3
Number of firms	49	39	334
Average retention ratio	0.94	0.83	0.58
Percent of years with positive dividends	33%	83%	98%
Median capital stock-1970 (millions of 1982 dollars)	27.1	54.2	401.6
Median capital stock-1984 (millions of 1982 dollars)	94.9	192.5	480.8
Average real sales growth	13.7%	8.7%	4.6%

Source: These calculations are based on samples selected from the Value Line database.

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, on average, very profitable. 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. While class 1 firms are small relative to firms in class 3, they are still large relative to U.S. manufacturing corporations in general.[14]

Table 2 presents information on new share issues and debt finance for each of the classes. 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 1. In contrast, the typical firm in class 3 has a demand schedule like D_1 and should not simultaneously pay dividends and issue new shares, given the taxation of corporate income. Consistent with the cost-of-capital schedule in Figure 1, firms in class 1 issue new shares more frequently—approximately one year in every four—than do firms in the other two classes. Even for class 1, however, the amount of finance raised from new share issues is small

Table 2
New share issues and debt utilization

	Category of firm		
	Class 1	Class 2	Class 3
Average percent of years with new share issues	28%	19%	10%
Average value of share issue as a percentage of cash flow	23%	13%	8%
Average ratio of debt to capital stock	0.57	0.52	0.33
Correlation of the earnings-to-capital ratio and the change in total debt-to-capital ratio (averaged over firms)	0.23	0.15	0.09

Source: These calculations are based on samples selected from the Value Line database.

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 firms in class 3 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; i.e., constrained firms appear to borrow up to their debt capacity.

Table 3 reports the estimates of the contribution of internal finance toward explaining investment after controlling for movements in Q. Equation 2 is estimated for each retention class with Q and CF/K as explanatory variables. Fixed firm and year effects are included, and the equations are estimated over three time periods: 1970-75, 1970-79, and 1970-84.

Given the method of construction of the Value Line database, the strongest case for asymmetric information between firms and outside investors can be made for the shorter time periods, particularly 1970-75. A firm is not added to the database until it is "of interest to subscribers and the financial community." Once a firm is added, however, observations on items from its income statements and balance sheets are collected as far back as possible; in practice, for at least 10 years prior to the date it is added to the Value Line database. The majority of class 1 firms were not recognized until near the end of the full-sample period, even though the data for these firms extend back to 1969. Thus, if asymmetric in-

formation is an important impediment to firms obtaining external finance, then the sensitivity of investment to fluctuations in internal finance for class 1 firms should be greatest in the earlier time periods.

The results in Table 3 show large estimated cash flow coefficients for class 1 firms. As expected, the cash flow coefficient is largest (0.670) in the earliest period. The coefficient is the smallest (0.461) for 1970-84. Furthermore, as the sample period is extended one year at a time from 1970-75 to 1970-84, the estimated class 1 cash flow coefficients decline monotonically. The cash flow coefficients in classes 2 and 3 are positive and approximately stable over time.

It is the difference in the estimated coefficients across the three classes that should be stressed. Comparing classes 1 and 3, the differences in the estimated coefficients range from 0.416 for 1970-75 to 0.231 for 1970-84. These differences are always statistically significant at very high confidence levels. It is also important to note that including internal finance in the investment model (Equation 2) explains a

Table 3
Effects of Q and cash flow on investment

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

Variable	Class 1	Class 2	Class 3
Sample period: 1970-75			
Q_{it}	-0.0010 (0.0004)	0.0072 (0.0017)	0.0014 (0.0004)
$(CF/K)_{it}$	0.670 (0.044)	0.349 (0.075)	0.254 (0.022)
$\bar{R}^2$.	0.55	0.19	0.13
Sample period: 1970-79			
Q_{it}	0.0002 (0.0004)	0.0060 (0.0011)	0.0020 (0.0003)
$(CF/K)_{it}$	0.540 (0.036)	0.313 (0.054)	0.185 (0.013)
$\bar{R}^2$	0.47	0.20	0.14
Sample period: 1970-84			
Q_{it}	0.0008 (0.0004)	0.0046 (0.0009)	0.0020 (0.0003)
$(CF/K)_{it}$	0.461 (0.027)	0.363 (0.039)	0.230 (0.010)
$\bar{R}^2$	0.46	0.28	0.19

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

much greater proportion of the variance of the investment-to-capital ratio (I/K) in class 1 than in the other two classes. In class 1, 46 to 55 percent of the variance in I/K is explained, depending on the time period analyzed, primarily by the variation in cash flow alone.

Several tests of robustness of these findings were undertaken.[15] In addition, alternative specifications of Equation 2 were estimated, including lags of cash flow and current and lagged sales. A number of investment studies in the literature have found that models which include sales or output ("accelerator" models) often outperform q models. Thus, the results in Table 3 could arise because cash flow and sales are correlated. When current and lagged sales are included in the model, the cash flow coefficient declines in all three classes. For firms paying out a large share of their income as dividends (class 3 firms), the coefficient falls so close to zero that it is insignificant, with one exception.[16] However, for firms retaining all of their income (class 1 firms), the cash flow coef-

ficient is 0.392 for 1970-75, 0.360 for 1970-79 and 0.301 for 1970-84; these coefficients are highly statistically significant. Thus, for class 1 firms, a large fraction of the fluctuation in investment continues to be explained by fluctuations in cash flow even after including sales in the model.

Aggregate investment fluctuations

The results in Table 3 strongly suggest that capital market imperfections do not have a uniform effect on investment behavior across firms. An implication of these results is that researchers looking for explanations of why aggregate investment is so volatile should focus their attention on specific types of enterprises. There are solid theoretical reasons for using retention behavior as a selection criterion in future studies. Additional empirical support is provided below.

The results in Table 3 indicate that at the *firm level*, fluctuations in cash flow appear to

Figure 2
Average investment-to-capital ratio (by dividend payout class)
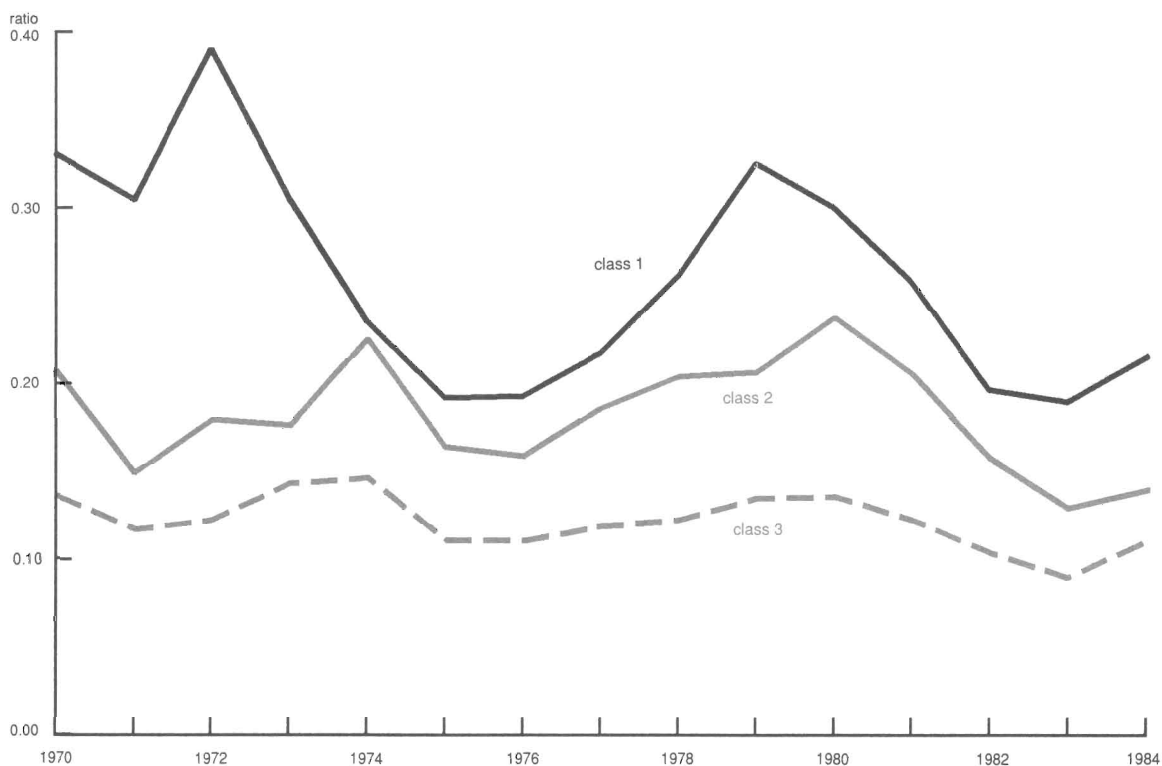
cause pronounced fluctuations in investment for firms exhausting all of their earnings. The important question for macroeconomics is whether this leads to pronounced *aggregate* fluctuations in investment.

Figure 2 presents a plot over time of the average investment-to-capital ratio *(I/K)* for each class, constructed by averaging across firms. It is apparent that I/K is procyclical in each of the classes. It is further apparent that the fluctuations in I/K are much more pronounced for the class 1 aggregate than for the class 3 aggregate. While not shown here, for the class 1 aggregate, the plot of the cash-flow-to-capital ratio is almost identical to the I/K plot. This is not the case, however, for the class 3 aggregate.

For the class 1 aggregate, there are peak-to-trough changes in I/K of 0.21 between 1972 and 1975 and 0.14 between 1979 and 1983. Peak-to-trough changes in the average cash-flow-to-capital ratio are of almost identical magnitude. In contrast, for the class 3 aggregate, there are peak-to-trough changes in I/K of 0.03 between 1973 and 1975 and 0.04 between 1980 and 1983. While not reported here, simple regressions of I/K on various measures of the aggregate economy reveal the same pattern.[17] These regressions indicate that investment is much more procyclical for firms which retain all of their income.

While not as interesting as the peak-to-trough movements in I/K, the variance of the I/K series also gives a rough impression of just how much more volatile is investment in the class 1 aggregate than in the other two classes. The variance of I/K for the class 1 aggregate over the 1970-84 period is four times greater than the variance of the class 2 aggregate and ten times greater than that of the class 3 aggregate. While not shown in Figure 2, two average I/K series were constructed, one for all of the firms in the sample and a second which excluded all class 1 firms. While class 1 firms make up only ten percent of the sample, excluding them causes the variance of the I/K series to fall by nearly one-third.

Conclusion

It is beyond the scope of this paper to give an estimate of what fraction of the fluctuation in aggregate investment in recent decades can be explained by imperfections in capital mar-

kets. Much depends, of course, on what fraction of investment comes from firms that are exhausting all, or almost all, of their internal finance. In the sample of firms employed in this study, that fraction is not particularly large (see Table 1). This is because the Value Line database is heavily weighted toward large, mature corporations; that is, towards firms for which public information is readily available.

Statistics indicate, however, that a substantial fraction of investment in the manufacturing sector is coming from firms with characteristics similar to the class 1 aggregate. For example, manufacturing firms of under $10 million in assets accounted for approximately 14 percent of total investment in manufacturing over the period 1970-84. (The average firm size in the class 1 category is considerably larger than $10 million.) The average retention ratio of these firms is very high—approximately 80 percent—and they raised a neglible fraction of finance from new share issues.[18] If these firms have I/K ratios that are as volatile as those making up the class 1 aggregate reported here, they could easily account for a major fraction of the investment volatility in manufacturing.

Finally, it is important to point out that the sample of firms utilized in this study were drawn entirely from the manufacturing sector. The average size of enterprises in other sectors of the economy, such as trade and agriculture, is much smaller than firms in manufacturing. For this reason, capital market imperfections such as asymmetric information may be even more important, and access to external finance more restricted in these sectors. Further research is needed to assess the volatility of investment in these sectors.

[1] See, for example, the findings in Greenwald and Stiglitz (1988).

[2] See the findings in Greenwald and Stiglitz (1988).

[3] See, for example, Greenwald, Stiglitz, and Weiss (1984).

[4] The test results presented in this paper draw heavily on the statistical results in Fazzari, Hubbard, and Petersen (1988).

[5] An extensive list of citations on this investment research can be found in Fazzari, Hubbard, and Petersen (1988).

[6] The difference between the tax rate on dividends and capital gains has been quite large because of (1) the exclusion of 60 percent of long-term capital gains; (2) the taxation of such gains only upon realization; and (3) forgiveness of the tax if the gain is not realized before death. Recent tax reform has greatly reduced the difference.

[7] These theoretical arguments draw heavily on the "lemons" problem first considered by Akerlof (1970).

[8] For example, suppose $q^G = 5$ and $q^A = 2$, 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.

[9] Financial distress refers to the set of problems that arise whenever a firm has difficulties in meeting its principal and interest obligations. Agency costs arise from the efforts of creditors of the firm to ensure that the firm honors its contractual obligations.

[10] For an overview of these assumptions, see the discussion in Summers (1981).

[11] Manufacturing firms were included in the sample only if they had observations from 1969 to 1984. 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. 675 firms had some data from 1969 to 1984. The sample was reduced to 422 firms for reasons discussed in the paper.

[12] The objective is to consider the investment behavior of firms constrained because of capital mar-

ket imperfections, as opposed to financial distress due to poor market performance.

[13] This approach limits the sensitivity of the classification scheme 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.

[14] Based on information from the *Quarterly Financial Reports* of the Securities and Exchange Commission, approximately 85 percent of manufacturing corporations had smaller capital stocks in 1970 than the average class 1 firm.

[15] For example, Equation (2) was estimated using first and second differences (as opposed to the conventional within-group estimation) to address measurement-error considerations. The coefficient estimates are quite similar. These tests are reported in Fazzari, Hubbard, and Petersen (1988).

[16] The exception is the full sample period of 1970-84.

[17] The regressions mentioned in the text are of the form:

$$(I/K)_t = \Upsilon_1 + \Upsilon_2 A_t$$

where A is either capacity utilization in manufacturing or unemployment. The regressions were run with and without time trends. The coefficient on A is, in absolute value, three to four times greater for the class 1 aggregate.

[18] Firms between $10 and $100 million in assets also have, on average, very high retention ratios. Information on total investment and retention ratios of manufacturing firms grouped by asset size can be found in the *Quarterly Financial Reports* of the Securities and Exchange Commission.

Bibliography

Abel, Andrew B. and Olivier J. Blanchard. "The Present Value of Profits and Cyclical Movements in Investment." *Econometrica*, vol. 54 (March 1986), pp. 249-273.

Akerlof, George A. "The Market for Lemons: Qualitative Uncertainty and the Market Mechanism." *Quarterly Journal of Economics*, vol. 84 (August 1970), pp. 448-500.

Auerbach, Alan J. "Taxation, Corporate Finance, and the Cost of Capital." *Journal of Economic Literature*, vol. 21 (September 1983), pp. 905-940.

Fazzari, Steven, R. G. Hubbard, and Bruce Petersen. "Financing Constraints and Corporate Investment." *Brookings Papers on Economic Activity*, forthcoming.

Greenwald, Bruce and Joseph Stiglitz. "Examining Alternative Macroeconomic Theories." *Brookings Papers on Economic Activity*, forthcoming.

Greenwald, Bruce, Joseph Stiglitz, and Andrew Weiss. "Information Imperfections in the Capital Market and Macroeconomic Fluctuations," *American Economic Review*, vol. 74 (May 1984), pp. 194-199.

Modigliani, Franco and Merton Miller. "The Cost of Capital, Corporation Finance and the Theory of Investment," *American Economic Review*, vol. 48 (June 1958), pp. 261-297.

Myers, Stewart C. "The Capital Structure Puzzle." *Journal of Finance*, vol. 39 (May 1984), pp. 575-592.

Myers, Stewart C. and Nicholas S. Majluf. "Corporate Financing Decisions When Firms Have Investment Information That Investors

Do Not." *Journal of Financial Economics*, vol. 13 (June 1984), pp. 187-220.

Srini Vasan, Philip Vijay. *Credit Rationing and Corporate Investment*. Unpublished Ph.D. Dissertation, Harvard University, October 1986.

Stiglitz, Joseph E. and Andrew Weiss. "Credit Rationing in Markets with Imperfect Information." *American Economic Review*, vol. 71 (June 1981), pp. 393-410.

Summers, Lawrence H. "Taxation and Corporate Investment: A q-Theory Approach." *Brookings Papers on Economic Activity*, 1981, vol. 1 pp. 67-127.

Tobin, James. "A General Equilibrium Approach to Monetary Theory," *Journal of Money, Credit, and Banking*, vol. 1 (February 1969), pp. 15-29.