Asymmetric Information, Corporate Finance, and Investment

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Introduction

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Studies of heterogeneity in firms' terms of trade in capital markets have occupied a prominent place in applied research in financial markets. The National Bureau of Economic Research commissioned monographs on the subject in the 1940s and 1950s—in part because of the differential importance of "financial factors" for the performance of various types of firms during the Depression—and again in the early 1980s.[1] Studies of the growth and development of firms have long proceeded in research in industrial organization, but formal analysis of the role of finance in the development of firms has come much more recently.

Beginning with the seminal work of Modigliani and Miller (1958), the idea that financial structure was indeterminate and irrelevant for investment decisions (apart from tax considerations) heavily influenced modern finance. The major developments in investment research in the 1960s—the neoclassical and q models[2]—made use of Modigliani-Miller propositions in employing variables from financial markets. Empirical work has traditionally produced results inconsistent with the notion of "financial irrelevance," including evidence on the role of breakdowns in financial trade in historically important economic contractions;[3] the role of movements in internal finance in predicting investment;[4] persistent differences in the way certain types of firms raise finance;[5] and the regular cyclical movements of financial variables (e.g., balance sheet positions, liquidity ratios, and bank credit).[6]

Reconciliation of theoretical and empirical research on finance and investment has made use of models in which informational asymmetries between "borrowers" and "lenders" introduce incentive problems in financial relationships, complicating the development of financial contracts and making financ-

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ing and investment decisions interdependent in specific ways.[7] Much of the new research has proceeded in two agendas, modeling (i) the role of asymmetric information in linking movements in inside finance and investment, holding constant underlying opportunities, and (ii) the importance of information problems in accounting for observed differences in financing patterns and mechanisms for corporate control. These agendas center on the common theme of the importance of particular asymmetries of information between "insiders" and "outsiders" in firm financial transactions and the present testable violations of "financial irrelevance" propositions in studying control and investment decisions. Below I review each in turn, grouping papers presented in the conference accordingly.

Asymmetric Information, Internal Finance, and Investment

One feature of many theoretical models of asymmetric information in capital markets is that the level of internal net worth becomes a critical determinant of the terms under which firms can borrow, holding constant true investment opportunities (see, e.g., Leland and Pyle 1977; Bernanke and Gertler 1990; Calomiris and Hubbard 1990; and Gertler and Hubbard 1988). This role for internal finance in the investment decision is potentially important for models of aggregate investment through two channels. First, to the extent that movements in firms' collateralizable net worth are procyclical, an "accelerator" mechanism emerges (see, e.g., Gertler and Hubbard 1988). This effect would not be present under perfect capital markets. Second, distributional considerations will be important for aggregate investment variability because of the impact of the redistribution on firms' internal net worth. This channel is closely related to the "debt deflation" arguments of Fisher (1933), Kindleberger (1978), and Minsky (1975), among others.

A second mechanism through which informational asymmetries can precipitate a difference in the cost of internal and external finance—that is, making internal net worth more valuable, holding constant investment opportunities—is a "lemons market" problem in valuation. The classic argument (due to Akerlof 1970) is that some sellers with inside information about the quality of an asset will be unwilling to accept the terms offered by a less informed buyer. This may cause the market to break down, or at least force the sale of an asset at a price lower than it would command if all buyers and sellers had full information. This idea has been applied to both equity finance and debt finance.

For equity finance, new shareholders demand a premium to purchase the shares of relatively good firms to offset the losses arising from funding lemons (see, e.g., Myers and Majluf 1984; Greenwald, Stiglitz, and Weiss 1984; and Fazzari, Hubbard, and Petersen 1988). This premium raises the cost of new equity finance faced by managers of relatively high-quality firms above the opportunity cost of internal finance faced by existing shareholders.

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In debt markets, Keeton (1979) and Stiglitz and Weiss (1981) have demonstrated that equilibrium "credit rationing" can arise in the presence of adverse selection.[8] In the simplest case, lenders cannot price discriminate (i.e., vary interest rates) between good and bad borrowers in loan contracts, because the riskiness of projects is unobservable. Thus, when interest rates increase, relatively good borrowers drop out of the market, increasing the probability of default and possibly decreasing lenders' expected profits. In equilibrium, lenders may set an interest rate that leaves an excess demand for loans. Some borrowers receive loans, while other observationally equivalent borrowers are rationed. Calomiris and Hubbard (1990) extend this approach by allowing for heterogeneity in borrower types and in endowments of inside finance. Depending on per capita levels of internal net worth, the allocation of new funds across classes of borrowers could either follow the symmetric-information credit allocation or ration funds away from some classes of borrowers who would receive credit in the absence of asymmetric information. A "financial collapse" may occur, in which some or all classes of "asymmetric information" borrowers are denied loans.

In summary, these approaches model the differential cost of external finance from securities and banking markets under asymmetric information and the role of internal net worth in influencing the cost of finance. This suggests that certain classes of borrowers may find it prohibitively expensive to obtain financing by directly issuing securities on the open market. Financial intermediaries help overcome this friction by exploiting scale economies in the evaluation and monitoring of borrowers—thus facilitating the flow of funds between savers and certain kinds of investors. Hence, the terms under which intermediary credit is available are key determinants of investment by firms lacking easy access to direct credit (see Bernanke 1983; and Calomiris, Hubbard, and Stock 1986 for applications of these points).

Most of the research on the importance of asymmetric information in financial markets has focused on specific microeconomic models of market failure in debt or equity markets, as in the studies noted above. To the extent that a sufficient number of firms must raise finance in markets lacking perfect information, microeconomic market failures can generate correlations in aggregate data different from those suggested by standard models of investment or the consequences of macroeconomic policies. In particular, some "price" signals in capital markets will be less important; interest rates would be deemphasized as a determinant of borrowing and investment, with movements in internal net worth of corporate borrowers being relatively more important.

Bruce Greenwald and Joseph Stiglitz consider the effects on investment decisions of equity and credit rationing at the firm level. Positive aggregate profitability shocks raise firms' net worth and inside finance, leading to increases in current and future investment, further stimulating an accelerator mechanism in aggregate investment. Similar logic is applied by the authors to other types of investment as well (e.g., in working capital or employment). They

extend these ideas in a model of the banking sector, which is also assumed to be effectively constrained in raising new equity capital. The availability of credit to firms now depends on the financial condition (accumulated internal net worth) of both firms and the banking sector, reinforcing the accelerator mechanism in investment. The Greenwald-Stiglitz model has both short-run and long-run implications. In the short run, the effects of monetary policy on investment and output are magnified through relaxation of financing constraints. Long-run dynamics are driven by rates of accumulation in capital and internal equity. The approach taken by Greenwald and Stiglitz underscores the ability of models of information-related capital market frictions to explain accelerator movements in aggregate variables, dynamics difficult to account for in conventional neoclassical models of investment and growth.

A related application exists for rationalizing the importance of contracting models in macroeconomics. The use of contract-based theories in models of aggregate supply has for some time been standard, most notably in "new Keynesian" explanations of Phillips curve correlations in aggregate time-series data. Roger Farmer employs a different set of contracting theories toward the same end, stressing problems in *financial* contracting in the presence of asymmetric information and limited collateral (self-finance). The transmission mechanism is drawn from models of the role of internal net worth in the investment decision. At high levels of profits or collateralizable net worth, incentive problems are mitigated, and the cost of funds is low, expanding economic activity. Farmer focuses on movements in interest rates in bringing about Phillips curve correlations in data. Deflationary shocks raise real interest rates, reducing the value of internal net worth, with negative effects on economic activity.[9] In addition, he stresses the role of the nominal interest rate; the optimal contract for the firm trades off the opportunity cost of holding liquid balances against the benefits of additional liquidity. The benefits arise from the fact that liquidity buffers permit firms to offer more stable wages, facilitating more efficient employment decisions.

Farmer presents some empirical work in support of the asymmetric-information/limited-collateral approach, with an application to simple Phillips-curve-type models. He finds (using data for the United States over the period from 1931 to 1986) that movements in the unemployment rate are negatively correlated with movements in inflation and corporate profits and positively correlated with movements in nominal interest rates. With the inclusion of the profits variable, the model is stable over subsamples of the postwar period. While the results are open to differences in interpretation, they suggest support for the idea that asymmetric-information problems in financial markets figure importantly in accounting for Phillips curve correlations.

To the extent that credit constraints are important for certain classes of firms, equilibrium models of asset pricing will be affected. William Brock and Blake LeBaron consider the impact of finance constraints on market valuation of firms within a particular class of asset-pricing models. Specifically, they

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develop a production-based, rational-expectations asset-pricing simulation model with and without credit constraints. "Constrained" and "unconstrained" firms are alike except that the former cannot use noncollateralized debt to finance investment. Unconstrained firms maximize their market value by selecting investment projects that optimally trade off expected returns and systematic risk. The investment of constrained firms, on the other hand, is restricted by past shocks (by assumption), since these firms cannot obtain funds beyond their current resources. Their marginal expected returns will be "too high."

Brock and LeBaron use this setup to analyze the phenomenon, noted in many recent empirical studies, of "mean reversion" in security returns. They show that mean reversion is amplified by financing constraints—positive shocks to productivity affect a constrained firm's investment program more than they affect an unconstrained firm's program. Brock and LeBaron emphasize that binding credit constraints are an important feature of mean-reverting returns in security markets. The authors also discuss a number of suggestive implications of their work, including applications to recent results on seasonal patterns in excess returns for small (a priori, financially constrained) firms.

A key feature of many models of capital market frictions based on asymmetric information is that firm heterogeneity is important. Large, mature enterprises with substantial internal finance relative to their investment opportunities are less likely to have their investment subject to financial constraints than are younger, growing firms with lower net worth. Empirical tests of these ideas have grouped firms according to proxies for the "net worth" distinctions (see, e.g., Fazzari, Hubbard, and Petersen 1988; and Hoshi, Kashyap, and Scharfstein 1990). Michael Devereux and Fabio Schiantarelli pursue this route, motivating finance constraints by including a cost of debt increasing in the level of debt, with the increased cost accounted for by the agency ("financial distress") cost of debt. Their model is an expanded version of the q model used by Fazzari, Hubbard, and Petersen and Hoshi, Kashyap, and Scharfstein.

Devereux and Schiantarelli use panel data on 689 U.K. manufacturing firms over the period from 1969 to 1986 and test for differences in the sensitivity of investment to the availability of internal funds for firms of different sizes and ages. They find that lagged measures of firm cash flow have an economically important effect on investment, holding constant investment opportunities (as measured by q); this effect is present for all size classes of firms. To the extent that information problems are important, one would expect that "age" is a reasonable characteristic by which to group firms according to information intensity. Devereux and Schiantarelli find that cash-flow effects are particularly important for younger, smaller firms. They note that the cash-flow effects for large firms could reflect their more diversified ownership structure and greater associated agency costs of finance.

One problem with many information-based models of links between inter-

nal net worth and investment is that it is often difficult to find empirical proxies sufficiently close to variables suggested by theory to permit formal tests. In particular, many theoretical models are cast in terms of relatively small enterprises producing a homogeneous good, with a single measure of collateralizable net worth. Case studies, focusing on firm heterogeneity within an industry, provide a useful alternative to studies based on aggregate time-series data or panel data for a large, diverse cross-section of firms. Peter Reiss uses this approach to analyze investment behavior over the past decade for firms in oil and gas extraction. Oil and gas prices have, of course, been quite volatile over this period, indicating significant fluctuations in both investment opportunities and the value of firms' net worth (as measured by the value of oil and gas reserves in place). Fluctuations in capital spending in the industry over this period were much more pronounced than in the economy as a whole.

Reiss examines the importance of information problems for the investment and financial contracting decisions of a set of "independent" oil and gas firms. His principal findings are two. First, movements in internal finance have systematic effects on investment spending—holding constant the value of drilling investment opportunities—particularly during downturns in oil prices. Second, the availability of internal funds affects drilling firms' ownership stakes in wells, as well as the structure of contracts through which external finance is obtained. The patterns are consistent with the simultaneous determination of financial structure and capital structure decisions under asymmetric information. Reiss's careful case study illustrates the usefulness of more narrowly focused analyses in measuring precisely changes in financial contracting and the costliness of capital market frictions under asymmetric information.

Another explanation of observed correlations between movements in internal finance and investment spending stresses that managers have substantial control over the use of corporate cash flows and have incentives to reinvest these funds in perquisites or non-value-maximizing projects (see e.g., the "free cash flow" model articulated in Jensen 1986). John Strong and John Meyer ask two questions in this line of thought. First, do firms with larger "free" cash flows exhibit different investment behavior? Second, do these differences in investment behavior lead to poorer or better financial performance? Their study centers on an adaptation of the "residual funds" model of Meyer and Kuh (1957). This approach posits that the level (and financing) of firms' capital spending depends on the "residual funds" available after a hierarchy of prior claims on corporate cash flow is satisfied. Likewise, investment spending is decomposed into "sustaining" and "discretionary" categories, the former corresponding to replacement investment and the latter to spending not required to sustain a firm's core business. In the presence of monitoring problems, discretionary investment should depend positively on residual cash flow. Residual cash flow should dominate total cash flow as a liquidity influence in that category of investment.

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ment decisions in 34 large paper corporations over the period from 1971 to 1986. The paper industry experienced substantial fluctuations in operating performance over the period and has undergone considerable restructuring. Their evidence for investment is consistent with the view that discretionary investment is influenced by movements in residual funds. Moreover, links between discretionary investment and shareholder returns are consistent with an agency-cost interpretation: higher discretionary expenditures, ceteris paribus, depress shareholder returns. The Strong-Meyer study suggests the benefits of considering other case studies of firms in "mature" and "growing" industries, to contrast links between cash flow and investment.

Finally, the possibility that information problems in lending markets raise the cost of finance for some classes of borrowers raises the question of whether direct government intervention in credit markets would increase the efficiency with which investment funds are allocated. Such a question is of more than academic interest. At the end of 1988, outstanding federal direct loans totaled $222 billion, with, in addition, two and one-half times as much outstanding in the form of loan guarantees. Loan and loan-guarantee programs exist in a number of sectors, including education, agriculture, housing, and small businesses, and the cost of the programs is substantial. Some of these sectors have been identified as prototypes for "credit rationing," at least raising the possibility that credit market interventions would be efficiency improving. Assessing the effectiveness of such policies in the context of formal models of credit rationing in loan markets is difficult and requires a careful specification of the information problem and of the form that potential government interventions would assume.

William Gale takes up these issues in his paper for this volume. He considers (in a model in which borrowers have private information about their risk characteristics) the efficiency costs generated by using collateral as a sorting device when it is worth less to lenders than to borrowers. In equilibrium, relatively high-risk borrowers choose a contract with a high interest rate and low collateral requirement; low-risk borrowers signal their type by choosing to put up substantial collateral in exchange for a lower interest rate. As long as all borrowers have projects whose gross returns are greater than their social opportunity cost (which is assumed in Gale's model), the efficiency loss created by the use of collateral creates a scope for government intervention. In the context of his model, subsidies to unrationed borrowers will reduce the extent of rationing in the whole sector, hence increasing efficiency. On the other hand, interventions targeting borrowers who are denied loans in private credit markets can raise the extent of rationing, reducing efficiency. Analyzing this distinction is important, since most government credit programs are aimed at the low-risk borrower. Gale's paper raises some concerns with this approach and suggests the need to analyze the effects of government credit programs on credit allocation using richer models that incorporate more general financial contracts.

Asymmetric Information, Corporate Control, and Differences in Financing Mechanisms

The problem of monitoring and controlling managers with access to private information about firm opportunities and costs has been noted at least since the seminal work of Berle and Means (1932). Modern theoretical work on principal-agent problems has stressed the endogeneity of financial contracts to align the incentives of "insiders" and "outsiders" in business transactions (see notably Jensen and Meckling 1976, and the large literature that followed). Much attention has been focused on capital structure decisions, in which the use of debt relative to equity is related to, inter alia, the specificity of assets and the relative importance of idiosyncratic and aggregate fluctuations in accounting for firm earnings movements. Other researchers have focused on mechanisms used by capital markets to minimize agency-cost problems.[10]

A key feature of the new research on capital market frictions stemming from asymmetric information is its emphasis on the use of particular forms of contracting mechanisms and monitoring arrangements. These mechanisms are chosen to minimize the added cost of finance under asymmetric information. While much of the traditional literature on capital structure decisions has focused on the choice of "debt" versus "equity," the asymmetric information approach stresses the design of contracts between "insiders" and "outsiders," which will, in general, embody a mixture of debt and equity features along with ancillary monitoring arrangements (see the overview in Gertler and Hubbard 1988). Empirical research here analyzes the determinants of firm financing arrangements, the information content of movements in security prices, and the value of particular monitoring arrangement between insiders and outsiders in corporate finance.

Do firms care who provides their financing? Most studies of capital structure (theoretical and empirical) address factors motivating the *choice of security* (e.g., debt vs. equity) rather than the *provider of funds* (e.g., private vs. public sources). If problems of asymmetric information in capital markets are significant, however, examining variation across firms in who provides funds is likely to be important. Finding that firms do indeed distinguish between private and public and internal and external sources of funds can rationalize observed effects of internal finance on investment. In addition, if credit market segmentation is important, fluctuations in conditions in particular credit markets will have real effects. Jeffrey MacKie-Mason pursues these questions, documenting trends and patterns in incremental sources of financial capital (at the industry and aggregate level) and analyzing a large sample of incremental corporate financial decisions. In particular, he distinguishes between theories that generate predictions for the *type of security* and theories that predict differences in the *type of provider.*

The empirical work begins with the distinction of choices of financial contract by type of contingent financial claim (debt or equity) and by the provider

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An important feature of many models of asymmetric information in financial markets is that institutional considerations for monitoring and financial contracting are significant. Evidence from a cross section of countries is particularly useful, since one can test whether differences in capital market institutions and financial regulation affect the design of financial contracts. Likewise, given the variation in the tax treatment of alternative sources of finance across countries, a finding of similarities in financing patterns would suggest the relevance of common factors in the costs and benefits of particular forms of financial contracts and arrangements. In his overview of financing patterns in the United States, United Kingdom, Japan, Italy, Germany, France, Finland, and Canada, Colin Mayer outlines a set of stylized facts about the strong common trends in corporate finance. Those patterns include the dominance of internal funds in financing investment, the importance of bank finance as a source of external funds, and systematic variations in financing patterns across firms of various sizes.

Mayer interprets the set of common factors in financing patterns for his set of countries as supporting recent theoretical models linking corporate finance to corporate control. The particular link he stresses is the claim that outside investors can make in the event of a default by insiders. In particular, assets specific to their current employment will be difficult to finance externally, and the use of external finance will be negatively related to the cost of organizing external control. The persistent common patterns in corporate finance across countries that Mayer identifies suggest that information-related capital market frictions are universally important. Further support for this view is provided by departures from common patterns, which can be explained by differences in monitoring and corporate control mechanisms. This suggests that case studies of corporate control mechanisms in particular countries will be useful for analyzing problems of asymmetric information.

To the extent that asymmetric information in financing decisions is important, analyses of seasoned equity issues should be of particular interest. Equity is a residual claim on firms, so that asymmetries of information should figure prominently in the decisions of buyers of common stock issues. In addition, a number of empirical studies have suggested that returns during the period surrounding an equity issue are abnormal, suggesting that information

is in fact being revealed during the issue. Robert Koracjzyk, Deborah Lucas, and Robert McDonald address these concerns and develop a model of stock price reactions to equity issues under asymmetric information. They begin by reviewing existing empirical evidence on increases in stock prices just prior to an equity issue and the subsequent drop in stock prices at the issue, noting that most explanations of these patterns individually in the literature cannot explain the two price movements together.

Koracjzyk, Lucas, and McDonald assume that managers—who act in the interest of existing shareholders—have private information about the firm's true value. Consider two firms—one undervalued and one overvalued—that plan to issue equity; because of having to forgo investment opportunities while waiting, postponing the issue is costly to both. Undervalued firms will wait for their price to rise (as their type is slowly revealed to the market) so that their price path rises before an issue. Overvalued firms do not wait, so that their price path is flat prior to the issue. Thus, on average, stock price path prior to issue will be upward sloping. The negative price reaction upon issue can be explained within a "lemons" framework—issuing signals that the firm is on average overvalued, so that the stock price drops.

Another possible explanation for the price rise prior to issue is that the market has learned of the arrival of a "good" project that the firm has yet to undertake. Koracjzyk, Lucas, and McDonald cast doubt on that alternative by demonstrating that price increases also occur prior to secondary issues (large block sales by existing equity holders) which reveal information but have nothing to do with additions to the firm's capital. On the other hand, firms issuing equity experience a rise in Tobin's q prior to the issue and a subsequent fall, a pattern consistent with firms' issuing equity to finance growth opportunities. While the evidence offered by Koracjzyk, Lucas, and McDonald is consistent with the importance of asymmetric information in explaining stock price reactions during seasoned equity issues, it is difficult to make inferences about effects on the efficiency of the investment process. If the stock price declines represent appropriate downward revision in the value of the firm, there has only been a shift in the timing of information about market value. On the other hand, if "bad" firms issue equity to pool with "good" firms, the lemons-market efficiency problems raised by Myers and Majluf (1984) become important.

Takeo Hoshi, Anil Kashyap, and David Scharfstein have focused on Japan as a case study of the development and value of monitoring arrangements in financial markets in the presence of asymmetric information. In their previous (1990) work, these authors examined the effect of internal finance on investment spending by Japanese firms, holding constant investment opportunities (as approximated by Tobin's q). Using panel data, they grouped firms according to whether they were members of *keiretsu* industrial groups. They find that membership in a group and the presence of a group "main bank" are important in the provision of information and the avoidance of credit rationing when investment opportunities are promising. While liquidity effects on investment were found to be important f
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vestment were found to be important for *nongroup* firms, the investment behavior of *member* firms is well described by a q model.

In their paper for this volume, Hoshi, Kashyap, and Scharfstein extend their earlier work by observing differences in the effects of banking relationships on the sensitivity of investment to internal finance during the 1980s (in the aftermath of a major deregulation of Japanese financial markets). The general features of the deregulation included easing restrictions on issuing bonds abroad and permitting the issuance of noncollateralized bonds in domestic securities markets. Reliance of firms on banks for debt finance diminished substantially during this period. Hoshi, Kashyap, and Scharfstein test for shifts in the investment behavior of group firms, contrasting firms that decreased their reliance on main bank finance (seeking finance instead from the domestic and foreign bond market) and firms who retained their bank ties. For the latter group, investment remained insensitive to movements in firm liquidity (holding constant investment opportunities) before and after banking deregulation. For the former, investment spending became more sensitive to fluctuations in firm liquidity. The key question is, then, the following: If bank monitoring overcomes information problems and relaxes credit constraints, why did some firms sever their bank ties? The authors' work points up important issues to consider in assessing the costs and benefits of banking relationships in Japan, as well as in the design of new theories of the choice between bank debt and public debt.

A variety of strategies is available in capital markets to mitigate the cost of capital market frictions in the presence of asymmetric information. These strategies need not involve modifications in capital structure; it is possible, for example, for outside shareholders in a firm to monitor insiders (managers). Of course, with a large number of shareholders with dispersed holdings, free-rider problems arise. However, large shareholders can realize the benefits of their informed action, and can effectively express their concerns about corporate governance through their voting power. There has been little direct evidence on the question of whether a large shareholder can reduce information-related costs in capital markets, deterring managerial self-interest. To the extent that larger shareholders can accomplish this, they provide a delegated monitoring function, in that their actions provide information to smaller shareholders, who individually do not find it in their economic interest to incur the cost of monitoring.

Richard Zeckhauser and John Pound consider this possibility. After outlining the potential impact of large shareholders on insiders' incentives and the flow of information, they use cross-sectional data on firms to test for systematic variation in performance among firms with large shareholders (after controlling for industry differences). As a proxy for the severity of information problem, Zeckhauser and Pound classify industries according to whether capital and investments are highly firm-specific. The basic idea is that when assets are specific to the management, it is more difficult for large shareholders (acting as monitors) to improve performance; that is, features of asset specific-

ity and closed information structure are assumed to be related. Zeckhauser and Pound find that earnings-price ratios (their measure of performance) are significantly lower for firms with large shareholders in industries with open information structures (i.e., where assets are less specific and monitoring is potentially valuable). There is no comparable "large shareholder" effect for firms in industries subject to closed information structure. The evidence presented by Zeckhauser and Pound provides a suggestive first step toward measuring the benefits of the delegated monitoring mechanism provided by large shareholders.

Notes

1. See, e.g., Koch (1943), Merwin (1942), Lutz (1945), Dobrovolsky (1951), and Friedman (1982b, 1985).

2. See, e.g., Hall and Jorgenson (1967) on neoclassical models. On q models, see Brainard and Tobin (1968), Tobin (1969), and subsequent developments in Hayashi (1982), Summers (1981), and Abel and Blanchard (1986).

3. See the discussion in Calomiris and Hubbard (1989) for the period in the United States prior to the founding of the Federal Reserve and the discussion in Bernanke (1983) for the 1930s.

4. This point was made forcefully by Meyer and Kuh (1957) and Eisner (1978). The development of empirical tests of the role of internal finance in the investment decision is discussed in Fazzari, Hubbard, and Petersen (1988) and extended in the context of Euler equation models of financial constraints and investment by Hubbard and Kashyap (1989), Gilchrist (1989), and Whited (1989).

5. Such patterns were highlighted in an early study by Butters and Lintner (1945). Gertler and Hubbard (1988) review differences in financing patterns by firm size for contemporary data.

6. See, e.g., Wojnilower (1980), Eckstein and Sinai (1986), and Friedman (1982a).

7. This literature is summarized in Gertler (1988).

8. Earlier, Jaffee and Russell (1976) demonstrated that the cost of credit would in general be higher under asymmetric information—the market interest rate must increase, and loan size may be limited, when lenders cannot distinguish borrower quality.

9. Calomiris and Hubbard (1989) have stressed this channel in accounting for Phillips curve correlations in aggregate data for the United States in the period prior to the founding of the Federal Reserve system—a period in which deflationary shocks, investment collapse, and recession were coincident.

10. See, e.g., Easterbrook (1984), Jensen (1986), and Gertler and Hubbard (1990).

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