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Financial Factors in Business Fluctuations

Mark Gertler and R. Glenn Hubbard

Introduction

What role do financial market imperfections play in business fluctuations? This is a very old question, of course, one which surfaced as early as the Great Depression, motivated then by the collapse of the financial system that occurred just prior to the trough. There is new interest, however. Events such as the stock market crash, the debacle in Texas banking, the farm debt crisis, and the Third World debt problem have filtered into lunch table conversations, prompting new debates about the link between the financial system and the macroeconomy. At a more formal level, recent research in macroeconomics—both theoretical and empirical—has resurrected the idea that capital market imperfections may be significant factors in business volatility by making new progress in characterizing the mechanisms.

This paper outlines the case for a financial aspect to business fluctuations, in light of the contributions of this new literature. It also reviews some of the main evidence supporting this idea, evidence based on both historical and contemporary data. Finally, it presents some new empirical results consistent with the notion that particular capital market imperfections may contribute to the volatility of business output and business fixed investment, in particular.

To keep matters manageable, the analysis concentrates mainly on the implications of financial market frictions for investment volatility, though some of the basic arguments are relevant to explaining fluctuations in employment demand, inventory investment, and consumption[1] (particularly, expenditures on durable goods) as we discuss below. Also for tractability, the paper focuses on financial as opposed to monetary factors in business fluctuations. The following crude distinction is made: factors involving imperfections in markets for borrowing and lending are considered "financial," while those involving variations in the quantity of the medium of exchange are considered "monetary."

The next section expands on the motivation, and provides a general overview of the arguments we plan to make. We review informally existing evidence that supports these arguments. We then present a theoretical model that explicitly motivates how financial factors may affect investment, one which is a simplified and representative version of the models currently popular in macroeconomics. Following that presentation, we report some existing tests of the model's basic predictions, and also present two new sets of results. The first demonstrates that the inverse relation between sales variability and size documented in many studies may be due to financial rather than technological factors, in contrast to the conventional view.[2] The second lends support to a theoretical prediction of the model, that the effects of capital market frictions on investment should be asymmetric, having more impact in recessions than booms. The final section presents conclusions and addresses some policy questions. As the reader might expect, we discuss why the fact that the stock market crash has not had a major impact on the economy is not inconsistent with our overall message.

The interdependence of financial and real decisions

Overview

It is first useful to place this discussion in the context of contemporary research in macroeconomics. Over the last decade, much of the effort in this field has involved developing models of business

[1] The importance of "liquidity-constrained" consumers for aggregate movements in consumption is examined by Scheinkman and Weiss (1986) and Hubbard and Judd (1986).

[2] See, e.g., Mills and Schumann (1985).

fluctuations in which the structural relationships are explicit outcomes of rational economic behavior. The centerpiece is the "real business cycle" paradigm, developed by Kydland and Prescott (1982). Roughly speaking, this framework explains fluctuations using the stochastic competitive equilibrium growth model, altered to include variable labor supply. Tractability is a key aspect. To date, the (suitably modified) stochastic growth model is the only macroeconomic framework which evolves purely from first principles and which, at the same time, is capable of confronting actual business cycle data.[3]

There are two features of real business cycle theory highly relevant to the discussion here. First, financial factors are completely absent. Because all markets function perfectly in the competitive equilibrium growth model, the Modigliani-Miller theorem applies; financial structure is both irrelevant and indeterminate. This limits the ability of this paradigm to explain severe economic contractions such as the Depression, where breakdowns in financial trade appear to play an important role.[4] In addition, the framework is silent about the regular cyclical movements of financial variables such as balance sheet positions, liquidity ratios, and bank credit, documented by a number of economists.[5] This issue is important to the extent that these financial variables may not merely be responding passively to the oscillations in real output.

The second key aspect is that the basic real business cycle model relies on large and persistent exogenous productivity disturbances in order to explain the observed magnitudes of business cycles. The problem here is that it is difficult to identify these disturbances in practice. They are not directly observable, making it difficult to corroborate the basic story.[6]

This latter feature has motivated a new stage of research aimed at enriching the endogenous component of the propagation mechanism. The common objective is to rationalize and test theories that

3 See Prescott (1986).

4 See Bernanke (1983).

5 See, e.g., Wojnilower (1980), Eckstein and Sinai (1986), and Friedman (1982) (1983).

6 See Summers (1986).

can explain how relatively small exogenous shocks can produce large fluctuations in output. Several different avenues are currently being pursued: one is to make productivity changes endogenous;[7] a second is to introduce increasing returns to scale and imperfect competition to motivate demand externalities;[8] and a third, which we consider here, is to explore the implications of certain capital market imperfections. These approaches can be viewed as complementary; they certainly need not be mutually exclusive.[9]

The notion of a financial aspect to the growth and fluctuation in output was common in earlier work.[10] A main contribution of the new research is to place the ideas in the traditional literature on firmer theoretical ground, to attempt to match the standard set in real business cycle theory. To this extent, it borrows heavily from the economics of information and incentives to explicitly motivate frictions in capital markets and, correspondingly, a meaningful role for financial structure in real economic activity.[11]

The new work stresses two basic avenues in which financial factors may contribute to investment volatility. Each presumes a setting where informational asymmetries between borrowers and lenders introduce incentive problems in financial relationships.

The first involves the firm's internal net worth, which becomes a critical determinant of the terms under which it can borrow in this type of environment. To the extent that movements in the firm's collateralizable net worth are procyclical, an "accelerator" mechanism emerges. During booms it becomes easier to borrow; the rise in borrower net worth reduces the premium attached to (uncollateralized) external finance. Conversely, the premium rises in recessions, making it more difficult to borrow. The countercyclical movement in the wedge between the cost of external and internal funds makes invest-

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7 See, e.g., Christiano and Eichenbaum (1988).

8 See, e.g., Hall (1986).

9 Hall (1988) suggests one way in which the latter two approaches may be synthesized.

10 See, e.g., Fisher (1933), Gurley and Shaw (1955) and (1960), Roosa (1951), Kindleberger (1978), and Minsky (1964) and (1975).

11 See Gertler (1988) for a survey of the new literature and a discussion of the traditional work as well.

ment more volatile than it would otherwise be. Note the fact that this wedge does not exist in a setting of perfect markets.

A related implication is that redistributions of wealth between creditors and debtors also contribute to investment variability. This occurs due to the impact of the redistribution on borrower net worth. One example is the erosion of borrowers' collateral during the Depression. A large unanticipated price deflation induced this erosion. Declining prices increased the real debt burdens of borrowers by nearly 40 percent in the period from 1929 to 1933. Indeed, Irving Fisher (1933) cited the "debt deflation" as the main reason for the severe investment collapse.[12] Two more recent examples involve the decline in agricultural and oil prices. In each case, many argue, there was a financial factor present which magnified the impact of the price decline on investment activity. In particular, the drop in prices reduced the ability of firms in each sector to borrow by lowering their collateralizable net worth.

The second main avenue stressed involves the supply of intermediary credit, particularly business loans supplied by commercial banks. Underlying this channel is the idea that certain classes of borrowers—those for whom the added costs of finance induced by incentive problems are large relative to their funding needs—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. By doing so, they facilitate the flow of funds between savers and certain kinds of investors. In this regard, the terms under which intermediary credit is available are key determinants of investment by firms that do not have easy access to direct credit.

The corollary argument is that factors which alter the flow of intermediary credit may have important consequences for investment behavior. Examples include the flight of depositor funds out of the banking system during the Great Depression and the sharp rise in interest rates that induced "disintermediation" in the mid-1960s. In addition, some economists have resurrected the view that monetary policy matters primarily by influencing the supply of commercial bank

12 See also Tobin (1975).

credit rather than the quantity of the medium of exchange.[13] The idea is that substitutes for money are more readily available than substitutes for commercial bank credit (again, for certain classes of firms).

Theoretical models which motivate these types of real-financial mechanisms from first principles are now in abundance. The main challenge remaining is to quantify their importance. This task is at an early stage. A basic problem is that many different theories make similar predictions about the time-series behavior of investment. This has prompted a strategy of testing the cross-sectional implications of competing hypotheses. In contrast to the basic neoclassical model of investment (which the real business cycle model embeds), these new theories stressing financial effects predict that investment should vary across firms according to their net worth positions, holding constant everything else. This prediction offers a way to test the theories, to the extent that it is possible to find proxies for firms' internal net worth. As we discuss below, several papers have pursued this strategy; and subject to the caveat just mentioned, they have found evidence supporting a role for financial factors.

A related cross-sectional prediction is that financing patterns should vary across firms according to the differences in the (incentive-induced) costs they face in obtaining external finance. In particular, firms subject to capital market frictions should be more likely to rely on retained earnings and bank debt than on direct credit. These financing patterns do indeed emerge in the data, as we elaborate below, given that a firm's size is a reasonable rough proxy of its ability to borrow. Keep in mind that the basic real business cycle framework suggests no determinate pattern.

Overall, the theme that emerges from this initial empirical work is that financial factors are important to the behavior of small, growing firms, at least relative to large, mature firms. (However, we believe it would be a mistake to conclude that large firms never confront capital market frictions—Chrysler and Texaco provide good counter-examples.[14]) This raises the question: How significant are small firms

13 See, e.g., Blinder and Stiglitz (1983).

14 Cutler and Summers (1987) discuss measures of the costs of financial distress in the recent Texaco-Pennzoil case.

in business fluctuations? We are currently trying to obtain a precise answer to this question; it requires an ambitious effort. However, we present some numbers later indicating that small firms play a non-trivial role in the economy. This preliminary evidence supports pursuing the issue further.

Financial factors: historical evidence

The historical evidence linking financial factors to business fluctuations is compelling. The Great Depression provides the most prominent example. Bernanke (1983) details the breakdown in credit flows that likely amplified the downturn over the period from 1930 to 1933. There were two main causes: first, the collapse of the banking system; and second, the precipitous decline in borrower net worth. Regarding the former, nearly half of the banks existing in 1930 ceased operating by 1933, and many of the surviving ones suffered large losses. This had the effect of reducing credit flows to borrowers who did not have easy access to non-intermediated funds.[15] Regarding the latter, the ratio of debt service to national income more than doubled. The combined effect of declining output and deflation sharply deteriorated borrower balance sheets, shrinking their collateral, thus constraining their ability to obtain further credit.

Calomiris and Hubbard (1987) obtain related evidence for the period from 1879 to 1914, prior to the founding of the Federal Reserve System. They show that the basic debt-deflation story may apply to this era as well. Their results indicate that deflationary shocks preceded declines in bank loan supply and output. Moreover, deflationary episodes were associated with increasing spreads between the interest rates on "low quality" and "high quality" commercial paper of similar maturities.

During both these periods, there were also obvious differences in behavior across firms. Smaller firms tended to be more sensitive to the effects of financial market disturbances. Calomiris and Hubbard cite contemporary academic studies and newspaper accounts empha-

15 This is distinct from the purely *monetary* transmission mechanism (i.e., the decline in the money supply) stressed by Friedman and Schwartz (1963).

sizing the closing of many small, solvent businesses during the panics of 1884 and 1893. Credit was largely unavailable to small businesses during those periods; they were required to settle in cash. Sprague (1910) noted that during periods of tight bank credit, smaller firms were differentially affected both because lenders sought only notes of the highest quality and because larger firms had access to the commercial paper market.

Evidence of heterogeneity in the impact of credit stringency on firms in the early 1930s is widespread. See, for example, Hart's (1938) discussion of the problems faced by farmers and state and local governments; Klebaner's (1974) analysis of the difficulties faced by unincorporated businesses and small corporations in 1931 and 1932; Kimmel's (1939) account of the strong positive relationship between firm size and the availability of bank credit (holding constant the line of business); and the results of the Hardy-Viner study of credit availability in the Seventh Federal Reserve District in Stoddard (1940), noting the problems of small businesses (previously deemed by local lenders to have been of high quality) in obtaining bank credit.

It is interesting to observe that small firms bore a disproportionately large share of the decline in profits during the Great Depression. Merwin (1943) notes that, as a class, large firms (with assets of more than $50 million) reported positive profits even during 1931, 1932 and 1933. Similar evidence is discussed by Chandler (1971). Fabricant (1935) reports the high rate of losses relative to capitalization for small firms, a pattern mitigated or reversed for large firms. This differential impact on small versus large firms is further suggestive that financial influences may have been significant.

Financial factors and the modern economy

Documenting the significance of financial factors for contemporary business fluctuations is less straightforward, due to the absence of events as pronounced as the Depression. Nonetheless, there is a pattern of evidence which, at a minimum, is sufficient to justify further pursuit of this topic. The pattern is roughly as follows: First, small firms' sales and investment (per dollar of assets) are more volatile than large firms'. Second, there is evidence that capital market imperfections may be an important determinant of this added volatility.[16] Third, small firms are a nontrivial component of GNP, using various measures of "smallness." Beyond this, there are several recent episodes in which it is clearly possible to identify important financial influences on investment.

As a stylized fact, sales, employment, and investment are more volatile in small firms than large firms. These patterns are well known. Hymer and Pashigian (1962) and Evans (1987) find that the variability of firm growth decreases with firm size, and Evans (1987) finds that the probability of firm failure decreases with age. Greater variability of earnings and sales in smaller firms is true historically as well.[17] The negative correlation between firm age and life expectancy in the decade after World War II has been documented by Churchill (1955).

There exist nonfinancial theories capable of explaining qualitatively why firm volatility declines with size.[18] However, there is also considerable reason to believe financial factors are at work as well. To begin with, firms differ systematically in how they finance investment. These differences are related to firm size in a way that suggests they reflect varying abilities to obtain credit.[19] Small firms tend to rely more heavily on internally generated funds than do large firms, and the use of non-bank debt is important only for large firms. Commercial banks are an important source of credit for small and medium-sized firms which lack access to impersonal, centralized securities markets.

Using data from the Quarterly Financial Report of Manufacturing, Mining, and Trade Corporations, we summarize financing practices of manufacturing firms by size in Table 1.[20] Two features of Table 1 are of particular interest. First, internal finance provides the

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16 Brock and Evans (1988) put forth a related argument. They note that small corporations account for most of the observed mean-reversion behavior (i.e., non-random-walk behavior) in stock prices, and they cite finance constraints as a possible explanation.

17 See, e.g., Merwin (1943).

18 See Jovanovic (1982) and Mills and Schumann (1985).

19 Costs of flotation alone are not likely to be sufficient to account for these differences; see the review of studies in Fazzari, Hubbard, and Petersen (1988a).

20 These data exclude new equity issues, which are small in the aggregate.

Table 1
Sources of Funds by Size Class, U.S. Manufacturing Firms, 1970-1984

Sources of Funds (percent of total)

Firm Class	Short-Term Bank Debt	Long-Term Bank Debt	Other Long-Term Debt	Retained Earnings	Percentage of Long-Term Debt From Banks	Average Retention Ratio
All Firms	0.6	8.4	19.9	71.1	29.6	0.60
By size class						
Under $10 million	5.1	12.8	6.2	75.9	67.3	0.79
$10 - $50 million	5.9	17.4	6.9	69.8	71.6	0.76
$50 - $100 million	3.1	12.9	5.3	78.7	71.0	0.68
$100 - $250 million	−0.2	13.3	12.0	74.9	52.4	0.63
$250 - $1 billion	−2.3	10.6	15.4	76.3	40.8	0.56
Over $1 billion	−0.6	4.8	27.9	67.9	14.7	0.52

Notes: Entries are authors' calculations based on data taken from U.S. Department of Commerce, Bureau of the Census, ***Quarterly Financial Report of Manufacturing, Mining, and Trade Corporations,*** various issues. The data underlying the calculations are expressed in 1982 dollars. "Size class" refers to the value of net plant. Funds raised from new equity issues are excluded from the calculations.

largest fraction of net funds raised for firms in all size categories. In addition, the proportion of income retained by firms varies across size classes; there is a negative correlation between firm size and the retention ratio. That retention ratios and the fraction of net worth accounted for by accumulated retained earnings are negatively correlated with firm size is true historically as well.[21] This feature is noted in contemporary data on individual firms by Fazzari, Hubbard, and Petersen (1988a), hereafter known as FHP. Second, there are important differences in the composition of debt finance across firms. The percentage of long-term debt coming from banks—lending institutions specializing in monitoring borrowers through customer relationships—declines with firm size. The financing patterns present in the manufacturing sector tend to hold economy-wide as well.[22]

A second general type of evidence involves econometric studies of firm investment behavior using panel data. Indeed, using panel data from individual manufacturing corporations, FHP find that proxies for internal net worth are important in explaining investment behavior, particularly for smaller firms in the sample. These results arise after controlling for measures of investment opportunities, as we discuss in detail later.

FHP's results indicate that firms with assets of under $25 million (in 1982 dollars) tend to face capital market frictions (in the sense that internal funds were important for investment, controlling for investment opportunities). How important are these kinds of firms in the aggregate? Let us err on the side of understating their importance by picking a more conservative benchmark of $10 million in assets. In the nonfinancial business sector as a whole, firms in this category (under $10 million in assets) accounted for 45 percent of total assets and 46 percent of net worth in 1986.[23]

More detailed breakdowns of shares of total assets and receipts accounted for by firms of various sizes (as measured by total assets) are available for the corporate sector and are presented in Tables 2 and 3. Firms with less than $10 million in assets accounted for

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21 See Butters and Lintner (1945) and the references therein.

22 See *The State of Small Business: A Report of the President, 1988.*

23 *Ibid.*, p. 160.

Table 2
Firm Size, Assets, and Receipts: All Corporations

	Accounting for Percentage of Total		
Asset Size Class **($000s)**	Number of Firms	Assets	Receipts
No assets	3.8%	0%	1.1%
Less than 100	51.8	0.5	3.2
100-250	18.5	0.9	3.3
250-500	10.4	1.1	3.6
500-1,000	6.9	1.4	4.4
1,000-5,000	6.4	3.9	11.7
5,000-10,000	0.9	1.7	4.2
10,000-25,000	0.6	2.9	4.9
25,000-50,000	0.3	3.6	3.4
50,000-100,000	0.2	4.0	3.4
100,000-250,000	0.1	5.8	5.3
More than 250,000	0.1	74.2	51.5
	100.0	100.0	100.0

Note: All figures are for 1984, and are taken from ***Source Book: Statistics of Income, Active Corporation Income Tax Returns, 1984*** (published in *1987).*

31.5 percent of receipts in the corporate sector as a whole. The industry sector breakdowns for firms with less than $10 million are as follows: 72.4 percent in construction, 17.4 percent in mining, 14.8 percent in manufacturing, 70.5 percent in services, 10.4 percent in transportation and utilities, 52.3 percent in wholesale and retail trade, and 11.5 percent in finance, insurance, and real estate. It is important to recognize that these figures for the corporate sector understate the economy-wide importance of small firms, since the latter are much more predominant among unincorporated businesses (proprietorships and partnerships). Further, the unincorporated sector is nontrivial. It has accounted for 60 percent of total business and capital income in the postwar period. Corporate profits were 87 percent of pro-

Table 3
Firm Size, Assets, and Receipts: Corporations in Major Industry Groups

	Major Industry													
Asset Size Class ($000s)	Construction		Mining		Manufacturing		Services		Utilities		Wholesale & Retail Trade		Finance, Insurance, and Real Estate	
	A	R	A	R	A	R	A	R	A	R	A	R	A	R
No Assets	0%	1.2%	0%	1.6%	0%	0.76%	0%	1.1%	0%	0%	0%	0.8%	0%	2.5%
Less than 100	3.0	9.0	0.29	1.5	0.16	0.50	6.9	21.2	0	0	2.1	3.5	0.14	1.5
100–250	5.1	7.9	0.50	1.0	0.35	0.74	7.7	14.0	0.33	1.5	4.5	5.1	0.26	1.4
250–500	7.2	9.5	0.91	1.5	0.56	1.2	6.3	9.1	0.46	1.7	5.8	6.1	0.32	1.0
500–1,000	9.7	12.1	1.3	2.7	0.93	1.8	6.6	7.9	0.59	1.7	7.6	8.0	0.4	1.1
1,000–5,000	23.2	24.6	4.4	5.9	3.5	6.5	13.8	13.1	1.6	4.3	2.0	21.8	1.2	2.7
5,000–10,000	8.7	8.1	2.8	3.2	1.9	3.3	5.3	4.1	0.65	1.2	7.2	7.0	0.7	1.3
10,000–25,000	9.5	7.4	4.8	4.4	2.9	4.3	7.0	5.1	1.1	2.0	7.7	7.2	2.2	2.6
25,000–50,000	5.9	4.3	4.1	4.2	2.4	3.2	4.8	3.5	0.91	1.5	5.1	3.9	3.4	3.8
50,000–100,000	4.5	3.3	3.3	3.4	2.5	3.1	5.7	3.7	0.86	1.3	4.5	4.0	5.0	4.6
100,000–250,000	4.0	2.4	7.7	5.9	5.1	5.6	8.0	4.8	1.8	2.4	7.8	6.1	6.7	6.0
More Than 250,000	19.2	10.2	68.9	64.7	79.7	69.0	27.9	12.4	91.7	82.5	45.7	26.5	79.7	71.5
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Note: "A" and "R" refer to "assets" and "receipts," respectively. All figures are for 1984, and are taken from *Source Book: Statistics of Income, Active Corporation Income Tax Returns, 1984* (published in 1987).

Table 4
The Relative Importance of Small Firms in Major Industries

Major Industry	Share in Gross Product	Share of Firms with < 500 Employees	
		In GPO (1976)	In Employment (1986)
Agriculture	NA	NA	79.1%
Mining	3.0%	32.2%	34.7
Construction	5.3	83.5	85.4
Manufacturing	28.7	19.1	35.2
Transportation, Communications, and Public Utilities	10.8	21.6	33.2
Wholesale Trade	9.2	83.9	70.4
Retail Trade	12.0	62.4	59.0
Finance, Insurance, and Real Estate	16.7	45.6	44.5
Services	14.3	82.0	49.1

Note: Shares in GPO by sector and size for 1976 are taken from Joel Popkin, "Measuring Gross Product Originating in Small Business: Methodology and Annual Estimates, 1955 to 1976," Report to the Small Business Administration, September 1980. Shares in employment for 1986 are taken from *The State of Small Business: A Report of the President, 1988,* pp. 62-63. "Small businesses" are defined as firms with fewer than 500 employees.

prietors' income of sole proprietorships and partnerships in 1950, and 88 percent in 1986, the most recent year for which complete data are available.[24]

The number of employees is another measure available to assess the importance of small firms. Indeed, the official definition of a "small business" is a firm with no more than 500 employees. Using this criterion, small businesses accounted in 1986 for about 54 percent of total employment. We provide a further breakdown in Table 4 of the shares of small firms (those with fewer than 500 employees) in gross product originating (GPO) and employment. Small business shares are nontrivial in all sectors, ranging from 19 percent of GPO in manufacturing to about 84 percent in construction and wholesale trade. As the Small Business Administration report mentioned previously emphasizes, these firms are likely to face borrowing constraints; they have small asset bases (typically less than $10 million), and are likely to finance investments with retained earnings or bank credit. (The emergence of the "junk bond" market is changing this somewhat, at least for medium-sized firms. In the conclusion, we discuss why capital market frictions remain relevant to firms issuing junk bonds.)

Finally, several contemporary events provide some informal evidence in support of the themes being developed here. Consider the "credit crunch" of 1966. During this period, rising interest rates caused funds to flow out of depository institutions (which were subject to deposit interest rate ceilings at the time).[25] Chart 1 highlights differences in the rate of investment and the growth rate of real sales for various size classes of manufacturing firms during this period. (The groups are those classified in the ***Quarterly Financial Report of Manufacturing, Mining, and Trade Corporations.***) Declines in the rate of investment and in the growth rate of real sales were disproportionately borne by smaller firms, firms largely dependent on bank credit for external finance. The analysis of such episodes with panel data on individual firms is an important task for future research. We believe, however, that the preliminary evidence here

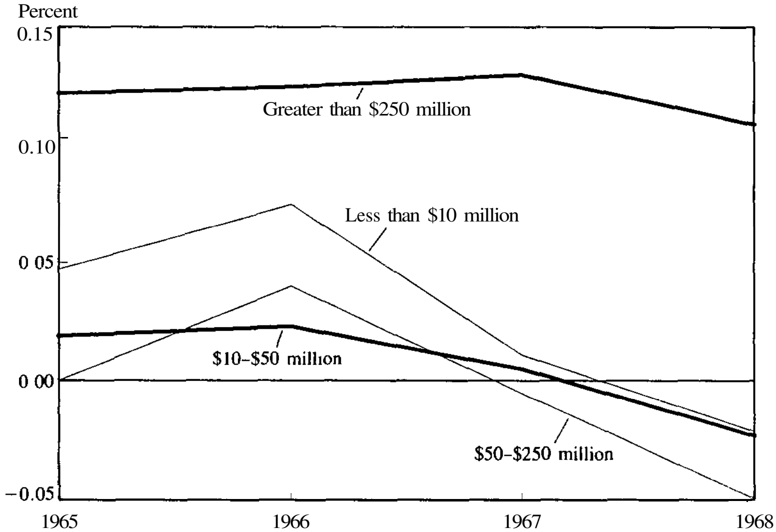
24 See Nelson (1988).

25 In the first half of 1966, primarily savings and loans felt the "crunch;" mortgage lending fell dramatically. Commercial banks felt the pinch in the second half of the year when the Federal Reserve lowered the ceiling rate on bank time deposits and increased reserve requirements.

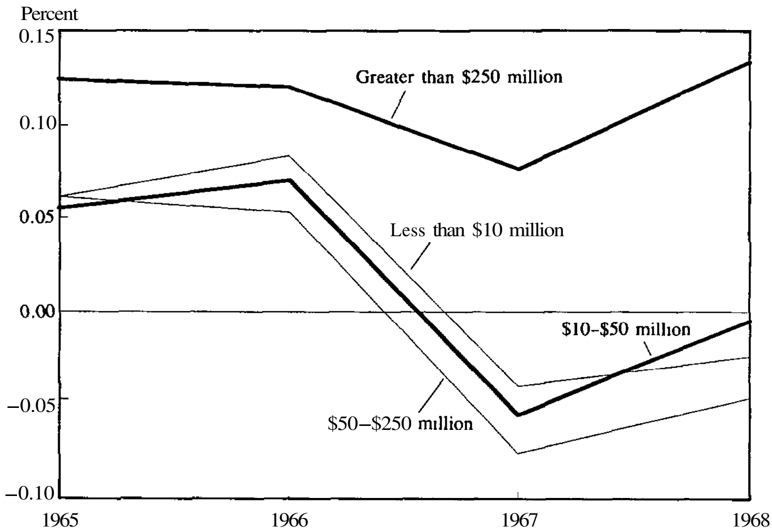
Chart 1

Movements in Investment and Sales—1966 'Credit Crunch'
(Manufacturing. **Firms, Groupings** by Size)

Investment/Capital



Growth Rate of Real Sales



is at least suggestive of the importance of firm heterogeneity in response to financial disturbances.

The recent deflations in the agricultural and oil sectors provide evidence supporting the idea that internal net worth may be a key factor in the investment decision. Calomiris, Hubbard, and Stock (1986) document how the collapse in farm land values (collateral) made it difficult for small farmers to obtain financing for still-profitable projects. Reiss (1988) notes that for the domestic petroleum industry, finance constraints on "independents" contributed to their sharp decline in exploration and development spending. He finds important effects of declines in cash flow on declines in investment spending, holding constant measures of investment opportunities. In addition, Reiss describes ways in which debt contracts placed restrictions on firms' decisions during deflationary periods, and analyzes the strong links between the value of firms' oil and gas reserves and the amount which producers could borrow.

A theoretical model of financial influences on investment

This section presents a simple partial equilibrium model of investment. We design the framework for expository purposes; it is intended to capture some of the basic aspects of the newly-developed models of finance and business fluctuations.[26] Our goals here are threefold: first, to illustrate how it is possible to rationalize formally an interdependence between real investment behavior and financial structure; second, to trace out the macroeconomic implications of this link; and third, to suggest some testable hypotheses. The subsequent section pursues these tests.

The model we develop characterizes the investment and financial decisions of an entrepreneur who undertakes risky projects. A central feature is that the entrepreneur has greater knowledge about certain aspects of the investment process than do the lenders from whom she seeks funding. This precipitates a conflict of interests between

26 See, e.g., Bernanke and Gertler (1989), Calomiris and Hubbard (1987), Farmer (1984), Greenwald and Stiglitz (1986), Townsend (1988), and Williamson (1987).

the two parties. The conflict (an "agency" problem) manifests itself by driving a wedge between the price of externally and internally generated funds. For this reason, the cost of investing, and hence the borrower's investment decision, depends on her financial position, particularly her collateralizable net worth.

In the example we choose, lenders cannot fully observe how the entrepreneur uses investment funds. It is not important that the informational friction assumes this particular form; a wide variety of plausible scenarios generate the same qualitative results.[27] Nonetheless, scholars from both the past (Berle and Means in 1932) and the present (Easterbrook in 1984, Jensen in 1986) emphasize that the inability of lenders to monitor perfectly the actions of borrowers is characteristic of many financial relationships, and is a fundamental source of "imperfections" in capital markets.

The problem arising under this information structure is that the entrepreneur has the incentive to misallocate funds to favor herself (e.g., to overinvest in perquisites or to select projects which provide her with some additional personal gratification). Lenders account for this problem by insisting that financial relationships be structured in a way that aligns the borrower's incentives with their own. The agency problem introduces real costs to the investment process to the extent that the provisions of the financial contract induce the entrepreneur to invest in a way that differs from what she would choose under symmetric information. In this regard, real and financial decisions are interdependent.

The model works as follows. There are two periods, zero and one. In period zero, a risk neutral entrepreneur uses hard capital K and (possibly) soft capital C to produce output Y which becomes available to sell in period one. The technology is risky, making output random. There are two possible productivity states, "good" and "bad," and this uncertainty is realized after the investment decision is made.

27 For example, in Bernanke and Gertler (1987), entrepreneurs have private information about the expected return on their investment projects, which adds an Akerlof (1970) "lemons premium" to the cost of external finance, analogous to Greenwald, Stiglitz, and Weiss (1984) and Myers and Majluf (1984). In Calomiris and Hubbard (1987), entrepreneurs have private information about the riskiness of their projects, which leads to credit rationing of some classes of borrowers, as in Keeton (1979) and Stiglitz and Weiss (1981).

Output is the numeraire good, and each kind of capital has its price normalized at unity. "Hard capital" refers to machinery. "Soft capital" may be thought of as any input which improves the likelihood that a given level of hard capital input will generate a good output realization. Examples include organizational expenditures, maintenance expenditures, and inventories.

To keep things as simple as possible, suppose the entrepreneur can improve the probability of a good output realization if she uses enough soft capital to satisfy a required level that is proportional to the quantity of hard capital used. In particular, suppose

$$\text{(1a)}\quad \tilde{Y} = \begin{cases} f(K), & \text{with probability } \pi^g \\ \alpha f(K), & \text{with probability } \pi^b \end{cases}$$

$$\text{(1b)}\quad C \geq \nu K,$$

and

$$\text{(2a)}\quad Y = \alpha f(K),$$

$$\text{(2b)}\quad C < \nu K,$$

where f(K) is twice continuously differentiable, strictly increasing, and strictly concave, with $f(0) = 0$, $f'(0) = \infty$, and $f'(z) \to 0$ as $z \to \infty$. Further, $\pi^g + \pi^b = 1$, $0 < a < 1$, and $v > 0$. Also, assume for simplicity that the random productivity realization (when soft capital is employed) is uncorrelated with events elsewhere in the economy.

Clearly, the entrepreneur will either use νK units of soft capital or none at all.[28] Suppose that, for any level of hard capital employ-

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28 See Genler and Rogoff (1988) for a setting in which project success probabilities are continuous concave functions of the quantity of soft capital employed. In that setting, the amount of soft capital used is a continuous function of the model's parameters.

ment, it is always efficient to use soft capital, in the sense that the expected gain in output net of costs is positive. This requires the following parameter restriction:

(3) $(\pi^g + \pi^b\alpha)/(1 + \nu) > \alpha$

It follows that ***in the absence of informational frictions*** the entrepreneur invests (chooses K) to satisfy

(4) $(\pi^g + \pi^b\alpha)f'(K) - (1 + \nu)r = 0.$

where r is the gross riskless interest rate and is given exogenously. The first term in equation (4) is the expected marginal benefit from adding a unit of hard capital, given a complementary addition of v units of soft capital. The second term is the marginal cost. Let K* be the value of K that satisfies equation (4), and refer to it as the "first best" value. Note also that K* is unrelated to financial variables; the Modigliani-Miller theorem applies.

The same need ***not*** hold under asymmetric information. Suppose, as alluded to earlier, that lenders cannot perfectly observe how the entrepreneur allocates the funds she borrows. In particular, suppose that expenditures on hard capital are observable by outsiders, but expenditures on soft capital are unobservable. The idea is that the quantity of machines in place is relatively easy to measure, but that organizational, maintenance, and inventory expenditures are difficult to monitor. The problem arising is that the entrepreneur may be tempted to divert funds intended for soft capital to enhance her personal gain. While this personal gain can assume many subtle forms,[29] we will posit simply that the entrepreneur can abscond with the funds, and invest them secretly in a riskless asset (e.g., a Swiss bank account).

Rational lenders recognize the incentive problem. Accordingly, they require that the financial contract be designed to eliminate the entrepreneur's incentive to cheat. The net effect is that K may fall below K*, and that the extent of this decline will depend inversely on the borrower's net worth. To see this formally, think of the

29 Refer to Berle and Means (1932) for a classic discussion.

entrepreneur as entering a contract with a competitive financial intermediary.[30] Assume the entrepreneur has an initial liquid asset position of W (in units of the numeraire good) and collateralizable expected future profits worth V/r in present value, where V is the value of this profit stream in the subsequent period (period one).[31] (Her net worth is thus W + V/r.) Suppose further that W is less than K*, to guarantee that the entrepreneur will want to borrow.

The contract specifies a quantity borrowed (equal to $(1 + \nu)K - W$), a payment P^g to the intermediary in the event that the project yields the "good" output level, f(K), and a payment P^b in the event of the "bad" output level, $\alpha f(K)$. The features of the contract are chosen to maximize the entrepreneur's expected profits, given by

$$(5)\quad (\pi^g + \pi^b\alpha)f(K) - \pi^g P^g - \pi^b P^b.$$

The contract must offer the intermediary an expected return equal to the opportunity costs of its funds, the gross riskless interest rate times the quantity borrowed. (The intermediary uses no resources; it simply channels funds from depositors to lenders.) Accordingly, the contingent payments P^g and P^b must satisfy

$$(6)\quad \pi^g P^g + \pi^b P^b = r[(1 + \nu)K - W].$$

The contract must also provide the entrepreneur with the incentive to allocate funds as promised, i.e., to invest in soft capital as a complementary input to hard capital, rather than to take the money for personal use. Thus, the provisions of the contract must satisfy the following "incentive constraint":

$$(7)\quad (\pi^g + \pi^b\alpha)f(K) - (\pi^g P^g + \pi^b P^b) \geq (\alpha f(K) - P^b) + r\nu K.$$

Equation (7) requires that the entrepreneur's expected gain from

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30 One key feature of the new literature on real-financial interactions is that contractual arrangements are derived endogenously so that the theoretical predictions do not hinge on arbitrary restrictions on financial structure.

31 See Gertler (1988) for a model in which V is derived explicitly. In that model, production is repeated over time, and entrepreneurs enter multi-period contracts with intermediaries.

honesty exceed her gain from misallocating the funds intended for investment in soft capital. The latter is the sum of the net contractual payoff, $\alpha f(K) - P^b$, she receives when there is a bad output realization (which is guaranteed when soft capital is not used) and the return on the funds she invests for personal use, $r\nu K$.

A way to lower the entrepreneur's temptation to cheat is to raise P^b, the amount she must pay the intermediary in the event of a bad outcome. The problem, however, is that the amount the entrepreneur can credibly promise to pay is limited by her available assets, in this case the sum of the gross revenue she earns in the bad state and the market value of her expected future profits. Thus, the following "limited liability" condition is also a constraint on the form the contract takes:

$$(8)\quad P^b \leq \alpha f(K) + V.$$

The formal contracting problem is to choose K, P^g and P^b to maximize (5) subject to (6), (7), and (8). When the incentive constraint is not binding, K simply adjusts to K*. This can be seen by substituting equation (6) into equation (5) and maximizing with respect to K. Further, the pattern of contractual payments is indeterminate; any combination of P^g and P^b which satisfies the expected return constraint (6) is acceptable.

Real investment and financial decisions are no longer independent when the incentive constraint (7) is binding. To see this, first note that the limited liability constraint (8) must also bind in this situation; this is because it is desirable to raise P^b as much as possible to lower the entrepreneur's temptation to cheat. We can accordingly obtain a relation for K by using (6) and (8) to eliminate P^g and P^b from equation (7):

$$(9)\quad (\pi^g + \pi^b\alpha)f(K) - r(1 + 2\nu)K + r(W + V/r) = 0.$$

When equation (9) holds, investment is an increasing function of the borrower's net worth,[32,33] that is,

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32 This result is a central feature of Bernanke and Gertler (1987), (1989) and Calomiris and Hubbard (1987).

33 To see that the derivative is positive, note that from equation (9),

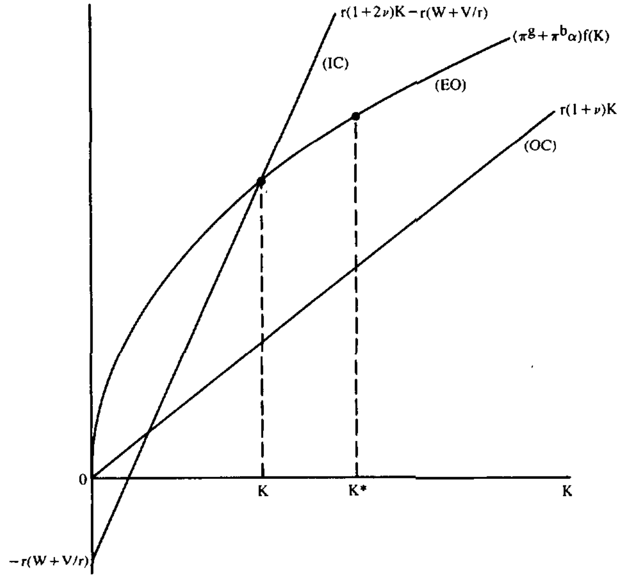
$$1 + 2\nu = \left[\frac{(\pi^g + \pi^b\alpha)f(k)}{K/r} + \frac{(W + \nu/r)}{K} \qquad \frac{(\pi^g + \pi^b\alpha)f'(K)}{r}\right] \quad \text{since } \frac{f(K)}{K} > f'(K).$$

$$(10) \quad \frac{\partial K}{\partial (W+V/r)} = [(1 + 2\nu) - (\pi^g + \pi^b\alpha)f'(K)/r]^{-1} > 0.$$

The problem here is that the entrepreneur's temptation to cheat depends positively on the amount of uncollateralized funds she borrows. Hence, additional net worth makes it feasible to invest more without violating the incentive constraint.

Figure 1 illustrates the solution. The (EO) curve portrays expected output as a function of hard capital input, given that soft capital is used as a complementary input. The (OC) curve portrays the opportunity cost of investment, also as a function of K. The first-best optimum corresponds to the value of K where the slopes are equal; that is, K equals K* at this point. The (IC) curve represents the sum of the entrepreneur's net gain from dishonesty and the cost of the funds she borrows, expressed as a function of K. Thus, the difference between the (EO) and (OC) curves reflects the entrepreneur's expected profits if she invests honestly, while the difference between the (IC) and (OC) curves is her gain from misusing the soft capital funds.

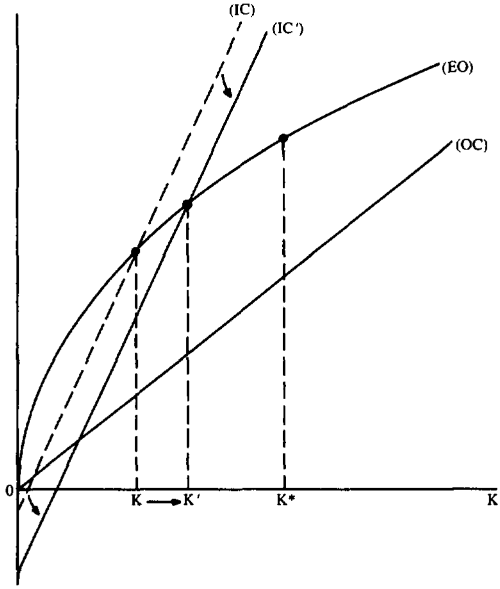
Figure 1
Internal Net Worth and the Investment Decision



The way the curves are drawn, the incentive constraint is violated if investment is fixed at K*; the gap between the (IC) and (OC) curves exceeds the gap between the (EO) and (OC) curves where K equals K*. The amount of uncollateralized borrowing must decline; therefore K must fall below K*. The solution is at the point below the first-best optimum where the (EO) and (IC) curves intersect. At this point, the entrepreneur's expected profits are maximized subject to the incentive constraint being satisfied. The incentive constraint holds since the gaps between the (EO) and (OC) curves and between the (IC) and (OC) curves are identical. Expected profits are maximized since they are lower at any smaller value of K, and since any larger value of K is not feasible (i.e., the incentive constraint is not satisfied).

A rise in borrower net worth shifts the (IC) curve rightward, pushing K toward K*. By increasing her personal stake in the project, the rise in (W + V/r) reduces the entrepreneur's incentive to misallocate funds intended for soft capital investment. This allows the entrepreneur to borrow more, permitting K to rise. Figure 2 illustrates this behavior. Once investment reaches K*, further increases in net worth have no impact; we return to this point later.

Figure 2
Effect of an Increase in Net Worth on Investment



In this situation, it is feasible to fix investment at the first-best optimum, so there is no reason to do otherwise; additional investment only lowers the entrepreneur's expected profits.

It is also useful to note that K depends inversely on the gross interest rate r, even when the incentive condition constrains investment below the first-best optimum. A rise in r pivots the (IC) curve leftward, moving K further below K*.[34] The rise in r magnifies the incentive problem by worsening the entrepreneur's financial position, thus increasing her gain from cheating (relative to being honest); the level of investment K declines accordingly.[35]

Finally, it is interesting to observe that financial structure becomes determinate in this case. The optimal financial contract specifies a unique pattern of payoffs, in contrast to the case of symmetric information. This occurs because the contract is designed to minimize the incentive problem. It is also interesting that the theoretical financial contract derived here resembles most "real world" contracts in the basic sense that lenders receive a smoother pattern of payoffs across risky outcomes than does the borrower.[36] (Recall that the optimal contract has lenders receive everything in the event of a bad outcome.)

Several features of the model are particularly relevant to thinking about economic fluctuations. First, the analysis suggests how there could emerge an "accelerator" mechanism which magnifies investment fluctuations. During booms, when borrower net worth is high—either due to past accumulation of assets (resulting in a high W) or to optimism about the future (resulting in a high V)—agency costs of finance are relatively low, providing added stimulus to investment.

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34 The effect of a rise in r is unambiguous in this case since $K > W$.

35 One way in which the rise in r lowers investment is by reducing the entrepreneur's collateralizable net worth (i.e., V/r falls). Indeed, Fisher (1911) originally stressed this mechanism. In a description of the impact of rising interest rates, he states:

> "Further, with the rise of interest, the value of certain collateral securities, such as bonds, on the basis of which loans are made, begins to fall. Such securities, being worth the discounted value of fixed sums, fall as interest rises, and therefore, cannot be used as collateral for loans as large as before." (p. 64).

36 For an example in which the contracts may resemble either equity or intermediary credit lines, see Bernanke and Gertler (1987).

Conversely, the decline in borrower net worth during recessions raises agency costs of obtaining finance, further depressing investment.[37, 38]

A second prediction is that investment fluctuations may exhibit asymmetries. Investment downswings in recessions may be sharper than upswings during booms. In booms, it is more likely the incentive constraints are relaxed; if this is so, further increases in borrower net worth may have a minimal impact on investment. In downturns, it is much more probable that the constraints bind; alternatively, it is more likely that they bind over a wider cross-section of firms. Thus, in recessions, investment may be more sensitive to movements in borrower net worth.

What are the testable implications of this model? Unfortunately, it is difficult to discriminate between competing theories with a pure time-series analysis. Most macroeconomic theories predict a "procyclical" relationship between investment and output (though some purely neoclassical frameworks have difficulty explaining the magnitude of investment fluctuations). However, the model presented here has implications for cross-sectional differences in investment behavior. In contrast to the frictionless neoclassical model, the framework here predicts that, ceteris *paribus,* investment will vary across firms positively with differences in firms' internal net worth. Furthermore, this variation is likely to be more pronounced in recessions than in booms.

A related prediction, one consistent with evidence presented earlier, is that financing patterns should vary across firms, depending on their

37 Calomiris and Hubbard (1987) discuss how this kind of setting may induce precautionary saving by firms. Gertler (1988) also discusses how entrepreneurs will have the incentive to adjust production to insure against fluctuations in their net worth, resulting in production being more volatile than otherwise. The relevance of these channels for economic fluctuations is documented in Eckstein and Sinai (1986).

38 In the context of the model we presented, effects of investment tax credits or changes in tax depreciation rules on the cost of capital will depend on internal net worth as well. In the symmetric information case, the introduction of an investment tax credit would pivot the (OC) curve to the right, increasing K*. However, for values of internal net worth for which incentive problems arise, the (IC) curve will also pivot to the right, raising actual investment K. In general, the net worth effects of tax policies—and not just their effects on the cost of capital—will be important. *Average* tax burdens—and not just effects of taxation on marginal incentives—will be important for investment decisions in some firms. See Fazzari, Hubbard, and Petersen (1988b).

respective net worth positions. In particular, internal financing should be relatively more predominant among firms with low net worth relative to their desired investment levels. Relatedly, bank loans—which involve monitoring and close customer relationships to address the incentive problems—should be the principal form of external finance for this class of firms.

Empirical evidence on financial factors and real outcomes

Evidence for *manufacturing* firms

In the previous section, we outlined testable implications of the "financial factors" approach for cross-section, time-series data. These implications involve: (i) variation across firms in financing patterns, (ii) a link between investment and internal net worth (holding constant measures of investment opportunities), and (iii) an asymmetry in the effect of changes in internal net worth on investment.

To test these propositions, we use data on 421 manufacturing firms over the period from 1970 to 1984 constructed from Value Line sources by FHP (1988a). We follow FHP in using long-run retention behavior as a proxy for perceived differences in the cost of internal and external funds. Such a criterion is intuitive. If the cost disadvantage of external finance is small, then retention behavior should be irrelevant to real investment decisions. On the other hand, firms that finance most of their investment from retained earnings may do so because they face high costs of obtaining external finance at the margin for the kinds of reasons discussed in the previous section. Fluctuation in internal net worth should affect investment spending for these types of firms. Insiders' net worth is, of course, unobservable in the data; we follow FHP, and use firm cash *flow* as a proxy.

To implement the classification by retention behavior, we group firms into three categories—"high retention," "medium retention," and "low retention." "High retention" firms have a ratio of dividends to net income of less than 0.1 for at least 10 years. "Medium retention" firms have a dividend-income ratio less than 0.2 (but greater than 0.1) for at least 10 years. The remaining firms comprise the "low retention" category. This is the classification suggested by FHP.

Table 5
U.S. Manufacturing Firms Grouped by Retention Patterns, 1970-84 Summary Statistics

	Category of Firm		
Statistic	High Retention	Medium Retention	Low Retention
Number of firms	49	39	334
Average retention ratio	0.94	0.87	0.58
Average real sales growth (percent per year).	13.7	8.7	4.6
Average of firm standard deviations of investment-capital ratios	0.17	0.09	0.06
Average of firm standard deviations of cash flow-capital ratios	0.20	0.09	0.06
Average of firm standard deviations of annual growth rate of real sales (percent per year)	26.0	19.1	14.0
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

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

We present summary statistics for the firms in each class in Table 5.[39] Firm size is negatively correlated with retention of earnings, corroborating the general pattern for the manufacturing sector illustrated in Table 1. By construction, the high-retention firms are closest to the margin of requiring external funds to finance investment opportunities. The evidence in Table 5 suggests that these firms had more

[39] Further discussion of the classification system is given in FHP (1988a).

variable internal net worth and investment than other firms in the sample. The standard deviations of the cash flow-capital ratio and investment-capital ratio are greatest for the high-retention group. In addition, sales variability—measured by the standard deviation of the growth rate of real sales over the period—is substantially higher for the high-retention firms than for the low-retention firms.[40] While a technological choice model might be able to explain heterogeneity in the variability of sales growth,[41] it would not explain the coincidence of sales and investment variability across retention classes. In Table *6*, we report standard deviations of sales growth by retention class for five (two-digit-S.I.C.) industry groups in which high-retention firms are most important. There are, of course, differences across industry groups in sales growth variability. In all cases, however, the standard deviation of the growth rate of real sales is roughly twice as large for the smaller, high-retention firms than for the larger, low-retention firms.

We next test directly for the sensitivity of firms' investment spending to movements in internal net worth. We work within the Tobin's q framework, since q—the ratio of the market value of the firm to the replacement value of its capital stock—will capture the ***market's assessment*** of the firm's ***investment opportunities.***[42] If financial factors are unimportant, internal and external funds will be perfect

40 This pattern holds up within individual two-digit-S.I.C. categories.

41 One explanation is that firms of different sizes could coexist in equilibrium in an industry subject to random demand. Mills and Schumann (1985) note that some firms could assume greater fixed costs taking advantage of scale economies, while other firms could rely more on variable factors (e.g., labor), trading off static efficiency for "flexibility." Using data on manufacturing firms from COMPUSTAT, Mills and Schumann find that sales and employment variability are negatively related to firm size and market share within an industry. The assertion that high fixed costs are incurred to take advantage of scale economies is probably questionable, since minimum efficient scales in U. S. manufacturing are, in general, small. See the discussion in Domowitz, Hubbard, and Petersen, (1988).

To pursue these ideas further, we regressed the firm standard deviations of real sales growth on (the log of) the beginning-of-sample-period capital stock (as a measure of size) and two-digit-S.I.C. industry dummies (as proxies for industry-specific sales variability). We found that firm size is negatively related to sales variability. When we allow for different intercepts by retention class, pure size effect virtually disappeared. Such results are again suggestive of the role played by financial considerations for smaller firms.

42 Variable definitions and construction are described in FHP (1988a, Appendix B).

Table 6
Sales Variability Across Retention Classes Within Industries

Industry Group	Standard Deviation of Real Sales Growth (Percent per Year) All Firms	High Retention	Medium Retention	Low Retention
20: Food and Kindred Products	15.1	28.5	27.6	11.2
28: Chemicals and Allied Products	13.1	21.3	17.5	11.7
35: Machinery, Except Electric Machinery	21.2	26.6	17.8	17.0
37: Transportation Equipment	19.1	38.2	16.4	15.5
38: Instruments and Related Products	16.4	23.8	12.1	11.3

Source: Authors' calculations based on samples of firms drawn from the Value Line data base.

substitutes, and q will be a sufficient statistic summarizing investment opportunities; contemporaneously dated information about internal net worth (here firm cash flow) should be irrelevant.[43] Specifically, we estimate for each retention class a model of the form.[44]

$$(11)\quad I_{it}/K_{i,t-1} = a_i + bQ_{i,t-1} + (c + d\ \text{RECESSION}_t) \times (CF/K)_{i,t-1} + u_{it},$$

where i and t represent the firm and time period, respectively.

43 This is strictly true under assumptions of perfect competition (equality of price and marginal cost) and constant returns to scale. In general, output measures may matter. FHP (1988a) explore this issue further. What we stress here are differences across retention classes in the effect of internal finance on investment.

44 For a derivation based on adjustment costs of investment, see Summers (1981), Hayashi (1982), and FHP (1988a).

All variables are measured at the end of the period. I and K denote investment and the replacement value of the capital stock; Q represents the value of Tobin's q (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 personal and corporate tax considerations. CF denotes cash flow (after-tax earning plus depreciation). RECESSION is a dummy variable equal to unity in 1974, 1975, 1981, and 1982, and equal to zero otherwise; it is included to test whether the effect of internal net worth on investment varies over the cycle; u is an error term. The equations were estimated over the 1970-1984 period with fixed firm and time effects. Results are reported in Table 7.

Table 7
Effects of Q and Cash Flow on Investment, 1970-1984

	Category of Firm		
Variable	High Retention	Medium Retention	Low Retention
$Q_{i,t-1}$	0.0005	0.004	0.002
	(0.0004)	(0.0009)	(0.0003)
$(CF/K)_{i,t-1}$	0.506	0.339	0.246
	(0.034)	(0.038)	(0.011)
RECESSION	0.197	0.099	−0.026
	(0.054)	(0.050)	(0.012)
$\overline{R}^2$	0.37	0.30	0.20

Note: The dependent variable is the investment-capital ratio $(I/K)_{it}$ for the ith firm at time t, where I is investment in plant and equipment and K is the beginning-of-period capital stock. Independent variables are defined as follows: Q is 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; CF/K is the cash flow-capital ratio. RECESSION is a dummy variable equal to unity in 1974, 1975, 1981, and 1982, and equal to zero otherwise. The equations were estimated using fixed firm and year effects (not reported). Standard errors appear in parentheses.

Two features of the results in Table 7 are of particular interest. First, there are important economically and statistically significant differences across retention classes in the effects of the previous period's cash flow on investment.[45] Greater retention is associated with a closer link between internal finance and investment, suggesting that internal and external finance are imperfect substitutes for high-retention firms. That such firms are, on average, small and rapidly growing (relative to other firms in the sample) is consistent with the predictions of models of asymmetric information stressing the importance of firms' internal net worth (balance sheet position). Second, the asymmetric effect of internal net worth on investment predicted by the model is present. Cash flow effects for high-retention firms and medium-retention firms are substantially stronger in economy-wide recession years. The same is *not* true for the large, mature low-retention firms.

Large firms, of course, account for a greater fraction of firms in the Value Line sample than they do in the economy. Again, we note that manufacturing firms of the same size or smaller than the firms in the high-retention and medium-retention classes account for an important fraction of aggregate sales and assets. From Table 3, manufacturing corporations with less than $100 million in assets account for about 15 percent of total assets and 25 percent of total sales in the manufacturing sector.,

Concluding discussion

Recent research by macroeconomists has stressed the development of business cycle frameworks in which financial structure is irrelevant. It seems doubtful, however, that such models can explain the

45 Similar evidence has been obtained for Japanese manufacturing firms by Hoshi, Kashyap, and Scharfstein (1988). They find that membership in a *keiretsu* group and the presence of a group bank are important in the provision of information and the avoidance of credit rationing when investment opportunities are promising. Indeed, Hoshi, Kashyap, and Scharfstein use panel data on Japanese firms to show that investment is sensitive to fluctuations in internal finance—after adjusting for investment opportunities measured by q—only for firms not in keiretsu groupings. The investment behavior of firms in the groups with access to a group "main bank" is well described by standard perfect-capital-market investment models.

magnitude of or heterogeneity in investment fluctuations without appealing to large exogenous disturbances. The approach taken here is to emphasize the role of financial factors in amplifying investment swings, the motive being to lessen the need to rely on external driving forces to explain economic fluctuations. While the issue is far from resolved, we believe there is sufficient evidence to date to continue trying to model and measure the role of "financial factors" in the business cycle.

We finish by addressing some issues pertinent to our analysis.

Implications of the stock market crash.

Most economists agree that the October 1987 crash appears to have had a minimal impact on real activity. After a temporary period of decline, initial public offerings of equity are back to their normal levels. Further, it is difficult to identify any obvious effects of the crash on the behavior of aggregate variables. How does this square with the analysis here?

The story we presented emphasized that the critical determinant of a firm's borrowing capacity is its internal net worth, the value of the stake of inside owners/managers. In this regard, it is important to recall that stock prices rose dramatically in the nine months prior to the crash; the effect of the crash was largely to wipe out these gains and return the market to trend. Even if one believes that movements in stock prices are closely connected to movements in internal net worth (we do not), it is still probably the case that the annual change in internal net worth was not exceptionally large (i.e., the change from January 1987 to January 1988). It is unlikely that high frequency variation (e.g., weekly variation) in net worth has much impact on investment because of adjustment costs. Seen in this light, it is not surprising that the stock market volatility had little impact.

It is probably also true that short-run variation in stock prices does not mirror movements in firms' internal net worth. First, a sizable fraction of a publicly traded firm's equity is typically held by outside parties who have no more information than any other claimants about the inner workings of the firm; it is not appropriate to include their holdings in the measure of internal net worth. What ultimately matters for our purposes is the value of the collateral (broadly defined) that creditors perceive the firm has to offer. This value may be unrelated to high-frequency variation in stock prices, and particularly so if this variation is not tightly connected to changes in fundamentals.

Also, before drawing any parallels with earlier times, it is important to recognize that the stock market crash in 1929 was not the most economically significant "financial" event of the Depression. Rather, as Bernanke (1983) emphasizes, the banking collapse and the debt crisis (induced by the massive deflation) had far more substantial effects on the severity of the downturn. Similar events, of course, did not arise in the aftermath of the 1987 crash. This was at least in part due to the commitment of the Federal Reserve to preserve the smooth functioning of the financial system—monetary policy was expansionary in response to the crash—in conjunction with institutional safeguards such as deposit insurance.

Fluctuations in employment demand and in spending on consumer durables

To the extent that labor is a quasi-fixed factor (as in Farmer, 1985) or there is a lag between labor input and production (as in Greenwald and Stiglitz, 1986), then the theory of investment demand presented here extends naturally to a theory of employment demand. In either of these cases, firms may need to borrow to finance labor input. It follows that procyclical movements in internal net worth can lead to accelerator effects on employment demand in the same way they may for investment demand. Indeed, using English data, Nickell and Wadhwani (1987) find negative effects of leverage and debt service on employment, holding constant real variables.

One could also envision developing a theory linking (household) net worth to durable goods demand. Suppose that consumers need to self-insure against adverse movements in their respective labor incomes due to the absence of perfect insurance markets. The need to hold precautionary balances may make their spending on large durables highly sensitive to their existing asset positions. Indeed, there is evidence linking household spending on durables to balance sheet variables.[46] Thus, financial factors could have a role in the volatil-

[46] See, e.g., Mishkin (1978).

ity of spending on consumer durables, as well as of spending on producer durables.

Agency costs of "free cash flows"

The analysis presented here may appear in conflict with the "free cash flow" theory of investment, invoked recently to explain the current wave of corporate restructuring as a product of excessive investment.[47] We stress, however, that the two approaches are not in conflict. Indeed, in the model we developed, outside lenders cannot determine directly whether borrowers are efficiently allocating investment funds, which is precisely the problem upon which the free cash flow theory builds. Underinvestment can occur in the approach we characterize here because the outside lenders take into account borrowers' incentives ***before*** supplying funds. The free cash flow story typically begins at a later stage, ***after*** lenders have already provided funds to the firm.

Further, the conclusion of the free cash flow theory that management should pay out ***outsiders'*** cash is perfectly consistent with our analysis. This is true because the theory we presented emphasizes the role of ***internal net worth*** in investment, and not cash flow, ***per se.*** The confusion arises (we think) because empirical researchers must rely on variables such as firm cash flow as proxies for movements of insiders' net worth.

'Junk bonds' and increased leverage

The recent growth of markets for non-investment-grade bonds ("junk bonds") has extended to smaller corporations the ability to issue marketable securities.[48] However, available evidence suggests that the terms under which these securities are issued are closely connected to the financial position of the firm, in a way consistent with

[47] See, e.g., Jensen (1986).

[48] Such bonds have existed previously (e.g., in the 1930s), but their popularity has resurged in the past decade. See the discussion in Loeys (1986).

the theory presented here—indeed, the security in our theoretical model is easily interpretable as a junk bond. Coupon rates on these bonds are typically quite high relative to Treasury bonds of similar maturity, reflecting a perceived default risk.[49] Further, studies indicate that measures of *(inter alia)* internal net worth and liquidity predict this default risk well, and thus predict well the spread between junk bond coupon rate and the riskless rate.[50] Given that the agency costs of investing are positively related to this spread (as our theoretical model predicts), then the link between internal net worth and real investment decisions clearly remains for firms issuing junk bonds.

What about the more general issue of the increased use of leverage in the corporate sector? In the theory presented here, the important distinction is how the value of the firm is divided between *insiders* and *outsiders,* given that the insiders' net worth governs the agency costs of investing. Less important is how the liabilities issued to outsiders are divided between equity and debt, the point being that there are likely to be agency costs associated with issuing equity, as well as with issuing debt. Thus, in our view, increased leverage is significant for macroeconomic stability only if it is associated with declining internal net worth, and/or only to the extent it makes insiders vulnerable to the risk of a sudden wealth redistribution, as occurred in the debt-deflation of the 1930s.[51]

49 Loeys (1986, p. 6) notes that the risk premium of non-investment-grade bonds over Treasury issues averaged 300-600 basis points over the 1981-1986 period. Over the period from 1970 to 1984, the default rate of non-investment-grade bonds averaged 2.1 percent per year, relative to roughly zero for investment-grade securities. See Altman and Nammacher (1986), Table 10.

50 See Altman (1987).

51 See also the discussion in Bernanke and Campbell (1988).

References

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

Akerlof, George A., "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism," ***Quarterly Journal of Economics*** **84,** August **1970,** pp. **488-500.**

Altman, Edward I., "The Anatomy of the High-Yield Bond Market," ***Financial Analysts Journal,*** July-August **1987,** pp. **12-25.**

Altman, Edward I. and Scott A. Nammacher, "The Anatomy of the High Yield Debt Market: **1985** Update," New York: Morgan Stanley, June **1986.**

Berle, Adolph and Gardiner Means, ***The Modem Corporation and Private Property,*** New York: Macmillan, **1932.**

Bernanke, Ben, "Non-Monetary Effects of the Financial Crisis in the Propagation of the Great Depression," ***American Economic Review*** **73,** June **1983,** pp. **257-276.**

Bernanke, Ben and John Y. Campbell, "Is There a Corporate Debt Crisis?", ***Brookings Papers on Economic Activity,*** 1988:1, pp. 83-125.

Bernanke, Ben and Mark Gertler, "Agency Costs, Collateral, and Business Fluctuations," ***American Economic Review,*** forthcoming, **1989.**

Bernanke, Ben and Mark Gertler, "Financial Fragility and Economic Performance," Working Paper No. **2318,** National Bureau of Economic Research, July **1987.**

Blinder, Alan and Joseph E. Stiglitz, "Money, Credit Constraints, and Economic Activity," ***American Economic Review*** **73,** May **1983,** pp. 297-302.

Brock, William and David Evans, "The Role of Small Business in Macroeconomics and Finance," University of Wisconsin, mimeo., **1988.**

Butters, J. Keith and John V. Lintner, ***Effect of Federal Tares on Growing Enterprises,*** Boston: Division of Research, Graduate School of Business Administration, Harvard University, **1945.**

Calomiris, Charles W. and R. Glenn Hubbard, "Firm Heterogeneity, Internal Finance, and Credit Rationing," ***Quarterly Journal of Ecoomics,*** forthcoming.

Calomiris, Charles W. and R. Glenn Hubbard, "Price Flexibility, Credit Availability, and Economic Fluctuations: Evidence from the United States, 1879-1914," Northwestern University, mimeo., **1987.**

Calomiris, Charles W., R. Glenn Hubbard and James H. Stock, "The Farm Debt Crisis and Public Policy," ***Brookings Papers on Economic Activity,*** 1986:2, pp. 441-479.

Chandler, Lester, ***American Monetary Policy, 1928-1941,*** New York: Harper and Row, **1971.**

Christiano, Lawrence and Martin Eichenbaum, "Notes on Endogenous Growth and Aggregate Fluctuations," Federal Reserve Bank of Minneapolis, mimeo., **1988.**

Churchill, Betty C., "Age and Life Expectancy of Business Firms," ***Survey of Current Business.*** December **1955,** pp. **15-20.**

Cutler, David M. and Lawrence H. Summers, "The Costs of Conflict Resolution and Financial Distress: Evidence from the Texaco-Pennzoil Litigation," ***Rand Journal of Economics*** **19,** Summer **1988,** pp. 157-172.

Domowitz, Ian, R. Glenn Hubbard and Bruce C. Petersen, "Market Structure and Cyclical Fluctuations in U.S. Manufacturing," ***Review of Economics and Statistics*** **70,** February **1988,** pp. **55-66.**

Easterbrook, Frank H., "Two Agency-Cost Explanations of Dividends," ***American Economic Review*** **74,** June **1984,** pp. 650-659.

Eckstein, Otto and Allen Sinai, "The Mechanisms of the Business Cycle in the Postwar Era," in ***The American Business Cycle: Continuity and Change,*** Robert J. Gordon, ed., Chicago: University of Chicago Press, **1986.**

Eisner, Robert, ***Factors in Business Investment,*** Cambridge: Ballinger Press, **1978.**

Evans, David S., "The Relationships Between Firm Growth, Size, and Age," ***Journal of Industrial Economics*** **35,** June **1987,** pp. **567-587.**

Fabricant, Solomon, ***Profits, Losses, and Business Assets, 1929-1934,*** Bulletin **55,** National Bureau of Economic Research, **1935.**

Farmer, Roger E.A., "A New Theory of Aggregate Supply," ***American Economic Review*** **74,** December **1984,** pp. **920-930.**

Farmer, Roger E.A., "Implicit Contracts with Asymmetric Information and Bankruptcy: The Effect of Interest Rates on Layoffs," ***Review of Economic Studies*** 52, 1985, pp. 427-442.
Fazzari, Steven M., R. Glenn Hubbard and Bruce C. Petersen, "Financing Constraints and Corporate Investment," ***Brookings Papers on Economic Activity,*** 1988a:1, pp. 141-195.
Fazzari, Steven M., R. Glenn Hubbard and Bruce C. Petersen, "Investment, Financing Decisions, and Tax Policy," ***American Economic Review*** 78, May 1988, pp. 200-205.
Fisher, Irving, "The Debt-Deflation Theory of Great Depressions," ***Econometrica*** 1, October 1933, pp. 337-357.
Fisher, Irving, ***The Purchasing Power of Money,*** New York: Macmillan, 1911.
Friedman, Benjamin M., "Debt and Economic Activity in the United States," in ***The Changing Roles of Debt and Equity in Financing U.S. Capital Formation,*** Benjamin M. Friedman, ed., Chicago: University of Chicago Press, 1982.
Friedman, Benjamin M., "The Roles of Money and Credit in Macroeconomic Analysis," in ***Macroeconomics, Prices and Quantities: Essays in Memory of Arthur M. Okun,*** James Tobin, ed., Washington, D.C.: Brookings Institution, 1983.
Friedman, Milton and Anna J. Schwartz, ***A Monetary History of the United States, 1870-1960,*** Princeton: Princeton University Press, 1963.
Gertler, Mark, "Financial Capacity, Reliquification, and Production in an Economy with Long-Term Financial Arrangements," University of Wisconsin, mimeo., 1988.
Gertler, Mark, "Financial Structure and Aggregate Economic Activity," ***Journal of Money, Credit. and Banking,*** 20 (3) Part II, August 1988, pp. 559-588.
Gertler, Mark and Kenneth Rogoff, "International Capital Flows and the 'Siphoning Effect,"' University of Wisconsin, mimeo., 1988.
Greenwald, Bruce and Joseph E. Stiglitz, "Information, Finance Constraints, and Business in ***Expectations and Macroeconomics,*** Meir Kahn and S.C. Tsiang, eds., Oxford: Oxford University Press, 1988.
Greenwald, Bruce, Joseph E. Stiglitz and Andrew Weiss, "Information Imperfections in the Capital Market and Macroeconomic Fluctuations," ***American Economic Review*** 74, May 1984, pp. 194-199.
Gurley, John and Edward S. Shaw, "Financial Aspects of Economic Development," ***American Economic Review*** 45, September 1955, pp. 515-538.
Gurley, John G. and Edward S. Shaw, ***Money in a Theory of Finance.*** Washington, D.C.: Brookings Institution, 1960.
Hall, Robert E., "Market Structure and Macro Fluctuations," ***Brookings Papers on Economic Activity.*** 1986:2, pp. 285-377.
Hall, Robert E., "A Noncompetitive, Equilibrium Model of Fluctuations," Working Paper No. 2576, National Bureau of Economic Research, May 1988.
Hart, Albert Gaylord, ***Debts and Recovery, 1929-1937,*** New York: Twentieth Century Fund, 1938.
Hayashi, Fumio, "Tobin's Marginal q and Average q: A Neoclassical Interpretation," ***Econometrica*** 50, January 1982, pp. 213-224.
Hubbard, R. Glenn and Kenneth L. Judd, "Liquidity Constraints, Fiscal Policy, and Consumption," ***Brookings Papers on Economic Activity,*** 1986:1, pp. 1-50.
Hymer, Stephen and Peter Pashigian, "Firm Size and Rate of Growth," ***Journal of Political Economy*** 70, December 1962, pp. 556-569.
Jensen, Michael C., "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers," ***American Economic Review*** 76, May 1986, pp. 323-329.
Jovanovic, Boyan, "Selection and the Evolution of Industry," ***Econometrica*** 50, May 1982, pp. 649-670.
Keeton, William, ***Equilibrium Credit Rationing,*** New York: Garland Press, 1979.
Kimmel, Lewis H., ***The Availability of Bank Credit, 1933-38,*** New York: National Industrial Conference Board, 1939.
Kindleberger, Charles, ***Manias, Panics, and Crashes,*** New York: Basic Books, 1978.
Klebaner, Benjamin, ***Commerical Banking in the U.S.: A History,*** Hinsdale: Dryden Press, 1974.
Kydland, Finn and Edward Prescott, "Time to Build and Aggregate Fluctuations," ***Econometrica*** 50, November 1982, pp. 1345-1370.

Loeys, Jan, "Low Grade Bonds: A Growing Source of Corporate Funding," ***Federal Reserve Bank of Philadelphia Business Review,*** November-December 1986, pp. 3-12.
Merwin, Charles L., ***Financing Small Corporations,*** New York: National Bureau of Economic Research, 1943.
Meyer, John R. and Edwin Kuh, ***The Investment Decision,*** Cambridge: Harvard University Press, 1957.
Mills, David E. and Laurence Schumann, "Industry Structure with Fluctuating Demand," ***American Economic Review*** 75, September 1985, pp. 758-767.
Minsky, Hyman P., "Financial Crisis, Financial Systems, and the Performance of the Economy," in Commission on Money and Credit, ***Private Capital Markets,*** Englewood Cliffs, New Jersey: Prentice-Hall, 1964.
Minsky, Hyman P., ***John Maynard Keynes,*** New York: Columbia University Press, 1975.
Mishkin, Frederic S., "The Household Balance Sheet and the Great Depression," ***Journal of Economic History*** 38, December 1978, pp. 918-937.
Myers, Stewart C. and Nicholas S. Majluf, "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have," ***Journal of Financial Economics*** 13, June 1984, pp. 187-221.
Nelson, Susan C., "Noncorporate Business Taxation: Before and After the Tax Reform Act of 1986," U.S. Department of Treasury, Office of Tax Analysis Working Paper 59, May 1988.
Nickell, S. and S. Wadhwani, "Financial Factors, Efficiency Wages, and Employment: Investigations Using U.K. Micro Data," London School of Economics, Centre for Labor Economics, Discussion Paper No. 295, November 1987.
Popkin, Joel, "Measuring Gross Product Originating in Small Business: Methodology, and Annual Estimates, 1955 to 1976," Final Report, Contract No.: SBA 2624-OA-79, submitted to Small Business Administration, September 1980.
Prescott, Edward, "Theory Ahead of Business Cycle Measurement," ***Federal Reserve Bank of Minneapolis Quarterly Review,*** Fall 1986.
Roosa, Robert V., "Interest Rates and the Central Bank," in ***Money, Trade, and Economic Growth,*** New York: Macmillan, 1951.
Reiss, Peter C., "The Effect of Credit and Finance on Oil and Gas Exploration," National Bureau of Economic Research, mimeo., 1988.
Schankerman, Mark, "Micro and Aggregate Shocks to Investment Decisions," London School of Economics, mimeo., May 1988.
Scheinkman, Jose and Laurence Weiss, "Borrowing Constraints and Aggregate Economic Activity," ***Econometrica*** 54, January 1986, pp. 23-46.
Shapiro, Eli and Charles Wolf, ***The Role of Private Placements in Corporate Finance,*** Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1972.
Sprague, O.M.W., ***History of Crises Under the National Banking System,*** National Monetary Commission, U.S. Senate Document No. 538, 61st Congress, 2nd session, 1910.
Stiglitz, Joseph E. and Andrew Weiss, "Credit Rationing in Markets with Imperfect Information," ***American Economic Review*** 71, June 1981, pp. 393-410.
Stoddard, W.L., "Small Business Wants Capital," ***Harvard Business Review*** 18, Spring 1940, pp. 18-24.
Summers, Lawrence H., "Taxation and Corporate Investment: A q-Theory Approach," ***Brookings Papers on Economic Activity.*** 1981:1, pp. 67-127.
Summers, Lawrence, "Some Skeptical Observations on Real Business Cycle Theory," ***Federal Reserve Bank of Minneapolis Quarrerly Review,*** Fall 1986, pp. 23-27.
Tobin, James, "Keynesian Models of Recession and Depression," ***American Economic Review*** 75, May 1975, pp. 195-202.
Townsend, Robert, "Information Constrained Insurance: The Revelation Principle Extended," ***Journal of Monetary Economics*** 21, March-May 1988, pp. 411-450.
U.S. Small Business Administration, The ***State of Small Business: A Report of the President. 1988.***
Williamson, Stephen D., "Financial Intermediation, Business Failures, and Real Business Cycles," ***Journal of Political Economy*** 95, December 1987, pp. 1196-1216.
Wojnilower, Albert M., "The Central Role of Credit Crunches in Recent Financial History," ***Brookings Papers on Economic Activity,*** 1980:2, pp. 277-326.