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The adverse effect of debt on investment

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City University of New York, 1990

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THE ADVERSE EFFECT OF DEBT ON INVESTMENT

by

Peter S. Gomori

A dissertation submitted to the Graduate Faculty in Economics in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

1990

This manuscript has been read and accepted for the Graduate Faculty in Economics in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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Chapter One

Introduction

Recent events in the financial markets such as the stock market crash in October of 1987, the widespread bankruptcies of the Savings and Loan industry and the current near collapse of the 'junk bond' market have raised concern as to what effects these markets have on other sectors in the economy.

A question that has seen a growth of interest has been to what degree the performance of financial markets might impact the real investment decisions of firms. In testimony before Congress, Minsky (1982, p. 49-55) using published data from the Federal Reserve's Flow of Funds Accounts for nonfinancial corporations, made the following observations based on the following ratios:

- fixed investment/internal funds from 1951 to 1967 fluctuated mildly (around 1.0) and becomes more volatile from 1967 to 1980 reaching a high of 1.5 in 1974 and dramatically dropping to just under 1.0 in 1976,
- total liabilities/internal funds fluctuated mildly from 6.2 to 7.2 from 1950 to 1967 and dramatically rising to 9.2 in 1970 and then to 10.75 in 1974, then falling to 7.2 in 1977,

- total liabilities/demand deposits have shown an overall upward secular trend which was more pronounced after 1965: for example, the ratio was approximately 5 in 1950, under 10 in 1965 and just under 20 in 1980.

Based on these observations, he then argued that the recent post WWII period in the United States from 1945 to 1965 was historically unique as it was a relatively mild epoch. In more recent times financial markets have inherent tendencies towards instability, and that the shift from relative tranquility to more volatility reflects fundamental changes in the way business, government and households finance their respective economic activities.

Again as compared to the period of 1945 to 1965 referring to more recent Flow of Funds data, Wolfson (1986, ch. 11) observes that from 1965 to 1985:

- the average debt-equity ratio rises (from below .60 to above .80),
- the average debt-maturity ratio rises (from below .30 to over .50). (The debt-maturity ratio takes as a ratio short-term loans and commercial paper to total liabilities.)
- liquidity ratio (cash to total assets) falls (from .40 to .25).

Based on this data Wolfson then remarks that while firms were becoming more dependent on outside sources for financing real investment, they were at the same time experiencing reductions in liquidity.

On the other hand Taggert (1986), while reinforcing the notion that the 1945-1965 period was historically a very stable period, has different observations based on the financial data. He argues that sources of financial data tend to have the following biases stemming from the reliance on reported accounting data:

- easing of depreciation calculations increase corporate cash flow while reducing reported profits and retained earnings,
- inflation tends to distort the information (i.e., debt can end up being overstated while asset values are understated),
- as a trend the real value of debt has been declining,
- lease obligations and pension obligations, until recently were not being reported.

If adjustments are made for inflation in order to measure real indebtedness, proportions of debt are not historically high. The growth of the debt-equity ratio seems more of a substitution by corporations of short-term debt supplied by the commercial banks and the commercial paper market for equity without any dramatic increase in long-term debt.

With respect to the three sources of funding (internal, debt and equity) indebtedness has grown when internal funds have declined with internal funds showing no observable trend. What does seem undeniable is the increased exposure to interest rate risk from more reliance on short-term debt and corporations facing a more volatile environment in the upcoming years.

Focusing on the 1980's, Ben Friedman (1986) also verifies this pattern of accelerated borrowing.

Prior to 1980, the debt-income relationship was fairly stable and then after 1980 it jumps. For example, summing up all nonfinancial sectors, the ratio of debt to income in 1980 was 137.7% of GNP (which was the approximate average throughout the 1953-1980 period). This figure jumps to 169.2% in 1985 (B. Friedman, op. cit. p. 32).

With respect to the rise of indebtedness of firms Friedman asks the following questions: "Has this increase eroded the ability of the U.S. economy to withstand economic shocks?" and "Can a disruption in the orderly payment flows stem from a purely financial cause?"

The study of indebtedness as a financial constraint touches on several areas of inquiry in economics. A partial list would include: business cycle theory, the economics of growth, monetary theory, short-term macrodynamics and financial economics.

An initial review of the literature can lead to the notion of a dichotomy of views.

On the one hand, the neo-classical school in studying real investment decisions by the firm found great success in applying the Modigliani-Miller theorem where real investment decisions could be analyzed separately from financial structure.

On the other hand, observations of real economic downturns associated with financial crises have encouraged a sophisticated revival of models in the Keynesian tradition.

Advances in the economics of information and agency theory have allowed for a better specification of the motivation of both borrowers and lenders. These advances coupled with greater ability in the gathering of statistical information have allowed for a possible theoretical reconciliation.

This recent literature tries to explain 'credit crunches' where banks ration credit rather than raise the interest rate represents not a rejection of the neo-classical approach but a challenge to the full information assumption and calls on the recent work in agency theory.

This study seeks to examine empirically the influence financial variables such as indebtedness have on real investment decisions of firms and to survey recent macroeconomic models that have been developed to portray the affect of debt on real investment.

Chapter 2

Review of the Literature

The predominant approach to analyzing the real investment process is the 'neo-classical theory of capital accumulation' associated with the work of Jorgensen (1963). Underlying the analysis are the standard assumptions of perfect competition, profit maximization and a Cobb-Douglass production function. In this approach, the addition to a firm's capital stock occurs in order to achieve an optimal relationship between the value of the marginal product of capital with its associated 'rental price' which reflects the associated costs of acquiring the services of additional capital goods. Another crucial feature is the exclusion of the firm's financial structure which is the result of the work of F. Modigliani and M. Miller (1958).

Briefly stated, the Modigliani-Miller approach argued that if capital markets are perfectly competitive in a world with no taxes, the firm's total investment value depends on the profitability and risk associated with its choice of projects not its choice of debt or equity for financing the investment.

This approach would also be reinforced by E. Fama's (1970) influential work commonly referred to as 'efficient markets' theory which argued that U.S. capital markets are the closest real world approximations of the perfect competitive model in economic theory.

An alternative view associated with the work of J.M. Keynes (1936) would essentially take issue with the assumption of a perfectly competitive capitalist system characterized by the flexible pricing of all economic variables.

Our purposes here do not allow for a survey of the enormous literature that evolved since Keynes' publication of the General Theory of Employment, Interest and Money, but to note some select highlights of the ensuing tradition.

Some key points that seem relevant here are:

- a need for analyzing the 'short' time period where not all prices are at their respective equilibrium points,
- an expansion of the role of money for other than transactions purposes,
- greater emphasis on the macroeconomic role that financial markets play in advanced capitalist nations and their respective influence is a partial explanation as to why advanced macroeconomics find equilibrium positions at less than full employment.[1]

This tradition would argue for an analysis acknowledging an interdependency between financial and real variables where observed financial resource allocation could not be viewed as

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simply reflecting real resource allocations. This approach could be represented by J. Gurley and E. Shaw (1955), H. Minsky (1975) and J. Tobin (1980).[2]

Here greater emphasis was placed on the role financial intermediaries play in facilitating exchange and financial factors such as the level of indebtedness and continued access to credit serve as a constraint for both households and firms in making decisions for consumption and investment.

The latter tradition would not have as strong an impact as the former for two reasons:

- the success of M. Friedman and A. Schwartz (1963) and later C. Sims (1970) in showing historical correlations between real output and a narrow definition of money (where money was viewed only as a means of exchange) and
- the strong influence of the Arrow-Debreu general equilibrium framework that would cause macro economic models to be viewed as incomplete unless specific microeconomic assumptions were made explicit (i.e., rational, optimizing behavior of individual economic agents in the context of market clearing) (Gertler, 1987).

While this tradition has often been viewed in contrast to the neo-classical tradition recent research (most notably at Princeton University) has incorporated elements of both schools of thought. Working along the lines of G. Akerloff's

(1970) 'lemons' theory, Rothschild and Stiglitz (1976) argued that insurance markets might not be able to achieve equilibrium or if they do the equilibrium would not have the conventional properties associated with competitive markets. The reason being that asymmetric information creates a 'moral hazard' situation where 'high risk' individuals have incentive not to fully reveal information which adversely affects 'low risk' individuals.

D. Jaffee and T. Russell (1976) and later Stiglitz and Weiss (1981) show that because of asymmetric information, financial intermediaries such as commercial banks become motivated to ration credit as it is difficult to select 'good' borrowers from 'bad' borrowers. Rather than raise the interest rate, the appropriate market response in order to maximize returns is to limit the credit available to applicants.

Greenwald, Stiglitz and Weiss (1981) extend this concept to show how firms can be rationed in the capital markets. The reason being that if firms forego borrowing in the credit markets then the sale of equity might be viewed as a negative signal. Potential investors might regard the firm as being of lesser quality with greater possibility of bankruptcy which is why they chose not to seek financing in the credit markets. The result is that firms cannot simply substitute equity for debt without facing a higher cost of capital.

Along similar lines, Myers and Majluf (1984) incorporate agency theory with asymmetric information. Agency theory, associated with the work of Jensen and Meckling (1976), is the study of the contractual relationship between parties with decision making delegated to one agent and where there are associated costs such as transactions costs, information costs and moral hazard costs.

Myers and Majluf argue that because of information in the context of an agency relationship, managers in serving current stockholders may prefer to seek internal finance or additional indebtedness rather than issue new shares of equity.

With respect to macroeconomic issues, Bernanke (1981) argued that the costs associated with bankruptcy such as legal and administrative costs, losses from sudden liquidation of assets, disruption of production and reduced access to credit are not negligible. Thus in the face of possible bankruptcy, firms find motivation to adjust their behavior by such maneuvers as avoiding debt and cutting planned investment expenditures.

Later Bernanke (1983) was to argue that if one notes that during the Great Depression between the years 1929 and 1933 half of all U.S. banks ceased operations and that the disruption of credit channels is a possible explanation for the persistent fall in the level of output during that same time period. Blinder and Stiglitz (1983) argue that in a world of imperfect access to information, banks become specialized in evaluating, screening and monitoring loan customers. Banks also devise contracts that include strong incentives to prevent defaults. These contracts often base future borrowing on past performance and for some small firms access to bank loans is their only source of credit.

If the Federal Reserve contracts money supply, a fall in real investment can take place without observing changes in the interest rate. As money becomes tight, very large firms may opt for public auction markets for external financing, medium sized firms may be further constrained while small firms might be shut out.

Parallel to this body of theoretical work, empirical work has also seen a revival of interest in analyzing the effects of financial factors on real economic activity. For example, M. Wolfson (1986) using aggregate financial data has evaluated different theories of 'financial crises' while C. Niggle (1989) using Flow of Funds data has argued the validity of Minsky's financial crises theory. Sinai and Eckstein (1983) enhance a neo-classical model with 'balance sheet variables' to assess the impact of tax policy on business fixed investment. Fazzari, Hubbard and Petersen (1988) present a model based on Tobin's 'q' theory of investment for firms classified by their respective earnings retention policies.

Most empirical models, however, reflect the 'neo-classical' approach of Jorgensen (1971) which views the desired level of capital as being determined by long run considerations. Here the firm adds to its capital stock based on a relationship between the value of its output to the rental price of capital where the assumptions include profit maximization, perfect competition and a neoclassical production function (i.e., Cobb-Douglass production function).

An alternative modeling approach that fell out of fashion was Meyer and Kuh's (1957) 'accelerator-residual funds' model that tried to emphasize more transitory decisions in the short run.

This approach which was best stated by Duesenberry (1958) who argued that investment by firms is undertaken based on an expectation of profitability from forecasting effective demand. The firm assesses demand for its output relative to its existing capacity and then compares these prospects to its ability to generate investment funding first from its internal cash flow and then from external sources of funds such as debt and equity. The firm desires to engage in capital expenditures as long as the capitalized cash flows generated from a marginal capital expenditure exceeds the capitalized financing costs that would be necessary for its initial purchase. The demand price for capital is then the present value of profit flows that result from the use of the capital asset while the supply price is the present value of cash commitments the firm must make in order to finance the marginal capital expenditure. The emphasis being on the short run mechanics of the average firm made in investment programs in response to a change in the firms perception of its immediate business environment.

Earlier criticism of this approach was that the variables used to represent liquidity such as retained earnings were really proxies for output or capacity. For example, Kuh (1963) in a later study compared a flexible accelerator model that included sales as a measure of capacity utilization with a flexible accelerator model that included profits as a measure of internal funds. He argued that the model that included sales had superior results than the model that included profits and that profits are really a proxy for output. In reviewing several studies, this was also Jorgensen's assessment. In a comparison of the neo-classical model developed by Jorgensen with accelerator-residual funds type models, the rankings would consistently favor the neo-classical model whether it be an analysis of firms or of industries (Jorgensen (op.cit)).

These studies were based, however, on samples of data of larger firms from the 1940's and 1950's, a more tranquil period in U.S. financial history (Wolfson (1986)). Fazzari and Mott (1986) argued that different results might come from using the Compustat database which currently has a wide distribution of firms from a more recent time period. In this study, use was made of Minsky's argument that the investment process of firms requires an evaluation be made of the relation between the source of funds derived internally versus forced dependence on external debt to complete an investment project. The supply of funds curve essentially has two regions: an inelastic one reflecting available internal sources of funds and an elastic one reflecting the degree of leverage the firms bears when it must resort to external finance.

As previously mentioned with the growing use of debt by firms coupled with greater access to capital markets, this modeling approach has seen renewed interest which is discussed more fully in the next chapter.

Notes For Chapter 2

1. For an exposition of the difference between the 'Neo-Classical' versus the 'Keynesian' traditions see Duesenberry (1958).

2. Although I. Fisher (1933) could also be included in this approach, he is not generally thought of as a 'Post-Keynesian.' We discuss his work in detail in Chapter 5.

Chapter 3

The Data

The data for this study was constructed using annual data from a tape provided by Standard and Poor's Compustat data service. It contained financial data (130 items) for manufacturing firms for the period 1969 to 1988. In the last year, there were 2,468 firms most of which were either listed on the New York Stock Exchange or the American Stock Exchange.

The key variables for the model were capital expenditures, net sales,total assets, total number of employees, net income, interest expense and depreciation.

To give a schematic view of these variables, Tables I to VII present some preliminary statistics for the years 1974 to 1988 (the years 1969 to 1973 were omitted because of the model's use of lags). Graphs I-VIII present distributions for each variable for the firms in the final year of 1988.

Initially, the construction of the histogram found the firms tending to cluster around the lower end of the distributions. (The statistics in Tables I-VII also verify that most of the firms for each year are skewed to the lower end of the spectrum.) Graph I where the natural logarithm of capital expenditures was taken over the sample of firm is presented as indicative of the other distributions. Thus the scaling of the horizontal axes for each graph had to be appropriately adjusted to give a fuller presentation of the data.

Capital expenditures (Table I and Graphs I and II) which represent expenditures used to: a) increase the capacity of an asset, b) increase the efficiency of an asset or c) extend the useful life of an asset. While the mean expenditure grew from 17.7 million dollars in 1974 to 162 million dollars in 1988, the median grew from only 6.7 million dollars to 17.0 million dollars in 1988.

While the average level of sales was just over 1.8 billion dollars, more than half of the reporting firms had less than 400 million dollars (Table II and Graph III).

Two variables used to gauge the impact of the size of the firm were total assets (Table III and Graph IV) and total number of employees (Table VII and Graph VIII). Total assets which is a valuation of the resources owned by the firm while having a mean 3.7 billion dollars were widely distributed across firms with values ranging from 1.8 million dollars to 207.7 billion dollars. Total employees ranged from a few to the extreme case of 766 thousand for General Motors with a mean of 12.4 thousand employees and a median of 2.4 thousand employees in 1988.

Net Income which measures profitability had a wide distribution as indicated by a range of a high of almost 5.5 billion dollars to a loss of 1.7 billion (Table IV and Graph V). Most firms in 1988 were profitable with a mean net income of 100 million dollars, yet almost one out of six reported losses as partly indicated with a standard deviation of 357.3 million dollars.

Depreciation expense which is an approximation of loss of value of fixed assets had a distribution similar to the one reflecting capital expenditures (Table VI and Graph VII). The mean depreciation expense was 98.6 million dollars with a median of 10.5 million dollars and a standard deviation of 422.6 million dollars.

Interest expense which was of particular concern witnessed a dramatic increase over the years with a mean of 34.3 million dollars in 1974 to 142.6 million in 1988 Table V and Graphs VI and IX). Median interest expense was more modest in its growth over the years as it grew from 3.2 million dollars in 1974 to 9.9 million dollars in 1988. While Graph VI shows that for 1988, most firms were at the lower end of the distribution, Graph IX shows interest expense in relation to sales and indicates that in 1988 a substantial number firms had devoted approximately 10% of sales to servicing debt.

Overall, the sample of firms may be upwardly biased in size (i.e., small businesses such as sole proprietorships and partnerships are not included), the sample does have characteristics within that may be useful in differentiating behavior between larger and smaller firms.

CAPITAL EXPENDITURES
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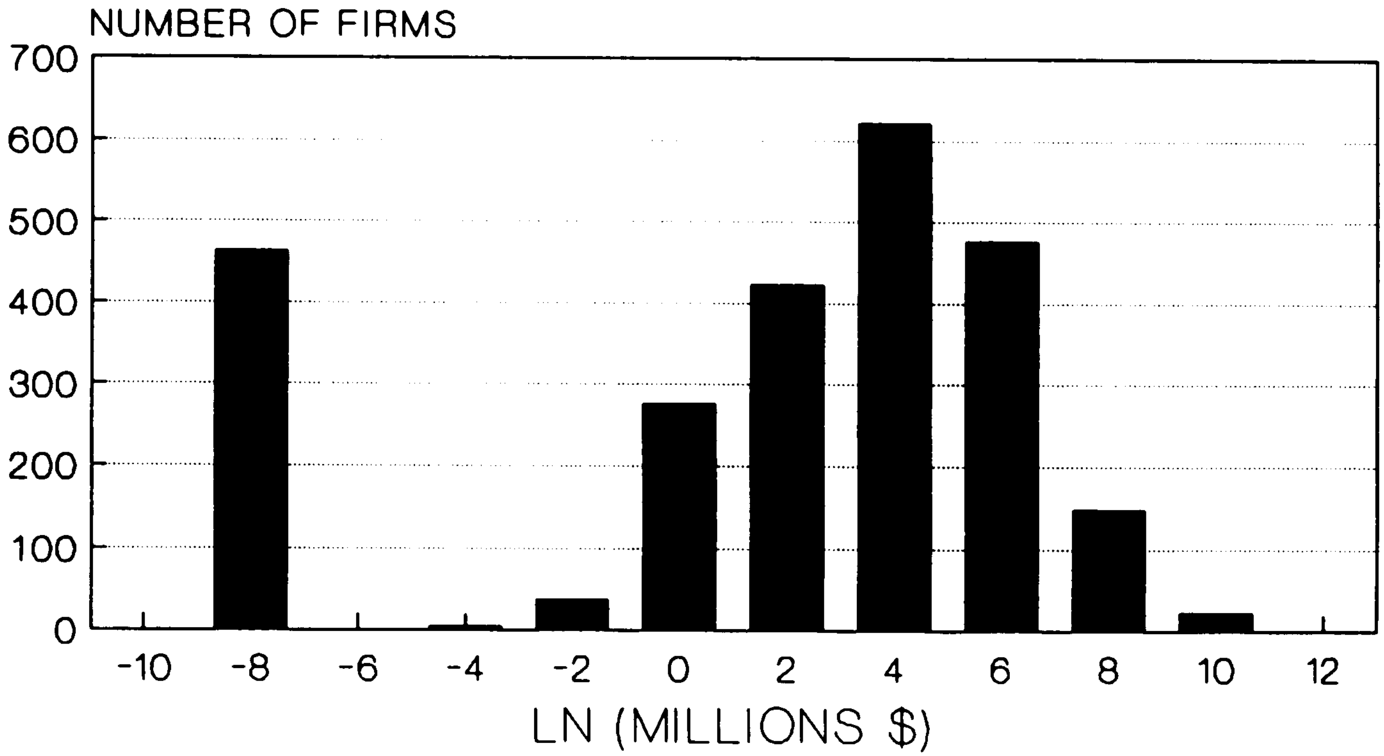

GRAPH I

TABLE I

CAPITAL EXPENDITURES ($ Millions)

YEAR	N	MEAN	STANDARD DEVIATION	MEDIAN	LOWEST	HIGHEST
1974	1424	17.7	336.9	6.7	0.0	10207.3
1975	1437	69.1	325.0	5.8	0.0	9761.0
1976	1456	73.5	348.9	7.0	0.0	10286.6
1977	1485	82.7	383.8	8.6	0.0	11599.6
1978	1501	98.2	450.2	10.4	0.0	13620.4
1979	1535	124.3	570.2	12.6	0.0	16106.2
1980	1582	139.9	633.5	13.3	0.0	17749.4
1981	1606	155.6	701.8	15.9	0.0	18679.7
1982	1666	158.1	709.0	13.2	-9.6	17636.5
1983	1748	135.1	572.8	12.4	0.0	15978.3
1984	1826	150.1	537.2	14.3	0.0	9139.0
1985	1951	160.1	584.2	13.9	0.0	11122.8
1986	2081	146.3	507.0	13.7	0.0	11711.6
1987	2168	141.8	497.4	15.0	-289.6	8772.0
1988	2010	162.4	589.7	17.0	0.0	12042.0

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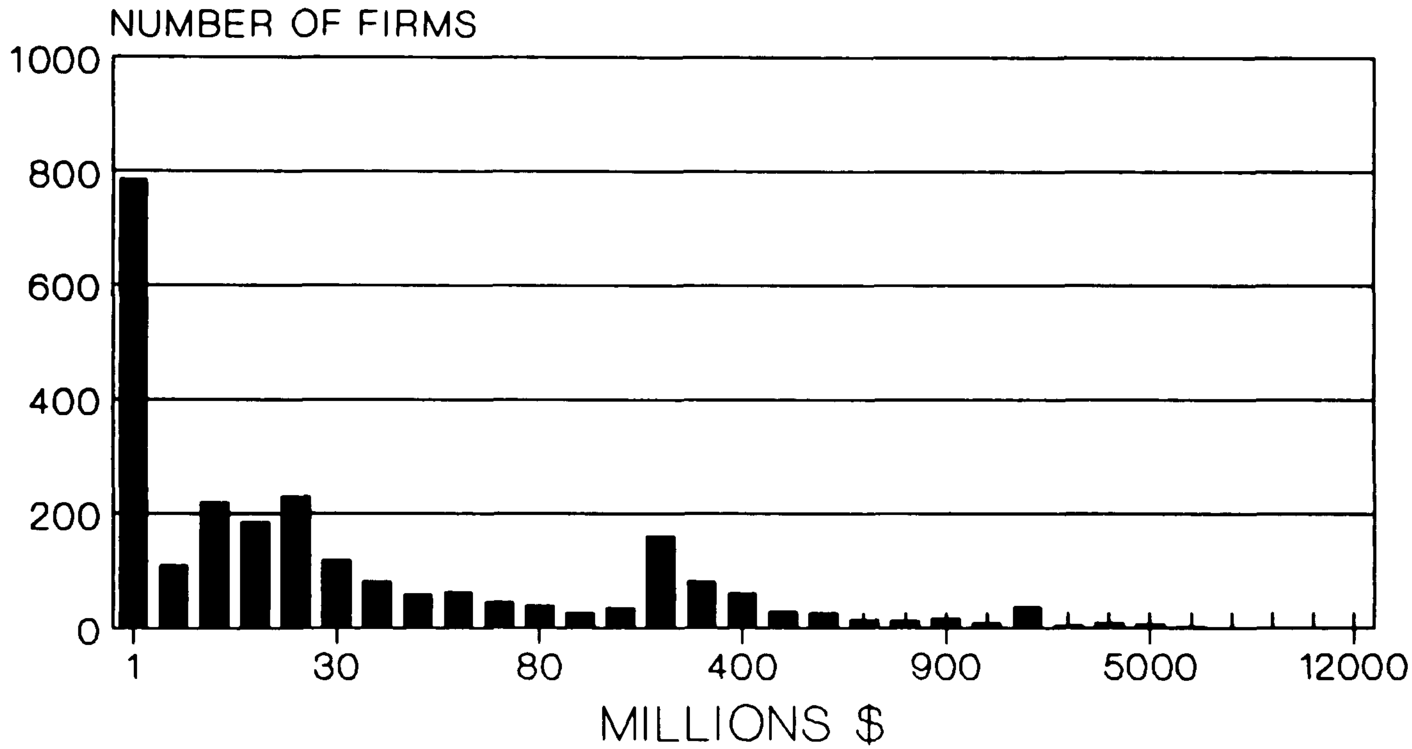

GRAPH II

TABLE II

SALES ($ Millions)

YEAR	N	MEAN	STANDARD DEVIATION	MEDIAN	LOWEST	HIGHEST
1974	1560	685.0	2290.0	124.3	0.3	42,061.8
1975	1574	711.7	2383.6	127.2	0.0	44,865.0
1976	1589	811.6	2769.8	146.2	0.1	48,631.1
1977	1620	909.6	3174.3	161.3	0.0	54,961.3
1978	1655	1021.4	3530.8	184.6	0.0	63,221.1
1979	1700	1201.3	4175.3	218.6	0.0	79,106.5
1980	1749	1357.3	4850.2	240.7	0.0	103,142.0
1981	1787	1479.8	5158.7	260.0	0.0	108,107.0
1982	1873	1490.6	5279.5	247.8	0.0	97,172.8
1983	1958	1473.7	5186.0	241.1	0.1	88,560.6
1984	2030	1576.9	5349.5	278.9	0.1	90,854.0
1985	2174	1593.8	5400.5	269.2	0.0	96,371.6
1986	2317	1545.2	4971.2	270.5	0.0	102,813.0
1987	2408	1661.6	5392.6	287.2	-5.7	101,781.0
1988	2228	1829.9	5927.5	336.9	0.0	121,085.0

SALES
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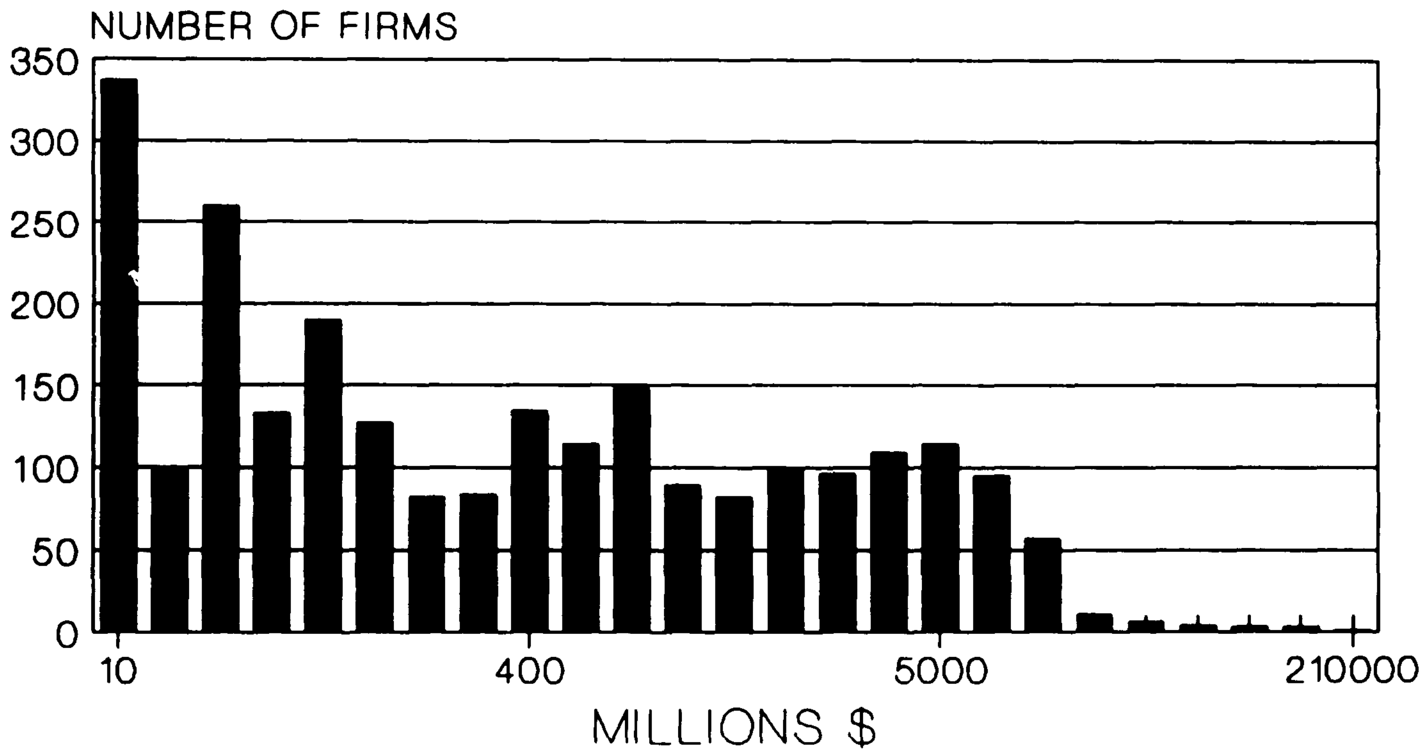


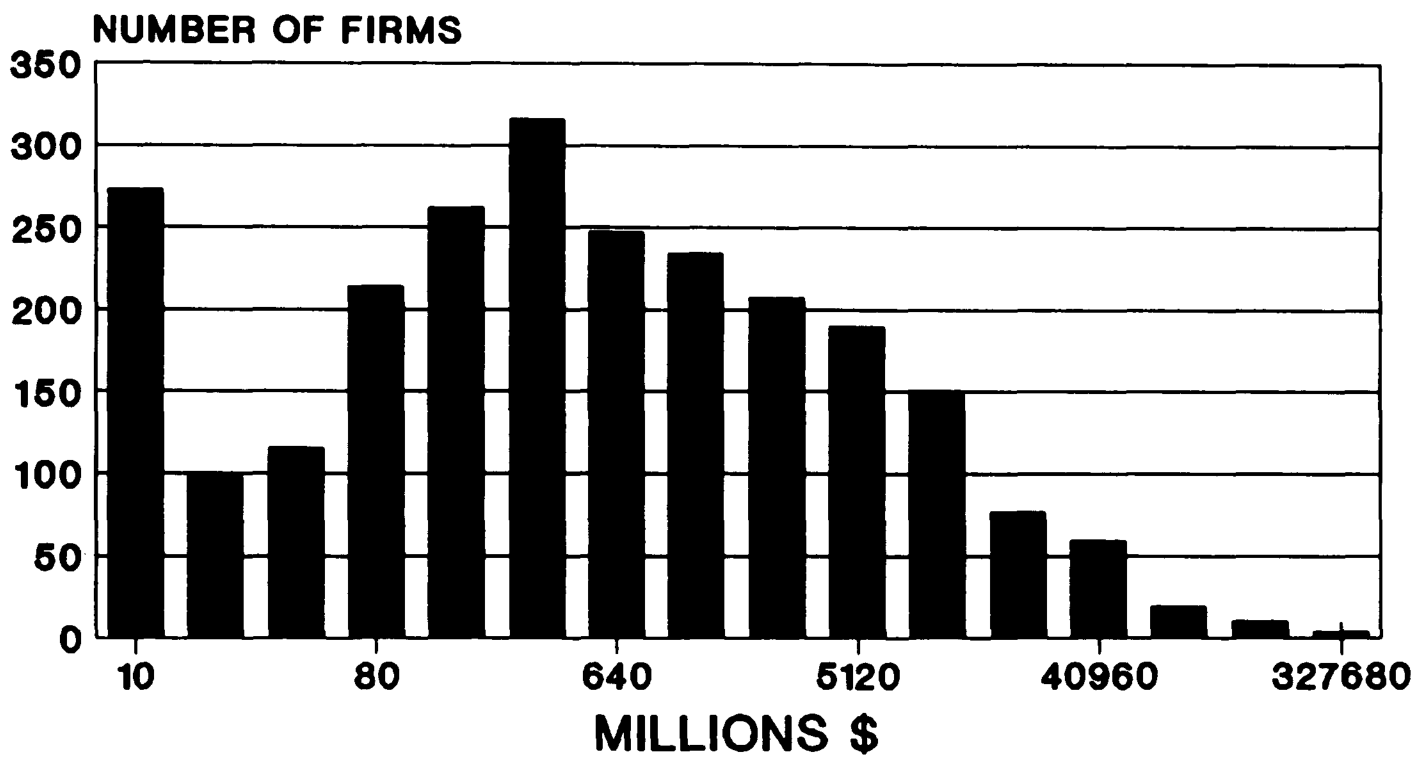
GRAPH III

TABLE III

ASSETS ($ Millions)

YEAR	N	MEAN	STANDARD DEVIATION	MEDIAN	LOWEST	HIGHEST
1974	1564	1059.5	3914.6	180.3	0.3	74047.3
1975	1575	1107.0	4089.7	143.8	0.2	80156.2
1976	1590	1218.3	4477.1	150.9	0.3	86717.0
1977	1620	1343.7	4980.2	164.3	1.1	93972.2
1978	1658	1521.2	5605.1	193.7	0.5	103327.0
1979	1701	1718.6	6381.8	222.3	0.8	113769.0
1980	1749	1881.8	6974.1	235.6	0.7	125451.0
1981	1789	2088.0	7739.2	262.5	0.9	137750.0
1982	1874	2293.4	8502.1	265.0	0.8	148185.0
1983	1960	2375.3	8598.4	271.5	0.5	149530.0
1984	2035	2545.7	8456.1	293.6	1.5	150586.0
1985	2180	2741.8	9230.5	290.2	0.3	173597.0
1986	2341	2936.2	9830.9	306.8	0.4	196124.0
1987	2424	3177.1	10821.0	334.2	1.1	203607.0
1988	2244	3675.3	12782.3	399.2	1.8	207666.0

ASSETS
FREQUENCY DISTRIBUTION



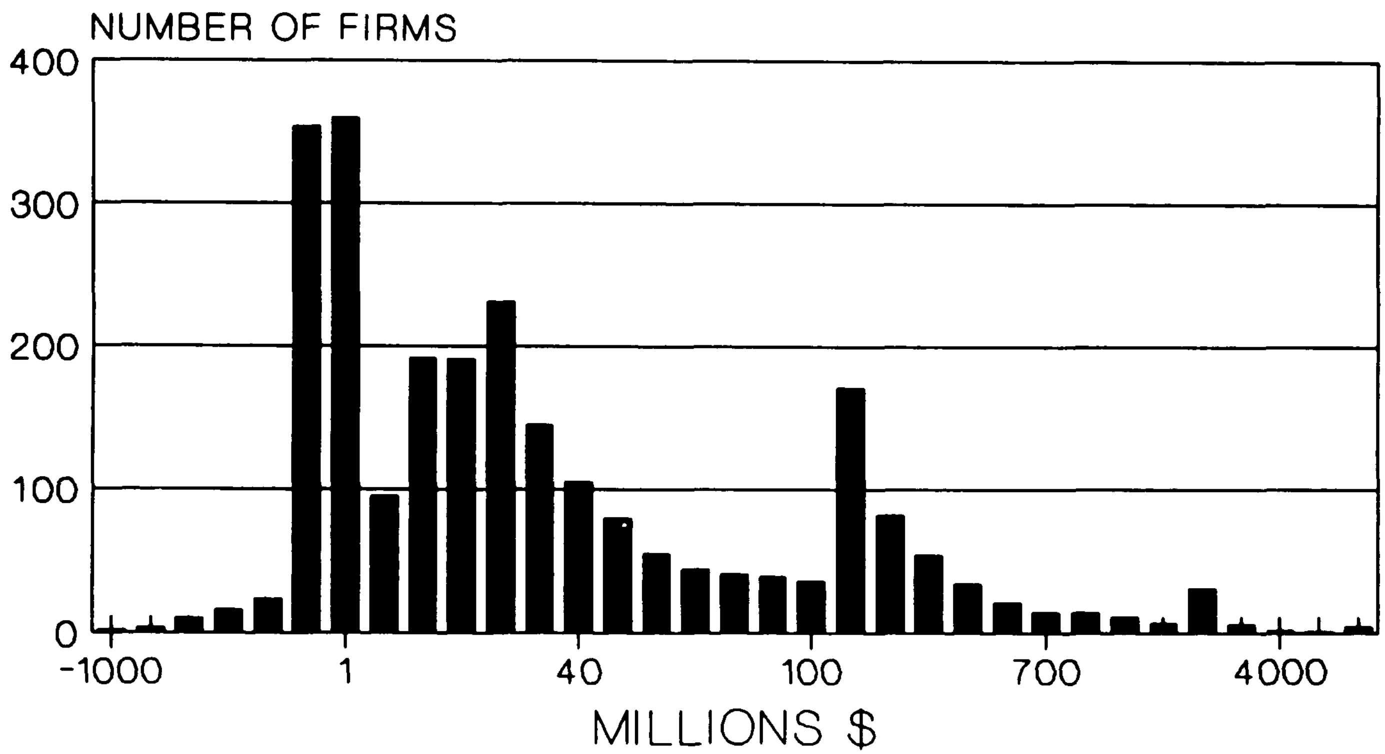
GRAPH IV

TABLE IV

NET INCOME ($ Millions)

YEAR	N	MEAN	STANDARD DEVIATION	MEDIAN	LOWEST	HIGHEST
1974	1560	39.3	160.8	5.8	-190.3	3170.0
1975	1574	36.5	141.0	6.1	-207.2	3147.7
1976	1589	45.8	177.3	7.7	-77.8	3829.2
1977	1620	50.8	200.1	8.3	-448.2	4543.9
1978	1655	58.0	221.1	10.4	-256.7	5272.6
1979'	1700	72.3	286.6	12.2	-1097.3	5674.3
1980	1749	70.9	301.1	12.0	-1709.7	6079.7
1981	1787	73.5	291.4	12.4	-1060.1	6888.1
1982	1873	63.6	282.4	10.1	-1469.6	6992.0
1983	1958	71.1	304.0	10.4	-1367.9	5746.6
1984	2031	81.5	317.2	12.2	-1087.0	6582.0
1985	2174	71.1	292.6	9.8	-854.6	6555.0
1986	2317	68.0	285.6	9.0	-3251.6	5360.0
1987	2408	79.2	226.0	10.5	-4407.0	5258.0
1988	2228	102.8	357.3	14.0	-1669.0	5491.0

NET INCOME
FREQUENCY DISTRIBUTION



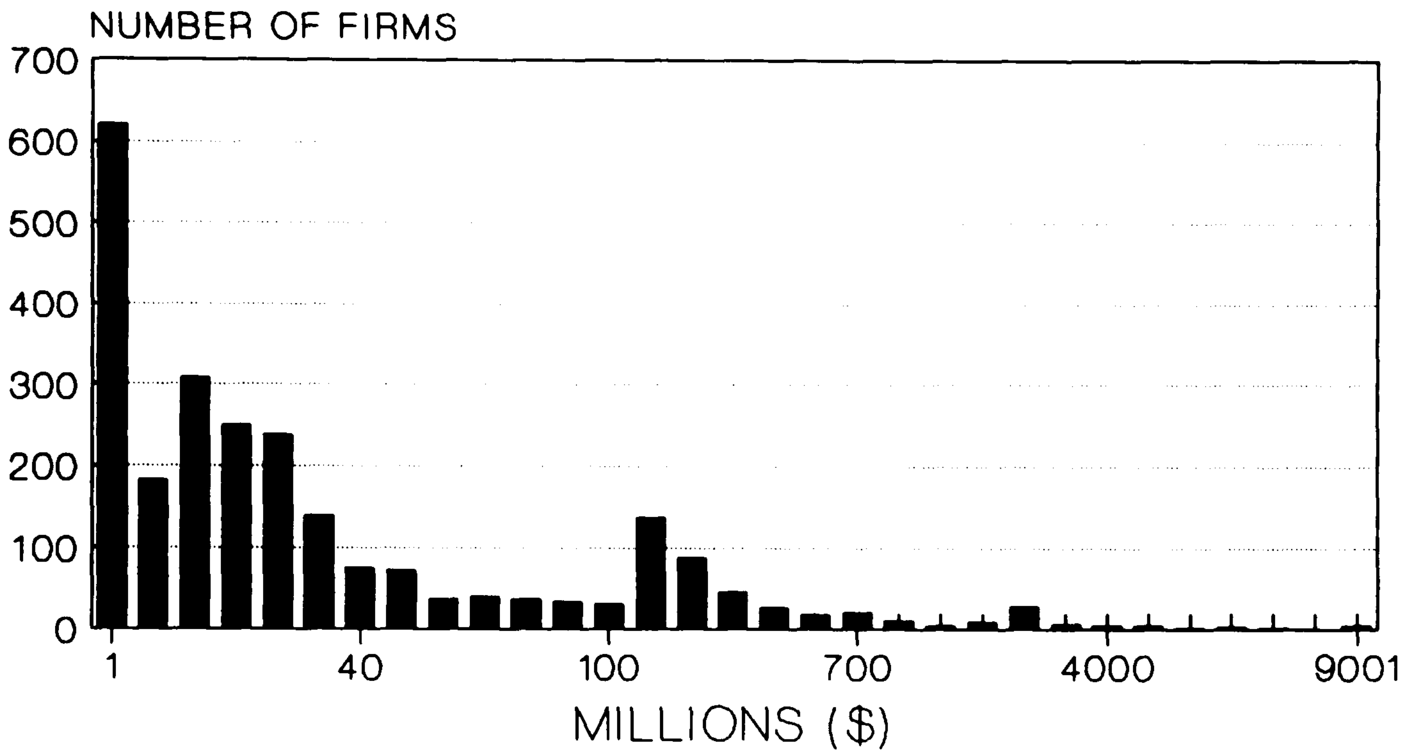
GRAPH V

TABLE V

INTEREST EXPENSE ($ Millions)

YEAR	N	MEAN	STANDARD DEVIATION	MEDIAN	LOWEST	HIGHEST
1974	1560	34.3	168.7	3.2	0.0	3392.3
1975	1574	32.5	158.7	3.1	0.0	2878.3
1976	1589	32.1	153.4	2.7	0.0	2832.0
1977	1620	35.0	169.0	2.9	0.0	3194.8
1978	1655	44.5	222.8	3.8	0.0	4561.3
1979	1700	60.2	331.9	5.0	0.0	7588.7
1980	1749	78.7	449.2	5.6	0.0	10495.0
1981	1787	108.3	632.5	6.6	0.0	14179.0
1982	1873	112.3	617.9	6.7	0.0	12647.0
1983	1958	96.9	515.0	5.7	0.0	11154.0
1984	2030	109.2	573.4	6.4	0.0	13875.0
1985	2174	107.9	561.9	6.7	0.0	14028.0
1986	2317	106.2	526.9	6.9	0.0	13096.0
1987	2408	112.4	574.2	7.6	0.0	15528.0
1988	2248	142.6	723.1	9.9	0.0	19006.0

INTEREST EXPENSE
FREQUENCY DISTRIBUTION



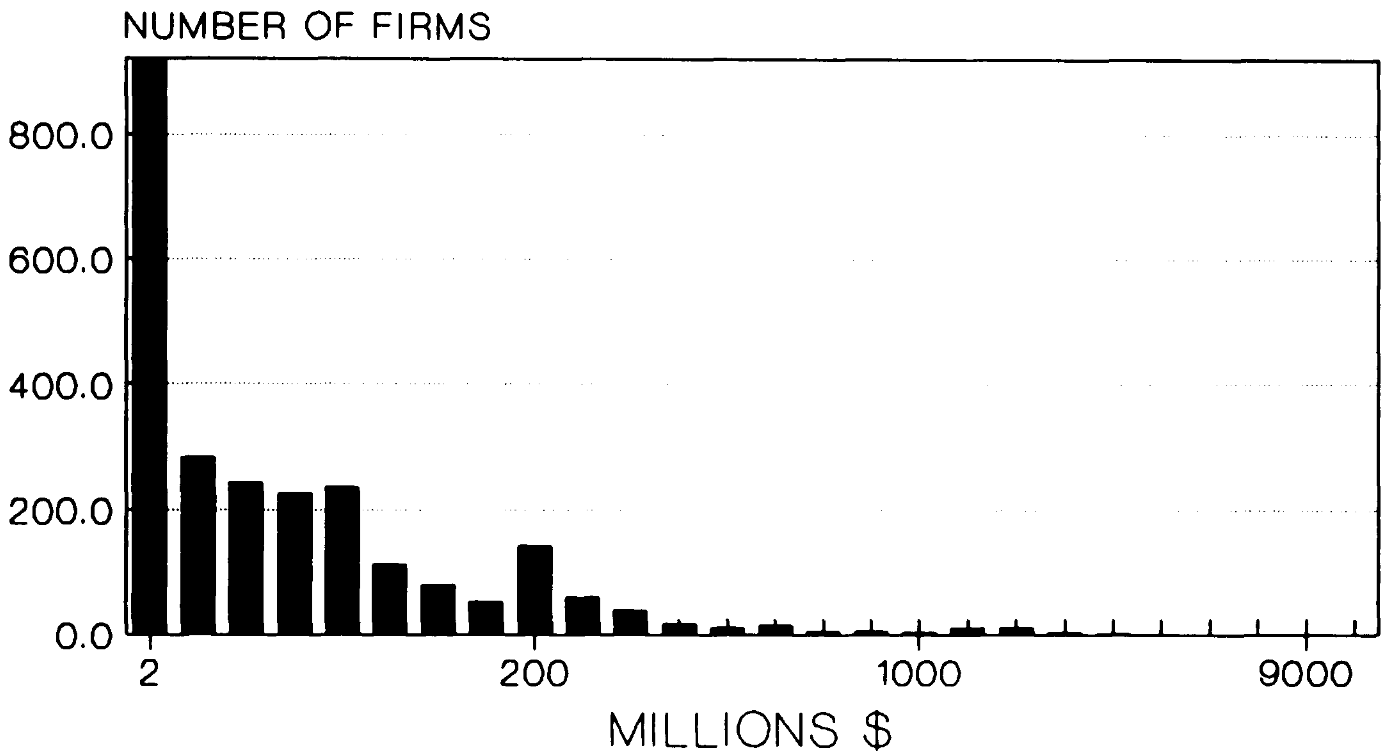
GRAPH VI

TABLE VI

DEPRECIATION ($ Millions)

YEAR	N	MEAN	STANDARD DEVIATION	MEDIAN	LOWEST	HIGHEST
1974	1434	28.2	136.8	3.1	0.0	3692.9
1975	1448	30.7	151.9	3.4	0.0	4089.5
1976	1463	33.3	162.9	3.6	0.0	4485.1
1977	1491	36.6	179.0	3.9	0.0	5046.8
1978	1505	41.8	202.2	4.6	0.0	5548.2
1979	1541	46.7	224.3	5.3	0.0	6176.5
1980	1586	52.9	261.5	5.6	0.0	7112.1
1981	1617	58.9	289.2	6.4	0.0	7900.0
1982	1684	65.8	319.5	6.7	0.0	8734.0
1983	1769	70.8	350.8	6.5	0.0	9854.2
1984	1838	74.4	289.1	7.3	0.0	4965.7
1985	1972	80.7	326.4	7.4	0.0	6208.5
1986	2108	85.5	343.0	8.2	0.0	6593.7
1987	2197	88.6	342.2	8.8	0.0	6112.0
1988	2021	98.6	422.6	10.5	0.0	9886.0

DEPRECIATION
FREQUENCY DISTRIBUTION

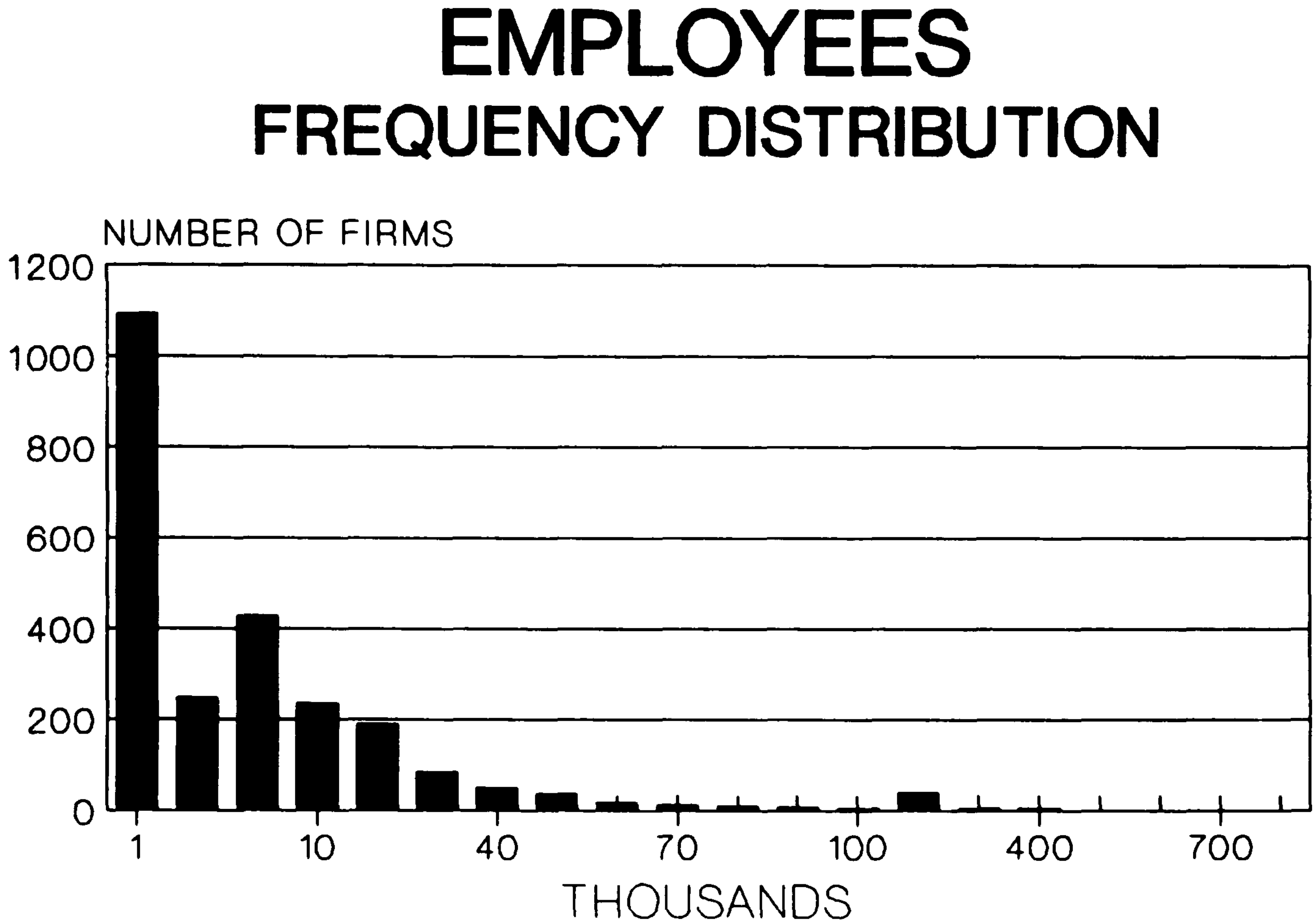


GRAPH VII

TABLE VII

EMPLOYEES ($ Thousands)

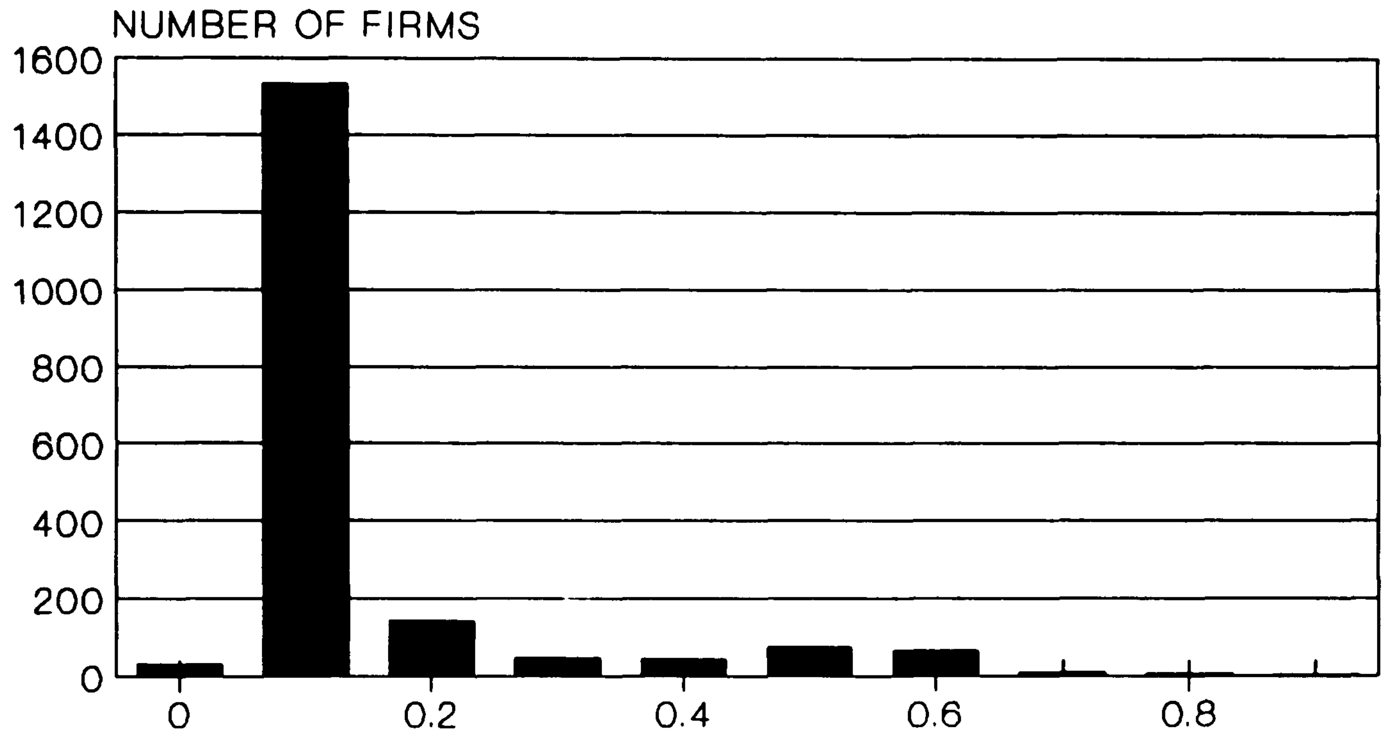
YEAR	N	MEAN	STANDARD DEVIATION	MEDIAN	LOWEST	HIGHEST
1974	1440	12.8	42.9	2.6	0.0	793.3
1975	1464	12.0	39.0	2.5	0.0	770.4
1976	1477	12.8	41.9	2.6	0.0	760.0
1977	1521	13.2	43.7	2.7	0.0	797.0
1978	1560	13.4	44.1	2.8	0.0	839.0
1979	1596	14.1	45.3	2.8	0.0	853.0
1980	1640	13.5	42.6	2.8	0.0	847.8
1981	1687	13.5	42.1	2.8	0.0	854.0
1982	1751	13.0	40.2	2.5	0.0	821.5
1983	1836	12.4	35.6	2.5	0.0	691.0
1984	1900	13.0	37.6	2.5	0.0	748.0
1985	2013	12.8	37.9	2.3	0.0	811.0
1986	2156	12.5	37.9	2.2	0.0	876.0
1987	2262	12.2	36.6	2.3	0.0	813.4
1988	2083	12.4	37.0	2.4	0.0	766.0



EMPLOYEES
FREQUENCY DISTRIBUTION
NUMBER OF FIRMS
1200
1000
800
600
400
200
0
1
10
40
70
100
400
700
THOUSANDS

GRAPH VIII

INTEREST EXPENSE / SALES
FREQUENCY DISTRIBUTION



GRAPH IX

Chapter 4

The Empirical Model

The growing use of debt by firms coupled with greater access to financial markets characterized as 'public auction' type markets has allowed for renewed interest in the 'accelerator-residual funds' model first seen in an econometric study by E. Kuh and J. Meyer (1957) (and later again by Meyer and Glauber (1964)) has been recently revived by S. Fazzari and T. Mott (1986) and S. Fazzari and M. Athey (1987).

To measure the influence of internal finance and external finance commitments separately, the Fazzari-Mott model identified as independent variables sales as a measure of capacity utilization, after-tax profits plus depreciation expense minus common and preferred dividends as a measure of internal finance, net annual interest expense to measure obligations to indebtedness and the book value of Gross Plant and Equipment as a proxy for size with the dependent variable being capital expenditures.

Using an industrial tape provided by the Compustat data service, the model was applied to approximately 1,000 firms over the time period of 1970 to 1982.

A similar approach which was the basis for this study was based on the Fazzari-Athey (1987) accelerator-residual funds model. The independent variables were difference in sales

(AC), internal finance (IF), net interest expense (IN) and Depreciation (DP). The preference for using differences in sales reflects Eisner's application of the permanent income hypothesis to investment (Eisner, 1967). Investment reflects the firm's expectations of the future with respect to future demand (as well as other economic variables). Future sales are then perceived as some monotonic function of past and current sales. Investment in the short term is a result of transitory behavior as past and current sales deviate from a perceived underlying long run trend. To capture both current as well as past influence of differences in sales, contemporaneous as well as a lag up to four years were included as independent variables.

An argument for the inclusion of a variable that measures internal finance(both current as well as past values) is that expected profitability is a motivation for net investment. Current as well as recent profitability may serve as a basis for forecasting future profits. Internal finance is calculated by adding net income to deferred taxes minus common and preferred dividends. The model includes current as well as lagged values up to two years for internal finance.

Rather than perceive capital markets as perfectly competitive, supporters of the accelerator-residual funds model have argued that there are imperfections in the process of financing investment (Gertler and Hubbard, 1988). Increases in the use of debt serve as constraints to the firm such that there would be a negative relationship between a variable that captures the use of debt and further investment spending. Previous studies have incorporated either an interest rate (ie. Evans used Moody's AAA Corporate Bond rate) or a stock variable (Resek (1966) measured 'debt capacity' as total debt minus retained earnings over total assets) while Minsky (1982) argued that flow variables are more important as investment is an ongoing process. To capture indebtedness as a constraint, net interest expense is used where net interest expense consists of interest expense minus interest revenues and where lagged values of two previous years are used to avoid collinear problems with internal finance. The model specified was:

$$\begin{aligned} CAP_i(t) = {} & a(0) + a(1)AC_i(t) + a(2)AC_i(t-1) \\ & + a(3)AC_i(t-2) + a(4)AC_i(t-3) + a(5)AC_i(t-4) \\ & + a(6)IF_i(t) + a(7)IF_i(t-1) + a(8)IF_i(t-2) \\ & + a(9)IN_i(t-1) + a(10)IN_i(t-2) + a(11)DP_i(t) \\ & + \epsilon_i(t) \end{aligned} \tag{1}$$

where:

CAP - Capital Expenditures

AC - Difference in Firm Sales

IF - Internal Finance

IN - Interest Expense

DP - Depreciation Expense

ϵ - residual error

i - firm i.

t - time period

Accelerator models have generally been very successful in partially explaining investment so the model includes the difference of sales (AC) contemporaneous as well as four years lagged as a version of the accelerator. Internal finance (IF) was calculated by adding net income and deferred taxes minus preferred and common dividends excluding depreciation which was run as a separate regressor. The variable IF included contemporaneous as well as lagged values of up to two years. Net interest expense (IN) (interest expense minus interest revenues) was lagged for two years and depreciation (DP) included contemporaneous values only.

The estimates, standard errors, t-statistics and Table I adjusted R-squared are reported in Table I.

Their results confirmed the following:

- a positive relationship between the accelerator and investment exists for up to a lag of three years,

- a positive relation between internal finance and investment exists for up to a lag of two years,

- a negative relationship between interest expense and investment for up to a lag of two years and

- a positive relationship between depreciation and investment contemporaneously.

A positive relationship between the firm's difference in sales (AC) and investment is a reflection of the firm's use of its sales experience to gauge excess demand. This relationship seemed to hold for up to three years prior but in the fourth year there is a sign reversal and the t-statistic indicated the coefficient was insignificant.

Internal finance was significant for current values as well as for the lag up to two years prior. The t-statistics seem to support the notion that internal finance has a separate and positive impact on the firm's investment plans.- The positive relationship between internal finance and investment reflects the need firms have for internal sources of funds to commence investment projects.

The negative relationship between interest expense and investment expenditure for two years prior reflects the constraint that contractual relationships have on a firms investment plans.

Depreciation expense had a strong positive relationship as indicated by a t-statistic of 50.185. The positive relationship between depreciation and investment can be interpreted in two ways. It can be viewed as a reflection of the need firms have for capital replacement programs or simply as a source of funds as it is a non-cash expense. The view taken here is that since firms must have an ongoing program to replace and to modernize, depreciation represents our best proxy for that effort.

In the original Fazzari-Athey study, the sample was constructed from data provided by the Value Line Data Service which consisted of financial data for 637 reporting firms. This same model was applied using a sample obtained from the Compustat data service which consists of financial data from the period 1969 to 1988. The number of firms ranged from approximately 1500 in 1974 to 2500 in 1988 (see Tables I-VII in Chapter 3). The results of this model using Ordinary Least Squares (OLS) are presented in Table II.

There are some differences in the results for the coefficients for the accelerator variables, the internal finance variable for the one year lag and the net interest expense for the one year lag. The accelerator coefficients are significant for the full four years and experience no sign changes. The signs for both internal finance lagged one year and net interest expense lagged one year were opposite than what was expected. While the results presented in Table II are similar to the results in Table I, a common problem in time series data is that the error term is often serially correlated. To adjust for this, all the variables (X(i)) were adjusted assuming a first order autoregressive process of the form:

$$e_i = \rho_i(t-1) + \upsilon(i) \tag{2}$$

where:

e - disturbance for firm i at time t
υ - stochastic disturbance with a zero mean and a variance of σ_i^2
ρ - coefficient of autocovariance.

Then for each firm, the coefficient of autocovariance was estimated as follows:

$$\hat{\rho} = [\sum_{t=2}^{n} (e_i(t))(e_i(t-1)]/\sum_{t=2}^{n} (e_i^2(t) \tag{3}$$

and the data was adjusted as follows:

$$X_i^*(t) = X_i(t)-\hat{\rho}_i X_i(t-1) \tag{4}$$

After adjusting the data in the second step,the model was run again using OLS to obtain the residuals (v(i,t))where the variables X (i,t) were replaced with X*(i,t).

As the data is also a cross section of firms we also expect to face the problem of heteroschedasticity where the residuals do not have a common variance. To adjust for heteroschedasticity, we deflate the data in the following procedure (Maddala (1977,chapter 12). Using the v(i,t) residuals the respective variance was estimated as follows:

$$S_i^2 = \frac{1}{T}\sum_{t=1}^{T} v_i(t) \tag{5}$$

TABLE I

Fazzari-Athey Accelerator Residual Funds Model

VARIABLE	ESTIMATE	STANDARD ERROR	T-STATISTIC
AC0	0.0055	0.0015	3.667
AC1	0.0141	0.0016	8.813
AC2	0.0075	0.0016	4.688
AC3	0.0062	0.0015	4.133
AC4	-0.0008	0.0015	-0.533
IF0	0.1270	0.0100	12.700
IF1	0.1170	0.0120	9.750
IF2	0.0970	0.0120	8.083
IN1	-0.5140	0.0400	12.850
IN2	-0.3520	0.0410	8.585
DP	1.3550	0.0270	50.185
Adjusted R Square		0.495	

The variables in the FA model were then adjusted as follows:

$$X^{**} = \frac{1}{S_i}(X^{*}) \qquad (6)$$

To eliminate the impact of inflation on the data, all variables were divided by the implicit price deflator for the U.S. Gross National Product. The estimates are reported in Table III were obtained from the model:

$$\begin{aligned} CAP^{**} = {} & a(0) + a(1)AC_i^{**}(t) + a(2)AC_i^{**}(t-1) \\ & + a(3)AC_i^{**}(t-2) + a(4)AC_i^{**}(t-3) \\ & + a(5)AC_i^{**}(t-4) + a(6)IF_i^{**}(t) \qquad (7) \\ & + a(7)IF_i^{**}(t-1) + a(8)IF_i^{**}(t-2) \\ & + a(9)IN_i^{**}(t-1) + a(10)IN_i^{**}(t-2) \\ & + a(11)DP_i^{**}(t) + \epsilon_i(t) \end{aligned}$$

The results are comparable to the original FA model except for the following: the accelerator was strong for the full four year lag as the t-statistics indicate the coefficients are significant, the results for internal finance was not as strong and the coefficient for net interest expense lagged one year was a positive sign which is not the sign expected.

As Eichner (1976) has argued that manufacturing in the U.S. economy is characterized by imperfect competition where a few firms dominate their respective industries we enhance the model to measure the impact of firm size. To account for firm size both total assets and total number of employees

TABLE II

Fazzari-Athey Model Using The Compustat Tape

VARIABLE	ESTIMATE	STANDARD ERROR	T-STATISTIC
INTERCEPT	12.8746	1.5571	8.268
AC0	0.0435	0.0021	20.949
AC1	0.0527	0.0023	23.406
AC2	0.0327	0.0023	14.294
AC3	0.0611	0.0026	23.220
AC4	0.0209	0.0019	11.230
IF0	0.1222	0.0177	6.908
IF1	-0.0998	0.0235	-4.248
IF2	0.1599	0.0219	7.315
IN1	0.1751	0.0357	4.909
IN2	-0.0765	0.0392	-1.960
DP	1.3682	0.0154	89.112

Number of Observations	21637
Degrees of Freedom - Model	11
Degrees of Freedom - Residuals	21625
Sum of Squares - Model	5782655800
Sum of Squares - Residuals	1044397557
Adjusted R Square	0.7868
F Value	10884.912
Mean Standard Error	219.761
Mean Dependent Variable	140.3352
Coefficient of Variation	156.5987
Durbin-Watson Statistic	1.693

(contemporaneous and lagged one year) were added to the model.

The model now specified was :

$$
\begin{aligned}
CAP = {} & a(0) + a(1)AC_i(t) + a(2)AC_i(t-1) \\
& + a(3)AC_i(t-2) + a(4)AC_i(t-3) + a(5)AC_i(t-4) \\
& + a(6)IF_i(t) + a(7)IF_i(t-1) + a(8)IF_i(t-2) \qquad (8) \\
& + a(9)IN_i(t-1) + a(10)IN_i(t-2) + a(11)DP_i(t) \\
& + a(12)AT_i(t) + a(13)AT_i(t-1) + a(14)EM_i(t) \\
& + a(15)EM_i(t-1) + e_i(t)
\end{aligned}
$$

where:

AT - Total Assets

EM - Total Employees.

The results are reported in Table IV. Internal finance and depreciation were still significant while interest expense was insignificant. Total assets were statistically significant showing a positive relationship for both current values and one year prior. Total employees were significant for the current year and one year prior but there was a sign change from positive to negative. As a proxy for size total assets seemed to be more effective as a variable than total employees.

As internal finance and net interest expense are both sources of funds, the model was adjusted to minimize collinearities. The model was changed such that instead of net interest expense, the variable IN reflects differences in net interest expense lagged one year and two years and internal finance was run contemporaneously only. As the coefficient for employees reverses sign, the variable for employees (EM) reflects differences in total employees and total assets was

TABLE III

The FA Model Adjusted Fur Inflation,
Serial Correlation and Heteroschedasticity

VARIABLE	ESTIMATE	STANDARD ERROR	T-STATISTIC
INTERCEPT	0.1403	0.0059	23.704
AC0	0.0308	0.0011	28.950
AC1	0.0386	0.0013	30.783
AC2	0.0324	0.0012	26.314
AC3	0.0259	0.0129	20.024
AC4	0.0197	0.0013	14.656
IF0	0.0288	0.0057	5.020
IF1	0.0153	0.0055	2.782
IF2	0.1196	0.0109	11.020
IN1	-0.0683	0.0173	-3.958
IN2	0.1650	0.0177	9.338
DP	1.4603	0.0107	136.373

Number of Observations	19864
Degrees of Freedom - Model	11
Degrees of Freedom - Residual	19852
Sum of Squares - Model	38692.55646
Sum of Squares - Residual	12093.15920
Adjusted R Square	0.7617
F Value	5774.299
Mean Standard Error	0.7804907
Mean Dependent Variable	0.6451812
Coefficient of Variation	120.9723
Durbin-Watson Statistic	1.917

run contemporaneously only. As changes in sales could be viewed as a signal for changes in demand, the difference in the current GNP price deflator from the prior year price deflator (DG) was added as a separate variable as firms may judge the phase of the business cycle by observing prices in addition to sales. The revised model is now:

$$\begin{aligned} CAP_I(t) = a_0 &+ a_1 AC_I(t) + a_2 AC_I(t-1) \\ &+ a_3 AC_I(t-2) + a_4 AC_I(t-3) + a_5 AC_I(t-4) \\ &+ a_6 IF_I(t) + a_7 \epsilon_I(t-1) + a_8 DP_I(t) \\ &+ a_9 AT_I(t) + a_{10} EM_I(t) + a_{11} DG_I(t) + e_I(t) \end{aligned} \quad (9)$$

where:

IN - the difference in interest expense from one year prior and two years prior,

EM - the difference between current total employees and one year prior,

DG - the difference in the current Implicit Gross National Product Price Deflator and one year prior.

The results are presented in Table V.

While the model was changed to reduce possible collinear effects, the coefficients for the accelerator and depreciation are still strongly significant. Internal finance and the difference in interest expense are also significant with the sign of the coefficient for both variables being positive and negative respectively as expected. Total Assets were strongly significant as a proxy for size while differences in employees also were significant with the sign of the coefficient as

TABLE IV

The FA Model With Total Assets and
Total Employees As Additional Variables

VARIABLE	ESTIMATE	STANDARD ERROR	T-STATISTIC
INTERCEPT	0.0877	0.0072	12.198
AC0	0.0118	0.0013	9.058
AC1	0.0287	0.0013	22.615
AC2	0.0193	0.0012	15.671
AC3	0.0141	0.0012	11.631
AC4	0.0164	0.0012	13.139
IF0	0.0407	0.0066	6.149
IF1	0.0862	0.0098	8.792
IF2	0.1764	0.0112	15.706
IN1	-0.3150	0.0208	-15.147
IN2	0.1380	0.0194	7.114
DP	0.8938	0.0160	55.987
AT0	0.0011	0.0001	12.635
AT1	0.0270	0.0013	21.358
EM0	0.0420	0.0011	38.519
EM1	-0.0437	0.0011	-38.906

Number of Observations	18934
Degrees of Freedom - Model	15
Degrees of Freedom - Residual	18918
Sum of Squares - Model	61373.71595
Sum of Squares - Residuals	14056.97925
Adjusted R Square	0.8135
F Value	5506.484
Mean Standard Error	0.862002
Mean Dependent Variable	0.8575158
Coefficient of Variation	100.5232
Durbin-Watson Statistic	1.888

expected. The difference in the GNP price deflator also was significant.

While the difference in sales is a strong variable, the addition of a proxy for change in prices also enhanced the model and suggests that firms use price changes as well as signals to gauge the overall business climate and carry on their real investment programs accordingly. A separate influence can be attributed to financial factors such as internal finance and net interest expense. Internally derived finance is a source of liquidity that is necessary as projects invariably rely on ongoing sources of funds. If firms decide to seek additional sources of funding to meet ongoing commitments, the model suggests that as increases in interest payments that result may temper additional capital spending. Total Assets as a proxy for size most likely reflects the fact that larger firms have larger capital stocks and establish consistent investment programs to maintain their market positions. This is also reinforced by the success of including differences in total employees. As larger firms add to their capital stock they also must hire additional employees.

As previously mentioned in Chapter 1, macroeconomic models typically depict firms as the 'average firm' while research in imperfect competition suggest the behavior of large firms as being fundamentally different from small firms (Marris,1972).

As firm size is often a criterion for access to public

TABLE V

The Revised Model

VARIABLE	ESTIMATE	STANDARD ERROR	T-STATISTIC
INTERCEPT	-0.1000	0.2000	-5.003
AC0	0.0208	0.0010	20.078
AC1	0.0339	0.0011	29.879
AC2	0.0220	0.0011	19.850
AC3	0.0131	0.0012	10.827
AC4	0.0135	0.0013	10.680
IF	0.0525	0.0065	8.048
IN1	-0.1966	0.0175	-11.216
DP	1.1043	0.0140	78.937
AT	0.0277	0.0006	48.806
EM0	0.0020	0.0002	8.945
DG	0.0459	0.0039	11.884

Number of Observations	19111
Degrees of Freedom - Model	11
Degrees of Freedom - Residual	19099
Sum of Squares - Model	54225.15026
Sum of Squares - Residual	12599.07129
Adjusted R Square	0.8114
F Value	7472.745
Mean Standard Error	0.8122018
Dependent Variable Mean	0.8507117
Coefficient of Variation	95.47321
Durbin-Watson Statistic	1.852

auction type capital markets, large firms may not be as constrained by access to external finance as smaller firms might be.

To test for the influence of size, the data was partitioned by percentiles with respect first to total assets and then by total number of employees. The percentiles chosen were lower twenty-fifth percentile('lower'), upper seventy-fifth percentile('upper') and a middle range group of above twenty-fifth percentile and less than seventy-fifth percentile ('middle'). The previous model (equation 9) was then applied to both groups with the results presented in Tables 6-8 for firms screened by total assets and in tables 9-11 for firms screened by total employees.

To test the hypothesis whether the estimates for the model for the entire data set has estimates (both the regression coefficients and the intercepts) significantly different from the sub-groups we use an F-test (Maddala, 1977 p.323) where the F ratio is calculated as follows:

$$F = \frac{(RSS-URSS)/(2N-2)}{URSS/(T-2N)} \qquad (9)$$

where:

RSS - restricted residual sum of squares

URSS - unrestricted residual sum of squares

N - number of firms

T - Total number of observations.

TABLE VI

The Revised Model Applied To Firms
In The Lower Percentile By Total Assets

VARIABLE	ESTIMATE	STANDARD ERROR	T-STATISTIC
INTERCEPT	0.0209	0.0211	0.993
AC0	0.0108	0.0018	6.143
AC1	0.0232	0.0018	12.567
AC2	0.0016	0.0018	8.725
AC3	0.0116	0.0019	6.092
AC4	0.0134	0.0022	6.051
IF	0.1867	0.0135	13.797
IN1	-0.3125	0.0308	-10.132
DP	1.0057	0.0160	62.858
AT	0.0223	0.0007	33.976
EM0	0.0009	0.0003	2.586
DG	0.0029	0.0042	0.688

Number of Observations	4167
Degrees of Freedom - Model	11
Degrees of Freedom - Residual	4155
Sum of Squares - Model	14607.21253
Sum of Squares - Residual	726.81187
Adjusted R Square	0.9526
F Value	7591.431
Mean Standard Error	0.4182399
Dependent Variable Mean	-0.0391402
Coefficient of Variation	-1068.57
Durbin-Watson Statistic	2.044

TABLE VII

The Revised Model Applied To Firms
In The Middle Percentile By Total Assets

VARIABLE	ESTIMATE	STANDARD ERROR	T-STATISTIC
INTERCEPT	-0.0291	0.0276	-1.056
AC0	0.0223	0.0014	16.010
AC1	0.0286	0.0016	18.160
AC2	0.0267	0.0015	17.573
AC3	0.0117	0.0015	7.502
AC4	0.0142	0.0016	8.812
IF	0.0648	0.0098	6.618
IN1	-0.2435	0.0295	-8.279
DP	1.0378	0.0226	45.903
AT	0.0302	0.0010	30.997
EM0	0.0036	0.0003	11.11
DG	0.0392	0.0053	7.464

Number of Observations	10598
Degrees of Freedom - Model	11
Degrees of Freedom - Residual	10586
Sum of Squares - Model	17280.04482
Sum of Squares - Residual	7125.37969
Adjusted R Square	0.7077
F Value	2333.867
Mean Standard Error	0.8204234
Mean Dependent Variable	0.8682609
Coefficient of Variation	94.49043
Durbin-Watson Statistic	1.819

TABLE VIII

The Model Applied To Firms In
The Upper Percentile By Total Assets

VARIABLE	ESTIMATE	STANDARD ERROR	T-STATISTIC
INTERCEPT	-0.3937	0.0553	-7.113
AC0	0.0240	0.0027	8.965
AC1	0.0392	0.0027	14.740
AC2	0.0206	0.0026	7.140
AC3	0.0160	0.0029	5.447
AC4	0.0141	0.0030	4.666
IF	0.0127	0.0126	1.013
IN1	-0.1813	0.0332	-5.463
DP	1.2597	0.0314	40.070
AT	0.0243	0.0013	18.217
EM0	0.0047	0.0006	8.034
DG	0.1124	0.0103	10.905

Number of Observation	4341
Degrees of Freedom - Model	11
Degrees of Freedom - Residual	4329
Sum of Squares - Model	16515.8250
Sum of Squares - Residual	44044.4705
Adjusted R Square	0.7889
F Value	1475.712
Mean Standard Error	1.0087
Dependent Variable Mean	1.6617
Coefficient of Variation	60.6700
Durbin-Watson Statistic	1.786

TABLE IX

The Model Applied To Firms In The
Lower Percentile By Total Employees

VARIABLE	ESTIMATE	STANDARD ERROR	T-STATISTIC
INTERCEPT	0.0251	0.0096	7.011
AC0	0.0112	0.0018	6.289
AC1	0.0226	0.0024	9.345
AC2	0.0171	0.0024	7.350
AC3	0.0105	0.0025	4.277
AC4	0.0106	0.0030	3.520
IF	0.0982	0.0157	6.297
IN1	-0.3358	0.0385	-8.695
DP	1.0126	0.0199	50.979
AT	0.0285	0.0008	34.433
EM0	-0.0019	0.0005	3.622
DG	0.0087	0.0058	1.509

Number of Observations	3797
Degrees of Freedom - Model	11
Degrees of Freedom - Residuals	3785
Sum of Squares - Model	13556.81301
Sum of Squares - Residual	1169.86086
Adjusted R Square	0.9203
F Value	3987.462
Mean Standard Error	0.555948
Dependent Variable Mean	0.1140673
Coefficient of Variation	487.3859
Durbin-Watson Statistic	1.829

TABLE X

The Model Applied To Firms In The
Middle Percentile By Total Employees

VARIABLE	ESTIMATE	STANDARD ERROR	T-STATISTIC
INTERCEPT	-0.0525	0.0276	-1.906
AC0	0.0182	0.0017	10.461
AC1	0.0294	0.0018	16.157
AC2	0.0244	0.0018	13.911
AC3	0.0100	0.0018	5.591
AC4	0.0175	0.0018	-0.527
IF	0.1440	0.0165	8.728
IN1	-0.2240	0.0243	-9.242
DP	0.9882	0.0254	38.974
AT	0.0270	0.0010	26.871
EM0	0.0047	0.0005	9.111
DG	0.0046	0.0052	8.863

Number of Observations	9546
Degrees of Freedom - Model	11
Degrees of Freedom - Residual	9534
Sum of Squares - Model	15875.0217
Sum of Squares - Residual	5729.9760
Adjusted R Square	0.7345
F Value	2401.287
Mean Standard Error	0.7752
Dependent Variable Mean	0.6516
Coefficient of Variation	118.969
Durbin-Watson Statistic	1.868

TABLE XI

The Model Applied To Firms In The Upper Percentile By Total Employees

VARIABLE	ESTIMATE	STANDARD ERROR	T-STATISTIC
INTERCEPT	-0.2428	0.0473	-5.134
AC0	0.0255	0.0020	12.572
AC1	0.0369	0.0021	17.962
AC2	0.0244	0.0020	11.311
AC3	0.0147	0.0022	6.791
AC4	0.0101	0.0022	4.533
IF	0.0256	0.0093	2.778
IN1	-0.1951	0.0368	-5.309
DP	1.2000	0.0294	40.806
AT	0.0270	0.0013	21.367
EM0	0.0035	0.0004	9.468
DG	0.0768	0.0087	8.832

Number of Observations	5680
Degrees of Freedom - Model	11
Degrees of Freedom - Residual	5668
Sum of Squares - Model	18699.7844
Sum of Squares - Residual	5381.5438
Adjusted R Square	0.7761
F Value	1790.469
Mean Standard Error	0.9744
Dependent Variable Mean	1.6775
Coefficient of Variation	58.4346
Durbin-Watson Statistic	1.7700

The restricted sum of squares is the residual sum of squares obtained from the model applied to the entire sample while the unrestricted sum of squares is the sum of the residual sum of squares of the three separate samples.

Comparing the model applied to the overall sample with the model applied to the three groups screened by total assets, the F ratio was 0.12802. The F ratio calculated for groups screened by total employees was 0.1362. Neither result suggesting the coefficients were significantly different than for the model applied to the entire sample.

In reviewing the individual coefficients, it should be noted that the variables that capture financial constraints (IF and IN) were individually more significant for smaller firms than for larger firms. Firms classified in the less than twenty-fifth percentile by total assets had a coefficient 0.1867 with a t-statistic of 13.797 while the 'middle' percentile had a coefficient of 0.0648 with a t-statistic of 6.618 and the upper percentile had a coefficient of 0.0127 with a t-statistic of 1.013. In that same order firms had the following coefficients for net interest expense; -0.3125 with a t-statistic of 10.132, -0.2435 with a t-statistic of 8.279, and -0.1813 with a t-statistic of 5.463.

With respect to firms that were classified by total employees, the coefficients for internal finance were as follows: for the lower percentile a coefficient of 0.0982 with a t-statistic of 6.297, for the middle percentile 0.1440 with a t-statistic of 8.728 and for the upper percentile 0.0256 with a t-statistic of 2.778, respectively. In the same order, firms had the following coefficients for net interest expense; -0.3358 with a t -statistic of 8.695, -0.2240 with a t-statistic 9.242 and -0.1951 with a t-statistic of 5.309.

One should also note that for the lower percentile of firms screened by either total assets or total employees the coefficient for the difference in the implicit GNP price deflator was insignificant suggesting that smaller firms do not use price level changes as a signal for excess demand or as to what the current phase the business cycle is in.

This pattern does suggest that large firms are less constrained by access to finance or by prior contractual commitments than seems to be the case for small firms.

Chapter 5

Macroeconomic Models That Include Debt

The Fisher-Minsky-Tobin Tradition

In chapter 1 using a residual funds-accelerator model we were able to show a positive relationship between real investment and selected financial variables (i.e., internal finance and interest expense). The argument being that because of imperfect access to information, firms may face credit rationing and thus a constraint on their investment plans.

One tradition that has consistently argued that financial factors help explain observed deviations of output from trend can be found in the works of I. Fisher (1933), H. Minsky (1975) and J. Tobin (1980).

Fisher's Debt-Deflation Theory

In his paper, "The Debt-Deflation Theory of Great Depressions", Irving Fisher argued indebtedness followed by price deflation were the key factors that lead to depression.

For Fisher, the study of the many causes for why economic variables experience "disequilibrium" involves "cycle theory." Fisher argued there were several cycles that happen concurrently. Two types of "cycle tendencies" that he identified were "forced" cycles and "free" cycles. Forced cycles are the result of impositions from outside the economic mechanism which continue unabated while free cycles are internally generated but eventually give way to equilibrium.

For economic variables to remain constant is to ask us "to assume that the Atlantic Ocean can ever be without a wave." Over time, there will be cases of "overproduction", "underconsumption", "overinvestment" and "over or under everything else." But these items do not explain big disturbances.

Fisher then argues that if you combine such factors as "over-investment", "overspeculation", or "over confidence" with "over-indebtedness" followed by price deflation, then you would witness crises of the magnitudes of 1837, 1873 or 1929 through 1933.

The following is Fisher's sequence of events that lead to crises:

- debt liquidation leading to distress selling
- contraction of deposit currency
- fall in the level of prices
- fall in the net worth of business causing bankruptcy
- profits fall
- reduction in output and employment
- loss of confidence
- hoarding which shows down velocity, and
- complicated disturbances in interest rates where

nominal rates fall while real rates rise.

From here, Fisher offers a paradox that results, "the more debtors pay, the more they owe." As debtors pay off their debts by liquidating assets, the price level may dramatically fall.

Fisher closes by arguing that given the policy choice of either letting the economy "naturally" solve its own problems or by government "reflating", it would be better for government to reflate.

Minsky's Theory of Financial Crisis

Minsky has written about the interaction of "real variables" with "financial" variables for several decades (Minsky, 1982).

Much of his work has been focused on the development of the concept of "financial fragility" which has drawn a fair amount of controversy as he has taken issue with what he has characterized as the "standard orthodoxy."[1]

Rather than focus on the process of price determination that results from the exchange of goods, Minsky focuses on understanding how firms finance the development of their productive capacity.

For Minsky, the message of Keynes was that the historical development of the capitalist system at the time of the Great Depression consisted of sophisticated financial markets and as a result the process by which capital assets are priced, financed and acquired is a complex one. It is this process that leads to instability.

As the economy moves through time, it exhibits fluctuations that reflect instability and incoherence that are results of an endogenous tendency toward a financially fragile structure implying a business cycle analysis often associated with the work of Kalecki (1971) and Goodwin (1982).

Minsky would argue that financial markets have inherent tendencies towards instability and that the recent post WWII period in the United States from 1945 to 1965 was historically unique as it was a relatively mild epoch.

Minsky's Interpretation of Keynes

In his book John Maynard Keynes, Hyman Minsky (1975) argues that the standard interpretation of Keynes' General Theory is both inadequate and misguided. Referring to the following three 'classic' models as representative of the "neo-classical synthesis":

- the basic consumption function model of Alvin Hansen (1949),
- Hicks'(1937) simultaneous satisfaction of the commodity-money market equilibrium conditions model,
- Patinkin's (1956) real balance effect,

Minsky states that these models passed over the essence of Keynes' work.

In reviewing the standard IS/LM model, Minsky argues that the financial variables that intervene to allocating savings to investment (Ex-Ante), are misspecified.

For example, the process by which capital assets are valued is not solely a function of the interest rate but also must include changes in the expectation of future cash flows that these assets must generate.

Minsky states that Keynes viewed assets as being of three types:

- money in the form of bank deposits,
- debt representing an exchange of "present money" for future cash inflows
- real assets that are utilized for generating future cash inflows.

With these categories in mind, the investment process includes the following:

- a willingness to incur debt where in exchange for cash, an obligation is made to provide future cash inflows,
- a development of expectations regarding future cash flows,
- a determination of the price of capital assets based on the yield of real assets and the rate of interest from indebtedness where the supply price of a capital asset must match its capitalized yield.

Here is a major area where Minsky argues that the neo-classical synthesis "runs past Keynes" - that is the complex determination of investment.

Instead of looking at the capitalist economy like it was a "village fair" where a decentralized market process moves to a stable equilibrium, Minsky argues that Keynes' focus is on the disequilibrating tendencies that stem from sophisticated financial markets. In a capitalist economy, financial institutions determine the process by which funds are obtained for the production and ownership of capital assets.

Rather than focus on the process of price determination that results from the exchange of goods, Minsky focuses on understanding how firms finance the development of their productive capacity. That is; the financing of capital accumulation at the firm level. For Minsky, the message of Keynes was that the historical development of the capitalist system at the time of the Great Depression consisted of sophisticated financial markets. As a result, the process by which capital assets are priced, financed and acquired is a complex one. It is this process that leads to instability in the financial markets.

If we postulate the existence of portfolios consisting of various capital assets (real and financial) then uncertainty will result as changing expectations about future cash inflows will be reflected in these portfolios quickly. Keynes was developing a business cycle theory that is multifaceted and not a theory overly dependent on any one primary cause.

While the neo-classical tradition perceives the capitalist economy heading towards stable equilibrium, Keynes' General Theory argues equilibrium to be transitory where there are tendencies towards as well as tendencies away from equilibrium. This is a much more cyclical orientation with a greater spotlight on factors such as the nature of investment and the role of uncertainty.

Uncertainty becomes important because businessmen making decisions in a decentralized economy must make choices with imperfect information. As these decisions are subjective, portfolios may change rapidly leading to an investment process characterized by volatility.

For Minsky the financing process of investment can take place in two basic ways: prior financing where all the necessary funds are raise before the project begins or segmented financing where money is raised as the project proceeds. It is the latter that Minsky argues is more common.

While investment takes several time periods to complete, various economic agents such as labor or creditors will require payments in the current time period. The financing process resolves this conflict. Analysis of cash inflows and outflows, the choice of sources of funds (internal versus external) will ultimately influence the behavior of the firm.

As decisions by firms are made to add to the capital stock, money is created form borrowing and lending, real and financial assets are acquired and financial liabilities are created: financial liabilities being contractual obligations where commitments for the delivery of fixed sums of money are made.

As production becomes more complex and the gestation periods of investment become longer, the short term profits generated by the firm are often insufficient in satisfying the payment requirements of the loan contract.

These commitments must then be met by supplementary profits with additional borrowing. This dependence on additional debt is reflected by the various financial strategies of the firm that Minsky characterizes as "hedge", "speculative" and "ponzi finance." (Minsky, 1982, p. 22-30).

This classification scheme reflects a firm's susceptibility to financial difficulties through the relationship between operating cash receipts to cash payment liabilities due to indebtedness. Hedge finance occurs when income exceeds payments due to contractual obligations. Speculative finance has the present value of income exceeding total cash outflows. In the near term cash inflows are less than cash outflows, but the income will still exceed the interest component of the obligation. Ponzi finance is a further extension of indebtedness as income in the near term cannot even cover the interest component of the payments. For both speculative and ponzi finance categories additional borrowing is necessary.

During a "boom" phase of the business cycle, the distribution of firms becomes more speculative and ponzi. The economy becomes more susceptible to shocks and financial crises.

Symptoms of a more financially "fragile" system include:

- tighter margins measured by using cash payment commitments relative to cash receipts,
- falling market values of assets relative to liabilities
- creditors become less willing to lend.

Interest rates rise during this period because firms are inelastic in their demand for new borrowed funds while the supply is elastic.

Macroeconomic Models Using Hicks' IS/LM Framework

In response to Keynes' General Theory, several macroeconomic models have attempted to portray the interaction between 'real' and 'financial' variables.

Several models have been developed that incorporate the previously mentioned "Fisher effect" (Tobin, 1980) and "Minsky crises" (Taylor and O'Connell, 1985) where use is made of comparative statics using versions of Hick's (1938) IS/LM analysis.

The 'IS/LM' framework of Sir John Hicks was meant to contrast Keynes' theory to what Keynes' characterized as the Classical school.

In a world where the time period in 'short' with one financial instrument, a fixed supply of money, two curves are drawn in Diagram 1 in (i,y) space where i represents the interest rate and y represents total output (or income).

The first curve represents the focus of possible equilibrium interest rates and levels of total income in order for the demand for new investment to equal the supply of desired savings. This curve is usually downward sloping as the desire to both invest and consume are viewed as inversely related to the rate of interest, hence higher levels of output correspond to lower levels of interest rates in real markets.

The second curve captures the demand to hold wealth in its most liquid form (money balances) given the possible levels of interest rates and total income. This curve was viewed as usually having a positive slope because given the increased desire to hold money balances for transactions purposes, the interest rate would also rise to temper this demand for money balances as there was usually assumed a fixed amount of money available.

As the General Theory was written during the Great Depression, Keynes was writing to show why a competitive market economy might not have the self-correcting forces to eliminate excess supplies of productive resources.

For example, focusing on the limits of monetary policy, at low levels of output the demand for holding money balances would be highly interest elastic. Firms and households exhibit extreme liquidity desires as they face an uncertain future. The motivation to shift from liquidity into bonds is nil as everyone believes the interest rate has reached some floor above zero. The interest rate cannot be moved lower and investment in turn will not be increased. This is the famous 'liquidity trap' and can be represented in Diagram 1 at lower levels of output where the LM curve becomes horizontal.

Corresponding to the IS/LM diagram, underneath is an aggregate demand (AD) and aggregate supply (AS) diagram drawn in (P, Y) space where P represents the overall price level and Y again represents real income. The aggregate demand curve represents a schedule of desired consumption of goods produced in the current time period at their respective periods while the aggregate supply curve reflects the willingness to supply goods and services in the current time period. Exchange in the economy occurs at market clearing points (P_0, Y_0) which is not necessarily to at full employment.

Note the slope of the aggregate supply curve is positive. This is meant to reflect the argument by Keynes that as prices fall, "money wages" would not fall at the same rate and hence firms facing a higher real wage would reduce output.

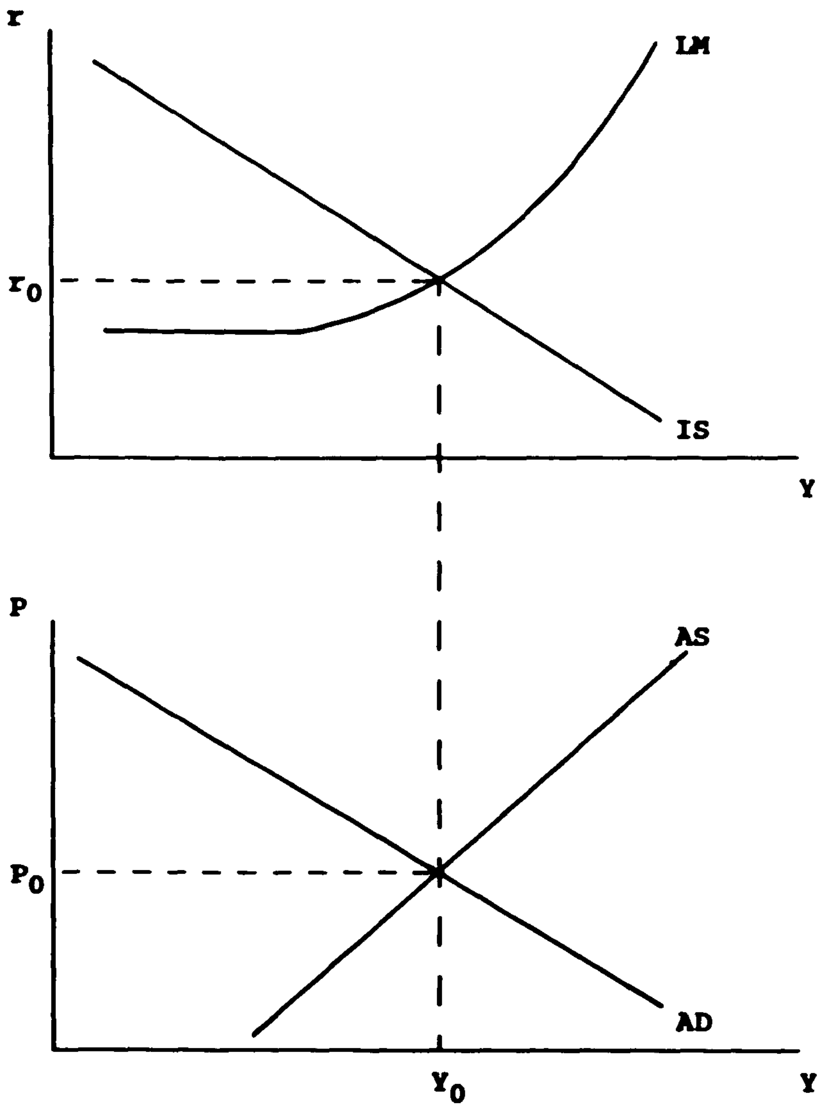
While Keynes argues the economy could find itself at a point of rest at less than full employment, A. C. Pigou

DIAGRAM 1

IS/LM Curve and AD/AS Curves

1a

1b



offered the counter argument that market forces did exist to move the economy back towards full employment. This is shown in diagram 2 where there is both a rightward shift in the LM curve as well as in the IS curve.

This argument was that as prices fell, the value of assets in money terms would rise because the purchasing power of a unit of currency would rise. As the public's value of their respective wealth rose, there would be an increased willingness to shift from savings to current consumption. Entrepreneurs would also shift money balances held for liquidity purposes towards new investment in capital goods. Overall there would be the resulting effect of the economy moving until all resources were fully utilized.

Incorporation of Fisher By Tobin

In comparing the Pigou effect to the Fisher effect, Tobin argues the distinction should between the long run versus short run consequences of deflation: the Fisher effect being the latter.

The argument being that while for every debtor there is a creditor, the spending propensities of the two parties may differ. Debtors can be viewed as having higher propensities to spend from income (or wealth) than creditors. Borrowers based on optimistic forecasts are willing to engage in contracts with expectations of rising prices. For example,young households must substantially borrow in order to acquire homes and firms often borrow to acquire capital goods.

In both cases borrowers are willing to own tangible assets worth more than their respective net worth.

Unexpected price reductions can cause declines in real market values of net worth to exceed the gains to creditors from the increased value of their respective nominal assets. Furthermore, as deflation occurs debt service as a proportion of debtors income grows causing restrictions in further access to credit. Any bankruptcies or technical insolvencies will negatively impact creditors by hampering their liquidity. In this environment restoring financial stability will be given priority over additions to real investment.

This is represented by a leftward shift in the IS curve moving the economy from Y_0 to Y_1.

Incorporating Minsky Crises by Taylor-O'Connell

While Tobin had shown that the Fisher effect could be incorporated into a Hicksian IS/LM framework, recent work by L. Taylor and S. O'Connell used a similar approach to model Minsky crises.

As previously mentioned Minsky argues that the increase of debt by firms leads to dangerous liability structures and a consequent fragile macroeconomy.

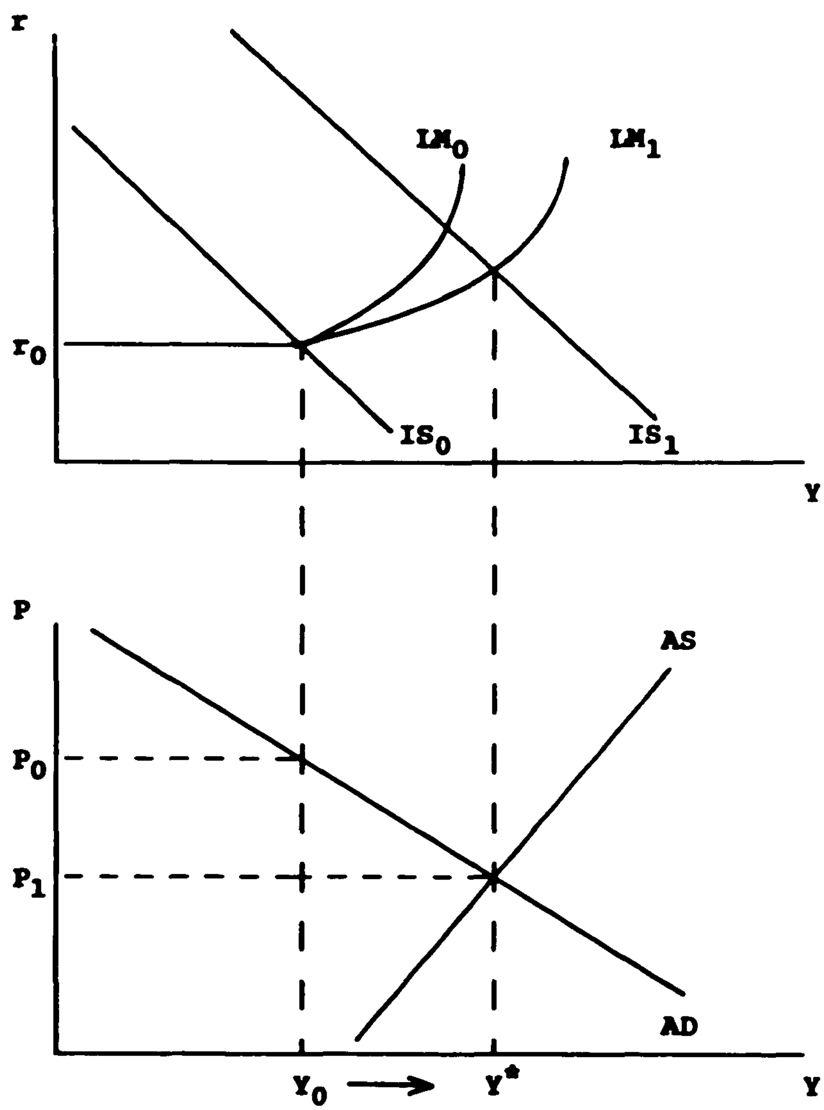
Taylor and O'Connell try to model Minsky crises by acknowledging more formally the portfolio adjustment of firms as a response to such economic variables as the current rate of profit, an expected increase to the current rate of profit and the interest rate charged by lenders. Under certain

DIAGRAM 2

Pigou Effect

2a

2b



circumstances, given the present debt of the firm, the decision to shift towards greater liquidity moves the economy even further in a downward direction.

We begin with a simplified balance sheet that summarizes the assets, liabilities and net worth of all firms and the assets and wealth of capitalist households.

<u>Firms</u>

$\frac{(r + z)}{i}$	E

<u>Households</u>

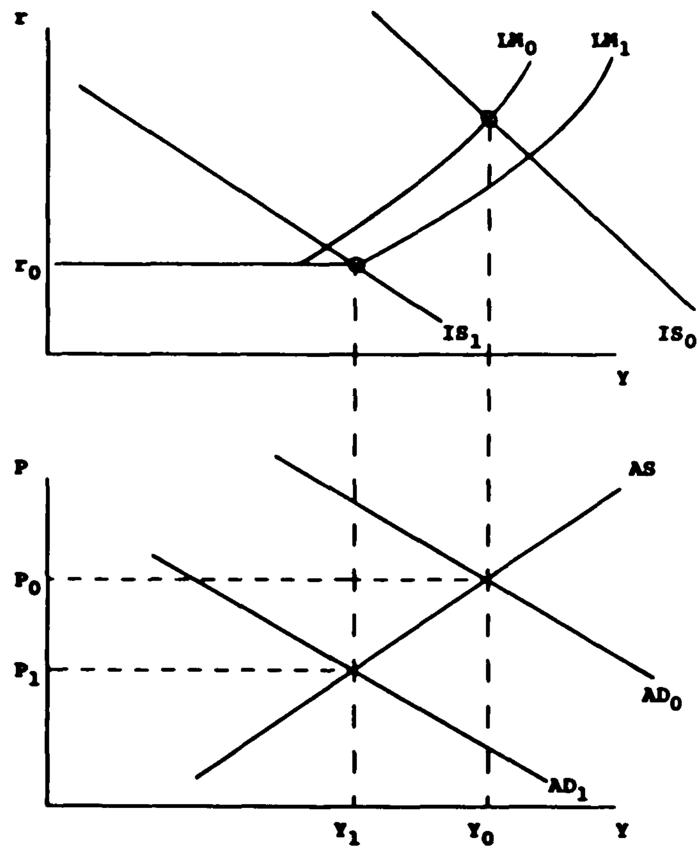
M	
B	
E	W

DIAGRAM 3

Fisher Effect

3a

3b



where:

P - Price Level

K - Aggregate Stock of Capital

E - Owners Equity

M - Money Balances

B - Bonds

W - Household Net Worth.

Firms build up physical capital by using finance available from the intermediation process, represented by the sale of stock.

Minsky's writings refer to individual firm decisions to acquire assets based on future generation of cash inflows. Taylor-O'Connell begin by essentially assuming the production of only one good, an investment good or a consumption good at the price of P.

P then is used to represent the price level which in turn is a constant mark-up over the wage bill:

$$P = (1 + q)wl \quad (1)$$

where:

q - markup

w - nominal wage

l - output-labor ratio.

The current rate of profit (r) would then be

$$r = \frac{PX - wX}{PK} \tag{2}$$

where:

X - output.

The value or implied price (P_k) of an additional unit of capital would be:

$$P_k = \frac{(r + z)}{i} PK \tag{3}$$

where:

z - expected increase to the current rate of profit

i - interest cost.

Firms build up their physical capital from the sale of equity (E) at the market price P_e. Fluctuations in the valuation of physical capital and their respective equity is reflected by changes in net worth (W).

Real Market Size

Savings come from the owners of firms who direct their savings in turn to firms through the equity markets. Workers are assumed to consume all of their wages. Savings (S) then come from profits at the rate s and is given by:

$$S = srPK \tag{4}$$

Let investment demand be based on the following:

$$PI = [g_0 + h(r + z - i)]PK \tag{5}$$

where:

g_0 - a constant representing autonomous capital stock growth

h - a reaction coefficient based on the firm's response to the difference between the current rate of profit and the expected increase to profit and the rate of interest.

Setting desired savings equal to investment demand (dividing both sides by PK) gives the equilibrium condition in the real market:

$$g_0 + h(r + z - i) = sr \tag{6}$$

The rate of growth (g) can be defined as

$$g = \frac{I}{K} = g_0 + h(r + z + -i) = sr \tag{7}$$

Solving for r in equation 6 and substituting in equation 7 gives the following:

$$g = \frac{s(g_0 + h(z - i))}{s - i} \tag{8}$$

Where s - h > 0.

Financial Markets Side

Households maximize their wealth by adjusting their portfolios which consists of money (m) and/or bonds (B)(that were created to finance government activities) and the purchase of equity (E) at the market price (P_e).

Wealth is allocated according to the following equations:

$$u(r + z, i)W = M \tag{9}$$

$$b(r + z, i)W = B \tag{10}$$

$$e(r + z, i)W = P_e E \tag{11}$$

where:

$$u + b + e = 1.$$

Investors base their decisions to hold equity on the expected growth in value of the capital stock of the firms, so focus is made on the expected rate of return (r + z).

If:

$$\begin{aligned} W &= M + B + P_e E = F + P_e E \\ W &- P_e E = F \\ W &= \frac{F}{1-e} \end{aligned} \tag{12}$$

Substituting (9) into (12)

$$u(r+z,i) = \frac{M}{P}(1- e(r+z,i) = a(1-e(r + z,i) \qquad (13)$$

Equation (13) describes equilibrium in the financial asset markets.

Note if we take the total derivative of (13):

$$n_i d_i + n_r d_r = -n_z d_z + (1-e)da$$
$$\frac{d_i}{d_r} = -\frac{n_r}{n_i} < 0. \qquad (14)$$

Where:

$n_i = u_i + ae_i$

$n_r = u_r + ae_r$

$n_z = u_z + ae_z$.

and where we assume d_z=0 and d_a=0. The slope of the curve describing the equilibrium conditions of (13) must be negative.

We graph the curves for real markets and financial markets representing equations (8) and (13) in diagram r in (r, i) space.

In our initial diagram both markets clear at (r_0, i_0). If, however, there was a fall in anticipated profits (represented reducing the demand for new investment. While there would be an upward shift in the financial market curve, there would be a downward shift in the real market curve resulting in a higher interest rate coupled with a lower profit rate.

A Simulation Based on Foley's Liquidity-Profit Cycle Model

While the work of Fisher and Minsky were modeled to show how indebtedness can be a factor using the Hicksian IS/LM framework, more recent theoretical approaches have argued that macroeconomic models need to be based on 'first principles' where closer attention is given to specifying the behavior of individual economic agents.

A reflection of this trend can be found in the work of D. Foley (1987). To specify the microeconomic behavior of the firm, Foley borrows from the work of K. Marx (1971).

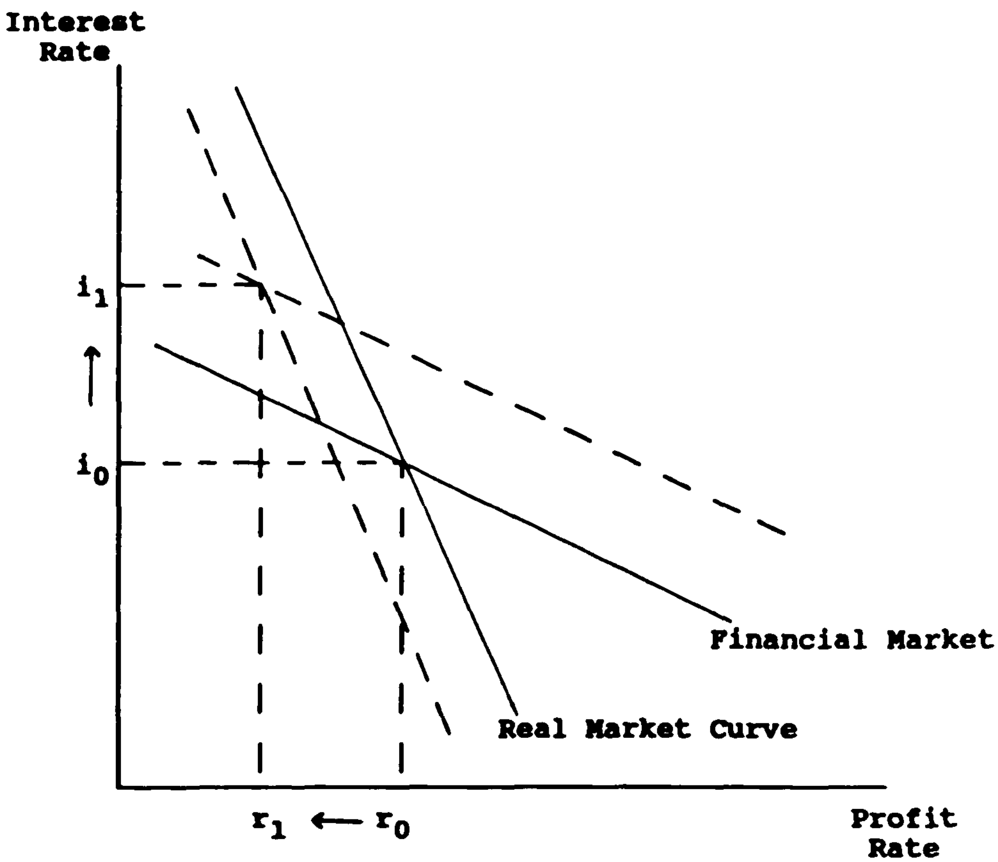
For Marx, the study of consumption and production in a capitalist economy was to be viewed as a circular flow which he called the circuit of capital (K. Marx (ibid) Vol.2 Chapter 1).

The circuit of capital is a specification of a sequence by which capitalists acquire factors of production (ie. labor and capital goods) in order to produce and sell commodities. This process can be represented as follows:

$$M - P(MP, LP) - C' - M+\delta M \qquad (15)$$

DIAGRAM 4

Shift due to a fall in z.



where:

M - money capital

P - production process

MP - means of production

LP - labor power

C' - newly created commodities

δM - surplus value

The circuit of capital begins with money-capital which consists of money used to acquire factors of production. It is the significance of finding labor available as a commodity in a free market context that underlies Marx's labor theory of value. Money becomes money-capital as capitalists as a class of owners of the means of production meet wage-laborers whose means of subsistence lie in the ability to sell their labor power. The production process in turn creates commodities that ultimately are exchanged for money receipts larger than the initial money-capital, the increment being what Marx referred to as 'surplus value.' [2] It is not only the completion of the circuit that interests Marx but also its re-initiation with the use of additional money-capital.

It is the focus of Marxist economic theory, Foley (1986, 8-9) argues, to study the 'ensemble' of capitals (firms) as they traverse the circuit of capital. In this approach use is made of concepts found in accounting such as income statements and balance sheets as they help measure the stocks and flows of value as the firm moves through the different phases of the circuit.

A model within this framework that analyzes firm behavior in the context of viewing finance as a constraint in the investment process is D. Foley's Liquidity-Profit Cycle model.

Here aggregate demand is looked upon from an "explicitly disaggregated, microeconomic point of view" which "emphasizes money as a link between enterprises." (D. Foley, op. cit. p.1)

We begin where all firms have the following balance sheet:

ASSETS	LIABILITIES AND NET WORTH
M	D
F	E
X	

where:

M - money balances

F - other financial assets (i.e. - commercial paper)

X - productive capital

D - financial liabilities

E - net worth

Productive capital consists of inventories of raw materials, partly finished goods, and finished goods awaiting sale. Goods are sold at a markup above cost and as firms make capital outlays they create demand for other firms' goods.

In addition to holding productive capital, firms hold financial assets and incur liabilities. The financial assets consist of money balances (M), loans made to other firms (F) and liabilities (D) consist of borrowings from other firms.

Flow variables can be specified as follows:

$$\dot{M} = i(F-D) + B - L - C \tag{16}$$

$$\dot{F} = L \tag{17}$$

$$\dot{X} = C - S(1-q) \tag{18}$$

$$\dot{D} = B \tag{19}$$

where:

i - interest rate

L - loans made by firms to other firms

C - capital outlays

S - sales

q - profit margin

· - indicates time derivative

Lending by the firm depends on the liquidity of the lending firm and on the spread between the profit rate and the interest earned on the loan while borrowing depends only on the spread.

$$\frac{L}{X} = l(p,m) \tag{20}$$

$$\frac{B}{X} = b(p) \tag{21}$$

where:

$$p = r - i \tag{22}$$

$$m = \frac{M}{X} \tag{23}$$

While firms grow by reinvesting all of their profits, this pattern of growth is tempered by dwindling financial assets, as represented by the ratio e where:

$$e = m + f \tag{24}$$

$$f = \frac{F}{X} \tag{25}$$

Capital outlays are then a function of both the profit rate as well as the stock of financial assets which is represented by:

$$\frac{\dot{C}}{C} = a(r, e) \tag{26}$$

Assume the following:

-money grows at a constant rate of g,

-all firms have the same balance sheets, profit rate and profit margin as well as the same propensity to expand capital outlays,

-i reflects the state of liquidity m such that:

$$p = p(m) \tag{27}$$

and that the rate of profit can be represented by:

$$r = \frac{qS}{X} \tag{28}$$

We can then say:

$$\frac{\dot{m}}{m} = \frac{\dot{M}}{M} - \frac{\dot{X}}{X} = g - r \tag{29}$$

$$\dot{m} = m(g-r) \tag{30}$$

Also:

$$\dot{f} = \frac{\dot{F}}{X} - \left(\frac{\dot{X}}{X}\right)\left(\frac{F}{X}\right) = \frac{\dot{D} - \dot{M}}{X} - \left(\frac{\dot{X}}{X}\right)\left(\frac{F}{X}\right) = b - gm - rf \tag{31}$$

$$r = \frac{qS}{X} = \frac{qC}{X} \tag{32}$$

$$\dot{r} = q\left(\frac{\dot{C}}{C}\right)\left(\frac{C}{X}\right) - \left(\frac{\dot{X}}{X}\right)\left(\frac{qC}{X}\right) = \left(\frac{\dot{X}}{X}\right)\left(\frac{qC}{X}\right) = r(a(r,e) - r) \tag{33}$$

As firms are reinvesting all of their profits in the firm, the growth rate of productive capital matches the profit rate. It, however, cannot go on indefinitely beyond the money growth rate as liquidity becomes a constraint.

Foley then simulates this model using the following formulas which generates a limit cycle for the profit rate (see graph 1):

$$a(r,e) = (1.0 + (e - 1.0)(0.5)/(0.5 + |e - 1.0|))r \tag{34}$$

$$b(m) = 0.2 + (m - 0.5)(0.2)/(0.2 + |m - 0.5|) \tag{35}$$

with initial values of:

g = 0.2; r = 0.1; m = 0.7; f = 0.7.

Given these initial values, the model works in the following way. The rate of profit being lower than the growth rate of money causes liquidity to grow. As liquidity grows, the rate of interest falls below the rate of profit encouraging borrowing. As borrowing and liquidity grow, capital outlays increase pushing up the rate of profit from a rise in aggregate demand.

As the rate of profit rises, liquidity declines pushing up interest rates. Borrowing as well as liquidity falls inhibiting the growth in capital outlays and hence, the cycle begins again.

Foley goes on to describe how the interactions between firms can be described on a macroeconomic level.

Foley's Macroeconomic Model

Let k be the fraction of capital outlays for wages and (1-k) be for other inputs. Furthermore, let u(i,j) represent the jth enterprise's proportion of its capital outlay that creates demand for the ith enterprise and u(0,i) represents spending for wages for the ith enterprise.

The sales for the ith firm becomes:

$$S(i) = u(i,j)(1-k(j)C(j) + u(0,i)k(j)C(j) \tag{36}$$

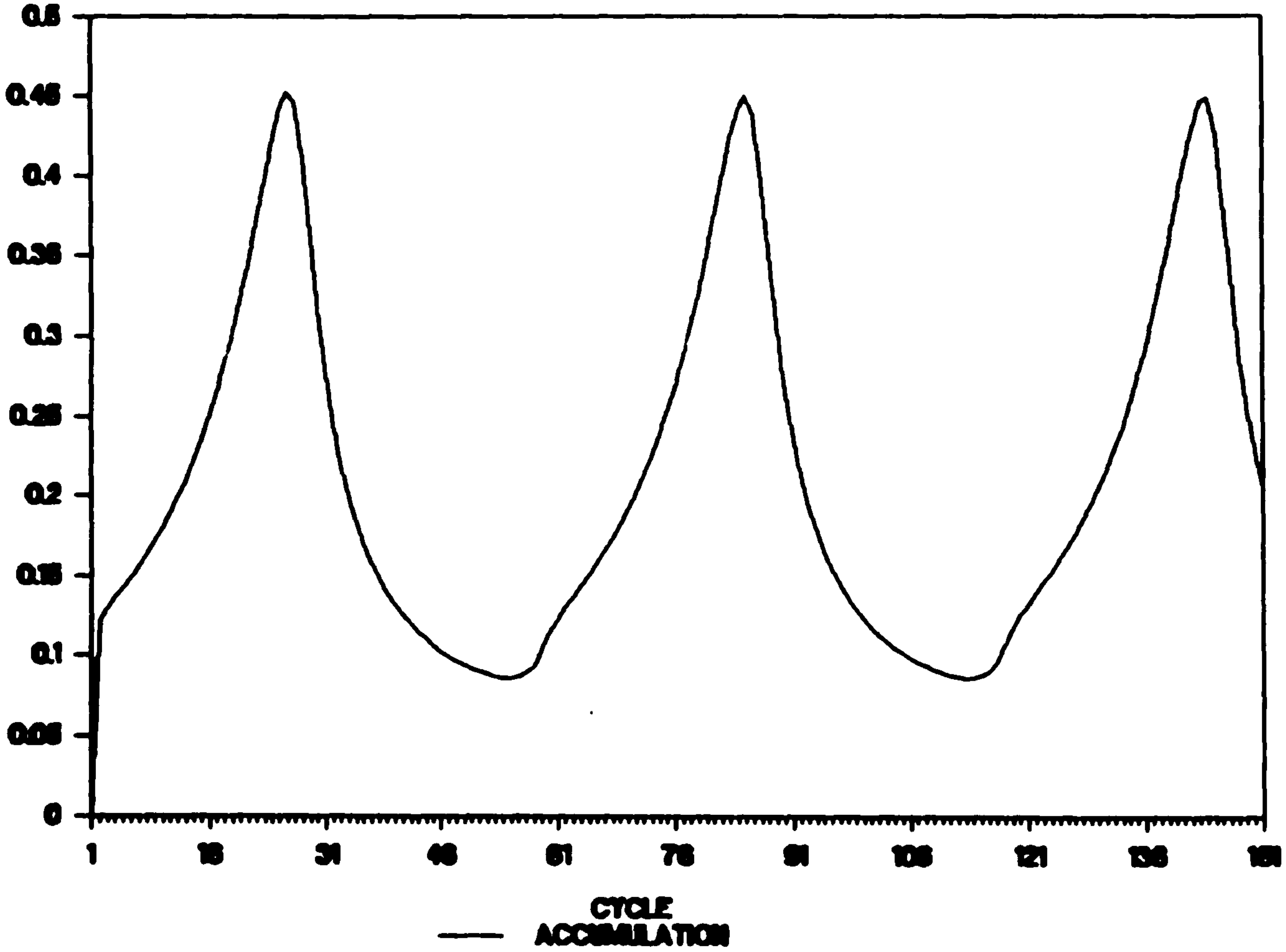
and let

$$v(i,j) = u(i,j)(1-k(j) + u(0,i)k(j) \tag{37}$$

If V is the matrix of the coefficients, sales for the entire economy would be:

$$S = VC \tag{38}$$

LIQUIDITY - PROFIT RATE CYCLES



The entire system is described in the following matrix notation:

$$\dot{M} = S + i(F-D) + B - L - C \tag{39}$$

$$\dot{F} = L \tag{40}$$

$$\dot{X} = C - (I-QS) \tag{41}$$

$$\dot{D} = B \tag{42}$$

$$\sum l[p,m]X = \sum b[p]X + \dot{M} \tag{43}$$

$$P = [R - i]I' \tag{44}$$

$$B = b[p]X \tag{45}$$

$$L = l[p,m]X \tag{46}$$

$$\dot{C} = A[r,e]RC \tag{47}$$

where:

Q - diagonal matrix of profit margins

l[p,m] - diagonal matrix of lending ratios

b[p] - diagonal matrix of borrowing ratios

R - diagonal matrix of profit rates

A[r,e] - diagonal matrix of a(i)[r(i),e(i)]

I - identity matrix

Simulation

As the mathematical properties of this model were complex, Foley developed a simulation on the rate of profit through time. This simulation presented in Graph 1 was duplicated using the MicroSoft BASIC language and formulas (20) and (21).

One aspect about the model is that all firms are assumed to be identical, have identical balance sheets and identical propensities to invest. There also exists however, a substantial literature on the heterogeneous nature of firms, most noteworthy being J. Robinson's work on imperfect competition (1969). Characteristics of imperfect competition are that firms have become quite large with sizeable asset structures, are interdependent as plans by some firms affect the decisions of other firms, and the nature of doing business is very often non-competitive as they share markets, information and sources of finance.

With the growing use of the computer, economists have been using simulations to examine models "whose rich internal structure makes formal solutions for the time paths of the variables impossible" (Laibman, 1987, p. 1).

Using Foley's model, a simulation was constructed to examine the case where firms could be viewed as heterogeneous rather than identical and to address the fact that decisions by some firms affect other firms.

Again using equations (20) and (21) we developed an interdependent relationship as the sales of one firm would depend on the capital expenditures of all other firms as in equations (22)-(24). To keep the model simple, data was provided for four firms with identical capital outlays, financial ratios (identical balance sheets) and rates of profit as in Graph 1 but rather than chart the rate of profit, the rate of growth of sales is shown instead in Graph 2.

Next we change initial conditions first by varying liquidity ratios (Graph 3) and then different rates of profit (Graph 4).

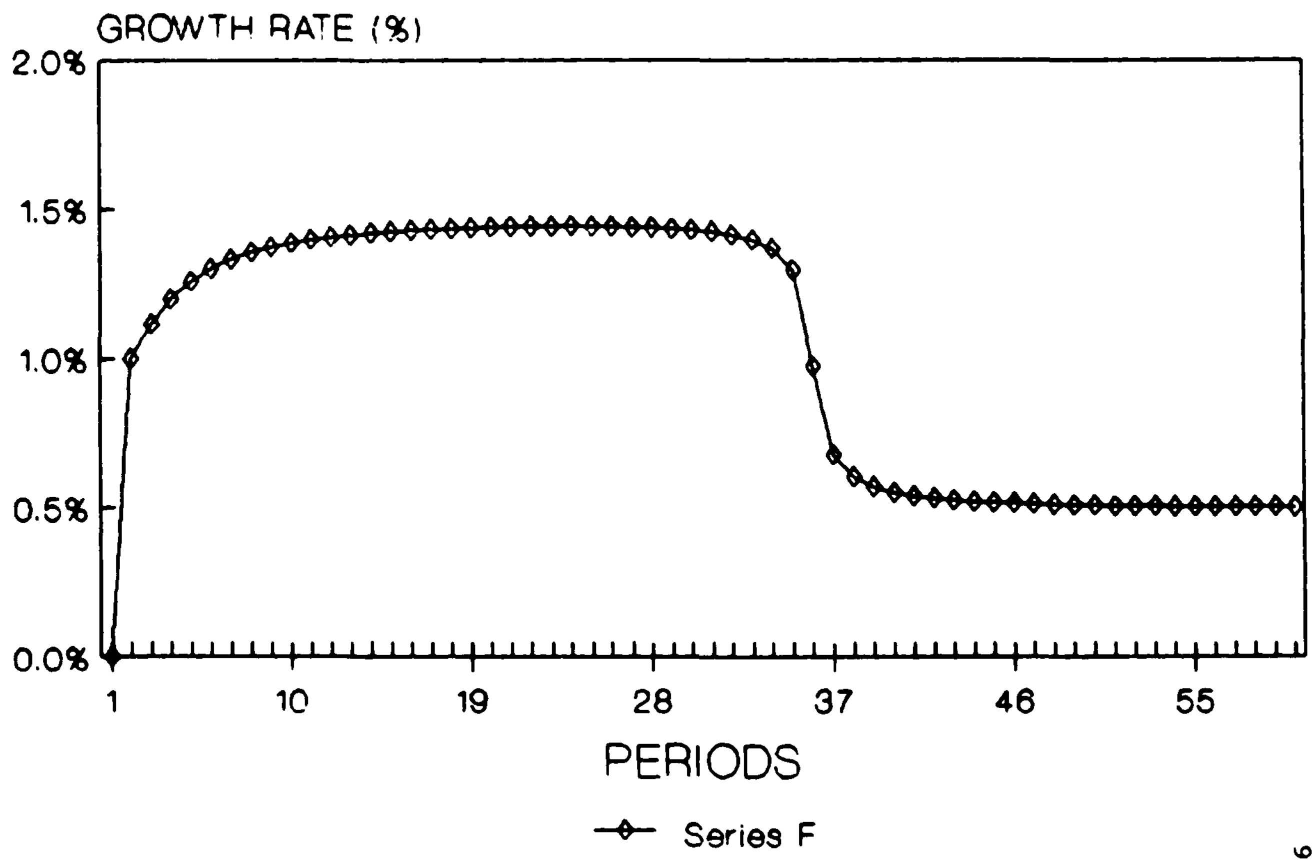
The results portray a transient behavior as the model experiences rapid growth, a slump before settling on a steady state growth (of sales) path.

As the initial conditions were varied in Graph 3, this settling takes place at a different point than in Graph 4 where the firm with the highest profit rate dominates.

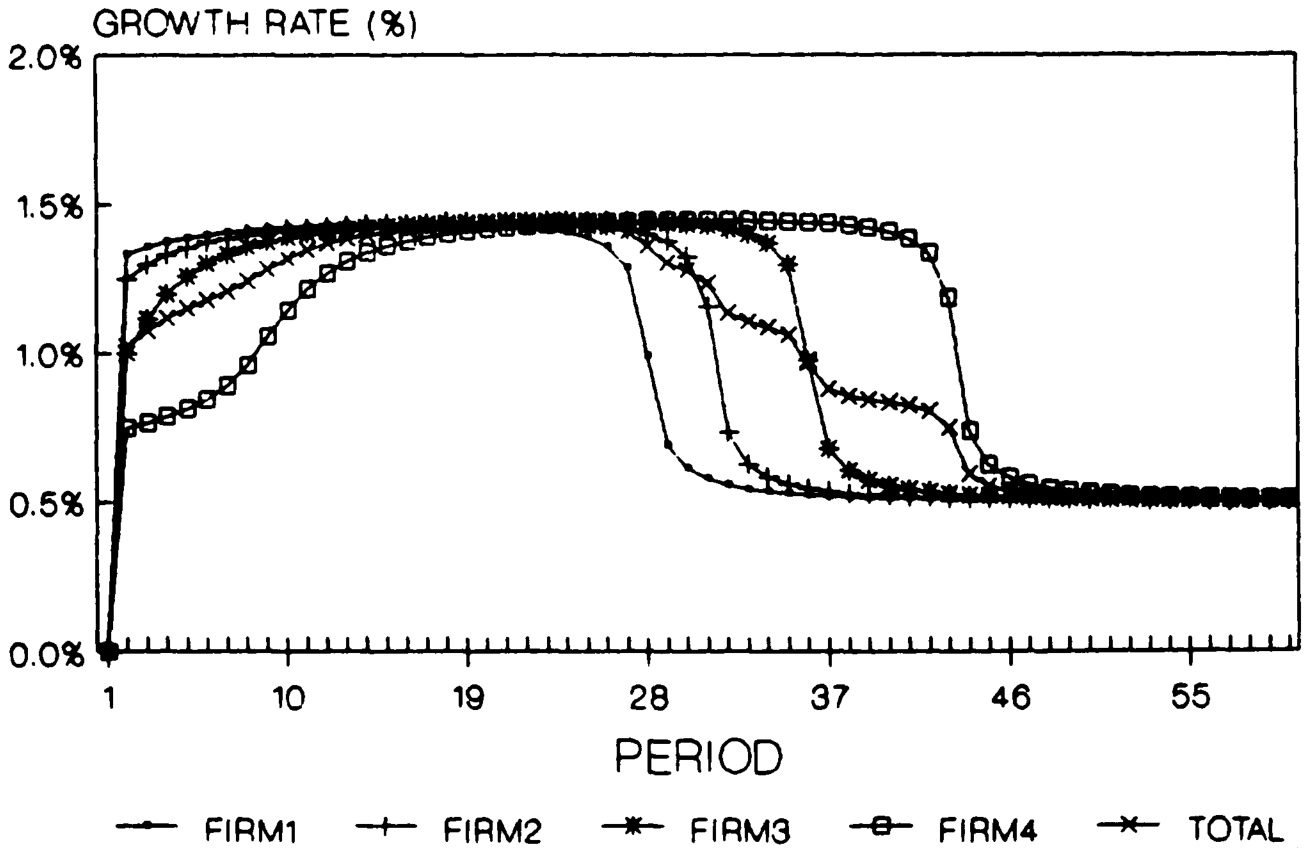
As Graph 4 indicates, one firm survives so a natural question given imperfect competition is why that doesn't happen in real life? (Marris (1986))

Needless to say, four firms is too small a sample to make bold statements and the nature of the interaction needs to be specified better but the purpose of this exercise was to show how simulations may allow for us to examine circumstances that standard mathematical models may not allow for.

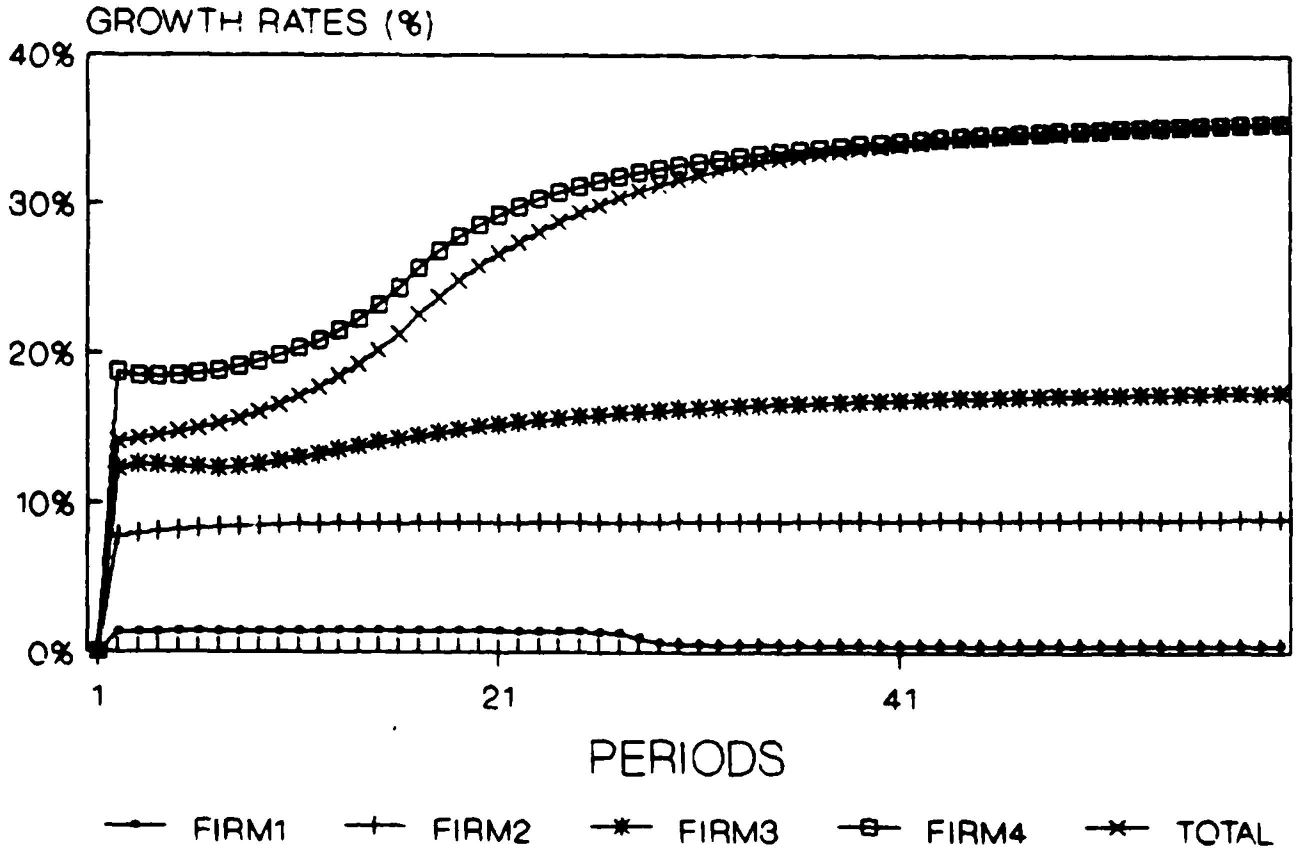
GROWTH RATE - ECONOMY
IDENTICAL FIRMS



FIRM GROWTH RATES
LIQUIDITY 100% - 25%



FIRM GROWTH RATES
PROFIT RATES 10% - 50%



Notes For Chapter 5

1.For a critique see Financial Crisis: Theory, History and Policy edit; C. Kindleberger and J.P. Laffargue (1982).

2. Marx later argued that the study of how an economic system reproduces itself was just as important as how it produces. This analysis consists of dividing the economy into a capital goods sector and a consumer goods sector and formed the basis of Simple reproduction versus Extended Reproduction which has often been the foundation for showing why the capitalist system has tendencies towards crises (A. Emmannuel (1985)).

Chapter 6

Concluding Remarks

The recent literature focusing on the notion of asymmetric information combined with agency theory allows for an examination of firms to be viewed as a heterogeneous group.

The empirical effort in the study suggested that the investment plans of small firms (size being defined by total assets) are more dependent on internally generated funds than are large firms. This may be due to the varying degrees faced by firms in having access to credit.

Large firms characterized by longer histories and less variability with respect to such variables as generating sales, making capital expenditures and levels of employment are viewed with greater certainty by potential lenders in the public auction type credit markets.

Commercial banks become the major source of external finance for the small firm. As credit restrictions become more stringent an important source of business activity and employment can become severely constrained.

Greater understanding of information problems associated with agency relationships have allowed for a better specification of the motivation of both borrowers and lenders.

Coupled with greater ability in the gathering of statistical information these advances hopefully will allow for both theoretical reconciliation as well as wiser government policy action to ameliorate the impact of sudden credit restrictions.

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