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for Research in Economics at Yale University

MONOGRAPH 20

Studies of Portfolio Behavior

EDITED BY

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Foreword

This monograph is one of three (Monographs 19, 20, and 21) that bring together nineteen essays on theoretical and empirical monetary economics written by recent Yale graduate students and staff members of the Cowles Foundation. Seven of these are based on doctoral dissertations approved by the Yale Economics Department, supervised by Cowles Foundation staff members and other members of the Department.

The sixteen authors do not necessarily have common views about monetary theory and policy or about empirical methods and findings. Their contributions do not fit together in any prearranged master research plan; the idea that they would make a coherent collection is a product of afterthought, not forethought. But the essays do have a certain unity, the result of a common intellectual climate which suggested many of the questions to be asked and many of the theoretical and empirical approaches to finding the answers.

The conception of "monetary" economics underlying this collection of essays is a very broad one. Monetary phenomena are not confined to those involving the quantity of currency and demand deposits, and commercial banks are not the only financial intermediary considered to be of monetary interest. There is no sharp dividing line between assets which are "money" and those which are not or between institutions that emit "money" and those that do not. The emphasis is on differences of degree, not differences in kind. To justify this emphasis, it is only necessary to recall the great difficulty which economists who stress the sovereign importance of the "quantity of money" have in drawing the dividing line to define money.

Monetary theory broadly conceived is simply the theory of portfolio management by economic units: households, businesses, financial institutions, and governments. It takes as its subject matter stocks of assets and debts (including money proper) and their values and yields; its accounting framework is the balance sheet. It can be distinguished from branches of economic theory which take the income statement as their accounting framework and flows of income, saving, expenditure, and production as their subject matter.

Of course, separation of the theory of stocks from the theory of flows is artificial and tentative. Economists work toward the synthesis of the two, and many attempts at combining them have been made, with varying degrees of simplification and success. Nevertheless, the artificial distinction seems a useful one, especially for the development of monetary economics. The processes which determine why one balance sheet or portfolio is chosen in preference to another are just beginning to be studied and understood. In studying these processes it helps to keep the links between capital account and income account as simple as possible. At any rate, that is the approach of most of the essays in this collection.

Like other branches of economic theory, monetary theory has both a microeconomic and a macroeconomic side. Monetary microeconomics concerns the balance sheet or portfolio choices of individual units—households, businesses, or financial institutions. The choices are constrained by the wealth of the unit and by its opportunities to buy and sell assets and to incur or retire debt. Within these constraints, the choices are affected by the objectives, expectations, and uncertainties of the unit. Monetary macroeconomics concerns the general equilibrium of the capital accounts in the economy as a whole, the way in which asset prices and yields adjust to equate the demands to the supplies of the various assets and debts.

Monetary economics is as old as any branch of economics, but until fairly recently it lacked a solid microeconomic foundation. Elsewhere in economic theory this foundation is supplied by some assumption of optimizing behavior, for example, maximization of utility by consumers or of profits by firms. But the usual assumptions of pure economic theory—perfect certainty, perfect markets, no transactions costs or other frictions—provide no rationale for the holding of diversified portfolios and balance sheets (much less for the holding of money and other low-yield assets) or for the existence of financial institutions. Monetary theory was therefore based for the most part on *ad hoc* generalizations about capital account behavior, based on common sense or empirical observation rather than on any logically developed notion of optimal behavior.

During the last twenty years, economic theory, stimulated in part by the upsurge of interest in management science and operations research, has tackled directly the problem of defining optimal behavior in situations involving market imperfections, transactions costs and other "frictions," and uncertainties about future prospects. The tools developed have proved to have some fruitful applications to monetary behavior. For example, the theory of optimal inventory policy gave solid theoretical explanations of the transactions and precautionary demands for cash—phenomena that have long played a central role in traditional monetary economics.[1]

Another theoretical tool with important uses in monetary analysis originated in the general study of decision-making under uncertainty. It became possible to give a precise expression to the common-sense observation that distaste for risk leads investors to diversify portfolios and to hold assets with widely differing expected yields simultaneously. In an earlier Cowles Foundation Monograph,[2] Harry Markowitz proposed a way in which the risk and expected yield of a portfolio could be defined and calculated from the subjective probabilities assigned by an investor to the various future prospects of the assets included in the portfolio.[2] He showed further how to compute *efficient* portfolios; an efficient portfolio is one whose expected return could not be raised by altering its composition without also increasing risk. Markowitz's interest was mainly normative; that is, his objective was to show investors how to be rational. However, if it is assumed that investors are in fact behaving rationally, the same approach can be fruitfully applied in positive monetary analysis. An early application of this kind to the famous question of the "speculative" demand for money was made in the article reprinted here as Chapter 1 of Monograph 19.

The seven essays in Monograph 19, *Risk Aversion and Portfolio Choice*, have both normative implications, as pieces of advice to investors, and positive implications, as descriptions of the economy. They are partly theoretical and partly empirical. They concern, on the one hand, the *attitudes* of investors toward risk and average return and, on the other, the *opportunities* which the market and the tax laws afford investors for purchasing less risk at the expense of expected return.

Monograph 20, *Studies of Portfolio Behavior*, is institutionally oriented. The six essays draw on the theoretical developments mentioned above

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[1] See William J. Baumol, "The Transactions Demand for Cash: An Inventory Theoretic Approach," *Quarterly Journal of Economics*, Vol. LXVI, No. 4 (November 1952), pp. 545–56; James Tobin, "The Interest-Elasticity of Transactions Demand for Cash," *The Review of Economics and Statistics*, Vol. XXXVIII, No. 3 (August 1956), pp. 241–8; and Don Patinkin, *Money, Interest and Prices* (Evanston: Row, Peterson and Company, 1956), Chap. 7.

[2] Harry M. Markowitz, *Portfolio Selection: Efficient Diversification of Investments* (New York: John Wiley and Sons, 1959).

and seek to apply them to the particular circumstances and objectives of various kinds of economic units: households, nonfinancial corporations, banks, and life insurance companies. It is our hope that the analytical tools contribute to the interpretation of the statistical data available on balance sheets and capital accounts.

The subjects of Monograph 21, *Financial Markets and Economic Activity*, are macroeconomic. They concern the conditions of equilibrium in economy-wide financial markets. The microeconomic principles discussed in the first two monographs are assumed to guide the behavior of individual economic units, including financial intermediaries, in demanding and supplying assets and debts in these markets. But the main focus is on the adjustment of interest rates and other yields to create equilibrium in various financial markets simultaneously. From this standpoint, the quantity of money as conventionally defined is not an autonomous variable controlled by governmental authority but an endogenous or "inside" quantity reflecting the economic behavior of banks and other private economic units. Commercial banks are seen to differ from other financial intermediaries less basically in the nature of their liabilities than in the controls over reserves and interest rates to which they are legally subject. Models of financial market equilibrium can be used to analyze a wide variety of questions about the behavior of financial markets. The theoretical studies in Monograph 21 apply this framework to investigate the consequences of various institutions and regulations for the effectiveness of monetary control. In addition some empirical findings on the structure of interest rates by maturity and by risk category are reported.

Some of the essays were, as indicated in footnotes, written under a grant from the National Science Foundation. We are grateful for their continuing support of research in this area at the Cowles Foundation. The staff of the Cowles Foundation—secretaries, librarians, and research assistants—has contributed efficiently and cheerfully to the original preparation of the papers and to their assembly into Monographs 19, 20, and 21. Particular gratitude is due Miss Althea Strauss, whose loyal and indefatigable service as administrative assistant provides important continuity at the Foundation, and to Mrs. Amanda Slowen, on whom fell the exacting task of retyping some of the material. Finally, the editors and all the authors are in greater debt than they may realize to Karen Hester, who painstakingly and skillfully edited the papers for inclusion in the monograph. She improved them both in English and in economics, but she is not responsible for the defects that remain.

New Haven, Connecticut
October, 1966

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Contents

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*Consumer Expenditures and the Capital Account**

HAROLD W. WATTS AND JAMES TOBIN

INTRODUCTION

Like a business firm, a household may be imagined to have two related accounts, an income account and a capital account. The income account comprises *flows* over a period of time; the items in the capital account are *stocks* at a moment of time. The shape of the household income account is determined by decisions concerning work and leisure; consumption and saving; food, shelter, recreation, and other categories of consumption; insurance premiums, mortgage payments, and other forms of saving. A second set of decisions determines the shape of the household balance sheet; amounts of various kinds of indebtedness; proportions of wealth held in securities, life insurance, cash, business or professional assets of self-employed, residence, automobiles, household appliances, and so on. Traditionally both theoretical and statistical analyses of household economic behavior have concentrated on the income account

* SOURCE: This paper is based on research undertaken in connection with a broad Study of Consumer Expenditures, Incomes and Savings at the Wharton School of Finance and Commerce of the University of Pennsylvania. The Study is based largely on the 1950 survey of the Bureau of Labor Statistics of 12,500 families in 91 representative cities. It is financed by a grant from the Ford Foundation.

The authors wish to thank the Yale University Computing Center for its support of the lengthy computational work. Thanks are also due to Sylvester Berki, Donald Hester, John Nagle and Alvin Puryear for their assistance in performing the calculations. The helpful comments of Arthur M. Okun and Robert Summers of the Cowles Foundation are gratefully acknowledged.

and on the corresponding decisions regarding flows. The present paper, following a less common but growing practice, emphasizes the capital account and investment decisions of the household.

The bridges between the two accounts are of two kinds: accounting and behavioral. By an elementary accounting identity, the increase in net worth of the household over a period must—apart from capital gains and losses—equal net saving during the period. More important are the connections in economic behavior. The over-all division of income between saving and consumption is conditioned by the household's current net worth viewed in relation to its goals of accumulation—next summer's vacation, children's college educations, retirement, legacies. Furthermore, the composition of current savings and investment depends on the structure of the capital account, as well as on net worth, and on the pattern, as well as the magnitude, of future consumption plans and aspirations. Many items of consumption, and many occupational pursuits as well, are either wholly inaccessible or available only at considerable extra expense to households who have not acquired specific assets. Accordingly many assets in the household's capital account—both durable consumption goods and business or professional capital—serve a dual purpose; they facilitate the desired pattern of consumption and work, and they help to meet at least some of the goals of wealth accumulation.

In perfect markets, it is worth noticing, only the over-all bridge between saving and net worth would be necessary. The household's decision problem would be less complex, and the analytic task of the interested econometrician would be easier. Decisions regarding the pattern of consumption could be taken without regard for the structure of asset holdings. By the same token, investment decisions could be reached with sole regard for capital appreciation, unconstrained by the household's consumption, or occupational, preferences. Thus the owner of a car and a washing machine would be able to consume the yields of these investments even if he chose, perhaps only temporarily, neither to ride nor to wash clothes—either by renting them out or by selling them, perhaps for later repurchase, and investing the proceeds in assets of liquid yield. Similarly the household wishing to include car mileage and washing-machine-service hours in its consumption program would not need to include the equipment in its asset portfolio but could buy the desired services. But in fact markets for rental and sale of durable goods are imperfect, so that it is both difficult to realize their value as an investment except by consuming their services directly, and expensive to consume the services without owning the goods. The rent a car owner can command by letting his car to someone else is much lower than what he would have to pay to hire the same service, from taxi or drive-yourself companies. Likewise, the price he could realize by selling his car is smaller than what he would have to pay a dealer for a car of the same age and quality. There are similar discrepancies—less for houses, more for smaller goods—between the buying and selling prices and rents of all consumers' durables, and indeed of business and professional equipment as well. These imperfections complicate the investment and consumption decisions of households, connecting the structures, as well as the net totals, of wealth and consumption.

They also complicate the accounting itself. In principle, no matter when a durable good was bought, the use of its services during a period—nothing more nor less—ought to be reckoned as consumption. The same services enter the other side of the account as income, offset to the extent perhaps of 100% or more by the decline in the value of the good due to age and use. The capital account would carry the value of the good; purchase of a new good would be an item of saving and investment rather than a consumption outlay. Were there perfect rental and sale markets, there would be unambiguous money values to assign to the consumption, net income, and capital values of durable goods. An approximation to this principle is attempted, both at a household level in budget studies and at an aggregative level in national income accounts, for houses, where rental and sales markets, though far from perfect, are better developed than for lesser consumers' durables. By and large, the margins of indeterminacy between buyers' and sellers' prices and rents are too great to permit the application of these principles of valuation and accounting. It is not, as often thought, simply the difficulty of collecting the necessary information about use and depreciation that is responsible for the unsatisfactory handling of durable goods in household budgets and national accounts. The essential imperfections of their markets make it impossible to express and to aggregate all items on balance sheets and income accounts in terms of a single homogeneous unit of value.

As a result, there are two approaches, both valid and both incomplete, to analysis of the demand for durable goods. From the standpoint of the income account, expenditures on consumers' durables, which provide for consumption of the related services sooner or later, compete with consumption outlays for food, recreation, services, etc. From the standpoint of the capital account, ownership of durables competes with the holding of cash or other financial assets, or with freedom from debt. On both counts, there are reasons to expect households to maintain some balance between their investments in durable goods and other forms of holding wealth. Consumption of the services of durable goods competes with more distant consumption objectives, which are better provided for by financial assets—securities, insurance, retirement programs. As investments, durable goods share the advantages and risks, with respect to changes in price level and relative prices, of business equities; but they are less liquid and offer less scope for reduction of risk by diversification. A prudent household will wish to balance a position in durable goods by ownership of assets of assured stability of money yield and money value. This motive will be stronger if the durable goods position is financed by mortgage or installment debt.

A rational household will not persistently hold cash and short-term liquid assets beyond transactions requirements when these could be used to reduce outstanding indebtedness. Simultaneous holding of liquid assets of low yield and debt of high interest cost can be explained by the fear that the opportunity to borrow might not be available later if and when funds were needed, and by restrictions imposed by lenders on the speed of debt repayment. It is, of course, rational to balance against debt investments of relatively fixed money value if they promise a higher rate of return or if they are, like life insurance and pension rights, imperfectly liquid means of meeting future goals of accumulation.

The basic hypothesis underlying the calculations to be reported in this paper is that households endeavor to maintain a certain equilibrium or balance among the various items of the capital account: goods, cash and liquid assets, long-term financial assets, debts. The desired structure of assets and debts will be different for different households, depending, among other things, on (*a*) their requirements and tastes for the services of consumers' durable goods, (*b*) their needs for balances of cash and liquid assets to meet transactions and to provide for contingencies due to fluctuations of income and outlay, (*c*) the investment requirements of their occupations, (*d*) the nature and remoteness of future demands on wealth, for retirement and for children, (*e*) their ability to borrow, (*f*) the extent of their information about capital markets, their estimates of the prospects, in terms of purchasing power, of various available assets, and their attitudes towards the associated risks, and (*g*) the difficulty and cost to them of making capital transactions. Since these factors are not directly observed, their influence must be sought in terms of observed variables with which they are likely to be related. Thus the desired structure of assets and debts may be expected to be different for households differing with respect to age, education, family size and composition, occupation, and location. It will be different for households at different levels of income or of "living"; as a determinant of fairly durable patterns of consumption, current income seems less relevant than a longer-run standard of living or "permanent income." Further, the relative proportions of different assets and debts can be expected to vary, for any given income level, with the general level of household wealth. For most households, a major decision affecting the structure of the balance sheet is whether or not to own a home. This decision depends on the factors already enumerated and, in addition, such unobserved considerations as frequency of occupationally required moves and attitudes towards the risk and effort specific to home ownership. Once this major decision is made, many other features of the balance sheet follow, e.g., mortgage debt and home furnishings. Home ownership is thus another observed variable to which the structure of the capital account is related. There will, of course, be residual differences in circumstances and tastes that are not measured by any of these observed variables; accordingly there will be unsystematic and unexplained differences in asset-debt patterns.

One implication of the hypothesis is the possibility of an imbalance in the actual asset and debt structure of households—too much of some assets, too little of others. (Throughout this discussion debts should be regarded as negative assets, high in value when low in absolute amount.) The structure cannot be changed overnight, given the imperfection of asset markets and the illiquidity of many assets. But circumstances and tastes can change so that a set of assets and debts that was once an equilibrium becomes a disequilibrium. Economists, at least until the vogue of *The Affluent Society*, have rightly been scornful of popular and journalistic notions of saturation and have emphasized that wants are unlimited and that households can never have too many durable goods, for example, in any absolute sense. But relative saturation there can be. Consumers can have too many durable goods, not in any absolute sense, but relative to their net holdings of financial assets. The opposite phenomenon, relative saturation with liquidity, no doubt characterized household balance sheets immediately after the war. Quite apart from dramatic shifts of circumstance or taste, the capital-account adjustments of a household are necessarily a continuing dynamic process; the appropriate amount and composition of wealth varies over the "life cycle." The adjustment process can be estimated by observing the relations of changes in assets and debts during the year to the levels of the same assets and debts at the beginning of the year. The hypothesis implies, generally speaking, that the change in each stock will be negatively related to the initial level of the stock itself but positively related to the initial level of other stocks.

The basic hypothesis suggests two sets of calculations, one in which stock levels are the variables to be explained, and a second in which changes in stocks, or flows, take this role. Each set of calculations consists in turn of two parts: regressions of the dependent variables on various combinations of explanatory variables; and calculations of the correlations, simple, partial, and multiple, among the dependent variables before and after the regressions. In the case of the regressions of the stock variables, the explanatory variables are those enumerated above—indicators of the biological, geographical, social, and economic circumstances of the household. The purpose is to measure the influence of each explanatory variable on asset and debt holdings, and to test their significance in explaining differences among households in these holdings. The hypothesis suggests not only that these variables will be significant explanatory factors for the stocks individually but also that much of the consistency in the structure of stocks will turn out to be due to their common dependence on these explanatory variables. This suggestion is the reason for the calculation of correlations among the stocks before and after the regressions; to the extent that the suggestion is correct, the correlations will be smaller after regression. The regressions and correlations computed for the flows are similar in purpose. However, the flow regressions have, in addition to the explanatory variables used in the stock regressions, the initial values of the stocks themselves. Their inclusion is designed to test the implications of the hypothesis regarding adjustment of the capital account and to estimate the parameters of the adjustment process.

THE OBSERVATIONS AND THE VARIABLES USED

Since the objectives of the study did not include exhaustive description of consumer behavior no attempt was made to use the entire 12,500 observations available. The hypotheses under consideration, while perhaps relevant to all kinds of consumers, can be fairly examined only by comparing behavior among relatively homogeneous households. Some categories of households were eliminated entirely, leaving several subsamples which meet the homogeneity requirement and at the same time are large enough to warrant the use of statistical analysis and inference. The body of data used can be concisely described as a sample of households including an employed, male head between 25 and 74 years of age as well as one or more other persons for at least part of the year. All households not meeting those specifications were dropped from the sample. In addition households headed by a "professional" with less than 8 years of education and those headed by "unskilled" workers with more than 12 years of education were eliminated. Finally, a few households were removed because of missing information on a variable used in the analysis.

The remaining households were divided on the basis of tenure status at the end of 1950. Households owning homes at the end of the year comprised one category and all other households a second. These classes will be referred to subsequently as home owners and renters respectively. All calculations and analyses have been carried out separately for home owners and renters. There are two reasons for this. First, as has already been mentioned, ownership of a home has a large impact on a household's capital account and can be expected to influence the amount as well as the composition of expenditures and assets. Second, housing level is used as one of the variables in the analysis and there is no clear solution to the problem of defining a measure of housing level which renders home owners and renters comparable.

Further subdivisions of the sample by age and education were made at some points in the analysis. For this purpose 4 age classes and 3 education

Table 1 Sample Frequencies by Tenure, Age, and Education Classes

Age	25–34	35–44	45–54	55–74	All
Home owners					
Education (yrs.)					
0–8	117	343	490	684	1,634
9–12	539	672	437	348	1,996
13 or more	228	354	226	135	943
All	884	1,369	1,153	1,167	4,573
Renters					
Education (yrs.)					
0–8	297	356	388	357	1,398
9–12	780	539	232	145	1,696
13 or more	368	176	117	73	734
All	1,445	1,071	737	575	3,828

classes were recognized. In the case of age the end-points were 25 to 34, 35 to 44, 45 to 54, and 55 to 74. For education the classes were defined as less than 9 years, 9 to 12 years, and more than 12 years. The class frequencies by tenure, age, and education are shown in Table 1.

Ideally an analysis of household capital accounts would start with data showing an exhaustive enumeration of major balance sheet items for each household. Such complete information is not available in the Survey of Consumer Expenditures and probably will not be available in surveys of comparable size and coverage for some time to come. Although a complete balance sheet is not available, an attempt has been made to glean as much of it as possible from the available data.

The information on inventories of durable goods has been used to build 8 of the stock variables used in this study. The inventory data show the ages of specific durable goods in 5 age classes. To form the new variables approximate values were assigned for each good owned by a household on the basis of its age, and the values thus obtained were combined under seven general headings. The seven variables are

A_1: Furniture,
A_2: Basic Kitchen Appliances (Range and Refrigerator),
A_3: Laundry Appliances (Washer, Ironer),
A_4: Deep Freeze,
A_5: Miscellaneous Appliances (Vacuum Cleaners, Sewing Machines),
A_6: Radios and Phonographs,
A_7: Television

An eighth variable, A_f, was formed by adding A_1 through A_7 together and, since this sum represents inventory value at the end of the year, the expenditures on durables during the year were deducted to arrive at a beginning of year value of durable goods. The schedule of values used in the assignment process are shown in Table 2. They were arrived at by applying "reasonable" depreciation rates to approximate prices of new goods in 1950 as shown in catalogs, *Consumer Reports*, etc.

Table 2 Assignment Schedule for Valuation of Durable Goods

	Year of Purchase	1950–1951	1946–1949	1941–1945	Pre 1941
A_1	Living room suite	$300	$250	$200	$100
	Dining room suite	300	250	200	100
	Dinette set	100	80	60	20
	Bedroom suite	300	250	200	100
	Upholstered Chair	100	80	60	20
	Rugs and carpets	200	150	100	50
	Pianos and organs	750	600	500	300
A_2	Range	200	120	40	30
	Refrigerator	300	180	60	45
A_3	Automatic washer	250	150	50	38
	Non-automatic washer	150	90	30	22
	Ironer	175	105	35	26
A_4	Deep freeze	300	180	60	45
A_5	Sewing machine	200	120	40	30
	Upright cleaner	75	45	15	11
	Tank-type cleaner	75	45	15	11
A_6	Phonograph	75	45	15	11
	Radio	50	30	10	8
	Radio-phono. comb.	250	150	50	38
A_7	Television	300	180	60	45
	Television comb.	400	240	80	60

Table 3 Assignment Schedule for Value of Automobile

Year of Purchase	Price Class			
	Low	Medium	High	Not Ascertained*
1950–1951	1500	2000	2800	1700
1946–1949	1000	1200	1600	1100
Pre 1946	300	400	600	300
Not Ascertained*	500	600	800	500

* Pertains only to age or price class—not to whether household owns a car or not.
Note: Schedule value above multiplied by 1.5 in the case of multicar households.

Two dimensions of the automobile stock are given in the data: the age and the price-class. Here, again, an assigned value was placed on each possible combination of age and quality of automobile. The variable T is this assigned value minus the net cost of automobiles purchased during the year to transform it to a beginning-of-year basis. The assignment schedule is shown in Table 3.

The variables cash in bank, C, and mortgage debt, M, were available directly in dollar amounts as of the beginning of the year. Installment debt, I, was punched in classes and was transformed into dollar amounts by assigning approximate "midpoint" values to the class codes. The "midpoints" used are shown in Table 4.

One other variable was, for all purposes, treated as a stock. Life insurance premiums can in some cases be interpreted as a proxy for the value of the policy—a proper balance sheet item for all non-term insurance. For this reason the reported premiums on Personal Insurance, Z, was added to the list of variables to be analyzed.

Table 4 "Midpoints" for Installment Debt Classes Used for Assigning Dollar Amounts to I

Class Intervals	"Midpoints"
0–0	0
1–100	50
100–200	150
200–300	240
300–400	330
400–500	420
500–1000	600
1000 and over	1200

As far as possible, flow variables were chosen and defined to correspond to stock variables. The reported expenditures on furnishings and equipment, E_f, thus corresponds to the stock variable A_f on total durable goods. Net cost of Automobile Purchases, ΔT, Change in Mortgage Debt, ΔM, Change in Installment Debt, ΔI, and Change in Cash Balances, ΔC, similarly correspond to the Stocks T, M, I, and C, respectively. It must be admitted that the correspondence is less than perfect for some of the paired stocks and flows but it does not seem that the differences are great enough to hamper seriously the modest objectives of the investigation.

In addition to these flows, Change in Total Assets, ΔA, and Change in Total Debts, ΔD, have been added to the list; both variables were directly reported in the Survey. Also the difference between the two, $S (= \Delta A - \Delta D)$, has been used. Although this difference will be called saving, it should be explicitly noted that it is different from the saving figure that would result from simply computing the difference between disposable income and consumption expenditures. It is difficult to say which measurement more closely approximates the "change in net worth" measure which would be ideal for the purposes of this study; there are considerations pointing in both directions. In any case, the nominal "net worth" measure was chosen here.

The group of variables upon which the stocks and flows are dependent according to the hypothesis may be described as a set of indicators of social status, economic status and prospects, life-cycle standing, and environment. The independent or determining variables to be used in the analysis to follow are: age (A), education (E), occupation (O), family size (N), region (R), community size (L), disposable income (Y), and housing level (H). It is claimed that these variables, as a group, provide a reasonably good description of a household's location with respect to the relevant dimensions mentioned above. Unfortunately the observable variables are not related in any simple way to those dimensions. For example a variable such as education may be relevant because of its relation to social status or because of its effect on income prospects. This consideration will complicate matters later when an attempt is made to interpret the empirical findings.

The variables age and education have been introduced in two ways. At some points the sample was classified by age and education and separate regressions fitted within each subgroup. This procedure allows age and education to interact freely with each of the other variables in the regression. When the two tenure groups were not subdivided, additive age and education effects were allowed for by introducing dichotomous dummy variables. Dummies A-2, A-3, and A-4 represent the older three of the four age classes, and E-2 and E-3 represent the two higher education classes.

The coefficients of these variables must be interpreted as differential effects relative to the youngest age class or the lowest education class, as the case may be.

Occupation also has been represented through the dummy variable device. Six occupation classes have been formed from the nine employed classes recognized in the "original" occupation of head code used by the B.L.S. The salaried professional class (dummy *O*-1) is parallel to the first "original" class. The self-employed class (*O*-2) also is the same as the second "original" class; it includes self-employed professionals, businessmen, managers, and officials. The third and fourth "original" classes are combined in the clerical and sales class (*O*-3). The fifth "original" class has become the skilled worker class (*O*-4) and the sixth is now the semi-skilled worker class (*O*-5). Finally, the seventh, eighth, and ninth classes are combined in the unskilled worker category (*O*-6). As in the cases of age and education, one of the dummy variables is redundant and must be left out of regressions. *O*-4 has been chosen for this purpose; as a consequence the effects of the other occupation dummies will be relative to the skilled workers.

Family size (*N*) has been measured by the average number of persons in the household. *N* takes on fractional values when some persons are a part of the household for a part of the year.

The three regions and three community size classes are based on the city area code used in the Survey of Consumer Expenditures. The regions are North (*R*-1), South (*R*-2), and West (*R*-3). The size classes are: large cities (*L*-1), suburbs of large cities (*L*-2), and small cities (*L*-3). For purposes of establishing dummy categories *R*-1 and *L*-1 were left out.

The last two independent variables, disposable income (*Y*) and housing level (*H*), are to be considered together as measures of the budget constraint on a household's decisions. In recognition of the deficiencies of current income as a measure of the theoretically relevant permanent or expected income, housing level has been introduced as a variable. The argument in favor of this practice is that a household's housing level is related to its permanent or expected income and is not likely to be freely adjusted to allow for short-run variations in income. Clearly a measure of housing level will not provide an exact measure of permanent income but to the extent that errors in the "housing" measure of permanent income are uncorrelated with the errors in the current income measure of permanent income (i.e., transitory income) the use of housing level can provide useful information. Disposable income and housing level can both be regarded as imperfect proxy variables for permanent income. They are both used because for present purposes two poor substitutes are better than one if they are partially independent of each other.

Disposable income was, of course, directly available in dollar amounts. Housing level was coded by classes; the measure being based on market value of home in the case of home owners and on annual rent for renters. The codes were transformed to dollar amounts according to the schedule of "midpoints" shown in Table 5.

Table 5 "Midpoints" for Housing Level Classes Used for Assigning Dollar Values to *H*

Class Intervals	"Midpoints"
Home Owners	
$1–4,999	$4,000
5,000–7,499	6,500
7,500–9,999	8,500
10,000–12,499	11,250
12,500–14,999	13,750
15,000–17,499	16,250
17,500–19,999	18,500
20,000–24,999	22,000
25,000 and over	30,000
Renters	
$0–249	$200
250–499	400
500–749	650
750–999	825
1,000–1,249	1,125
1,250–1,499	1,375
1,500–1,999	1,750
2,000–2,999	2,250
3,000 and over	3,600

For convenience the variables will often be referred to by symbol. Table 6 lists the variables and the symbolic equivalents.

THE STOCK CALCULATIONS

Multiple linear regression functions were fitted for each of the stock variables on some or all of the independent variables. Table 7 shows *F*-Ratios for testing, by analysis of variance, the significance of selected groups of independent variables. Test (9) in Table 7 shows results of the analysis in which each of the two tenure classes were subdivided by age and education and separate regressions fitted to each class. In the other tests age and education are included, if at all, in simple dummy variable

Table 6 List of Variables Used and Their Symbolic Equivalents

Stocks	
Furniture	A_1
Kitchen appliances	A_2
Laundry appliances	A_3
Deep freeze	A_4
Misc. appliances	A_5
Radio-phonograph	A_6
Television	A_7
Total durable goods	A_f
Automobile	T
Mortgage debt	M
Installment debt	I
Cash balances	C
Insurance	Z
Flows	
Durable goods purchases	E
Auto purchase	ΔT
Change in mortgage debt	ΔM
Change in installment debt	ΔI
Change in cash balances	ΔC
Change in assets	ΔA
Change in debts	ΔD
Saving	S
Independent Variables	
Education	E
0–8 years	E-1
9–12 years	E-2
13 or more years	E-3
Age	A
25–34 years	A-1
35–44 years	A-2
45–54 years	A-3
55–74 years	A-4
Occupation	O
Salaried professional	O-1
Self-employed	O-2
Clerical and sales	O-3
Skilled workers	O-4
Semi-skilled workers	O-5
Unskilled workers	O-6
Family size	N
Region	R
North	R-1
South	R-2
West	R-3
Community size	L
Large cities	L-1
Suburbs to large cities	L-2
Small cities	L-3
Disposable income	Y
Housing level	H
A_f, T, M, I, and C collectively as used in flow regressions	Σ

Table 7 "*F*"-Tests for Stock Variables

Variable	(1) Simple Effect of Occupation		(2) Effect of *N*, *R*, and *L* When Added to Occupation		(3) Effect of *N*, *R*, and *L* When Added to *A*, *E*, and *O*		(4) Effect of *Y* and *H* When Added to *O*, *N*, *R*, and *L*	
	Owners	Renters	Owners	Renters	Owners	Renters	Owners	Renters
Furniture (A_1)	26.24†	25.22†	17.48†	16.80†	12.43†	15.69†	86.09†	40.91†
Kitchen appliances (A_2)	1.75	3.39†	7.38†	11.45†	7.29†	9.09†	17.59†	4.15*
Laundry appliances (A_3)	13.09†	7.10†	21.23†	27.04†	11.80†	21.27†	45.36†	68.84†
Deep freeze (A_4)	21.42†	2.52*	3.36†	2.14	3.00*	2.00	88.05†	2.63
Miscellaneous appliances (A_5)	11.54†	18.51†	12.66†	14.60†	9.12†	12.40†	6.80†	13.94†
Radio-phono. (A_6)	7.96†	5.09†	24.22†	8.42†	15.95†	6.42†	44.13†	48.88†
Television (A_7)	6.91†	8.76†	82.68†	73.74†	90.19†	73.17†	53.38†	34.92†
Total durables (A_t)	4.70†	10.63†	3.96†	25.20†	2.80*	23.62†	74.89†	7.40†
Automobile (T)	9.34†	9.54†	0.87	1.47	0.032	1.52	13.87†	9.19†
Mortgage debt (M)	35.40†	1.62	22.60†	3.74†	13.99†	3.74†	158.92†	13.61†
Installment debt (I)	6.03†	4.99†	9.99†	3.92†	6.50†	3.06†	0.82	1.54
Cash in bank (C)	22.04†	23.84†	6.58†	9.15†	3.52†	6.39†	89.87†	87.80†
Insurance premiums (Z)	51.57†	26.76†	16.35†	6.62†	16.44†	7.77†	641.57†	1965.00†
Housing level (H)	187.21†	99.36†	28.63†	7.45†	25.88†	6.42†	–0–	–0–
Degrees of freedom: used/remaining	5/4567	5/3822	5/4562	5/3817	5/4557	5/3812	2/4560	2/3815

	(5) Effect of *Y* and *H* When Added to *A*, *E*, *O*, *N*, *R*, and *L*		(6) Additive Effect of *A* and *E* When Added to Occupation		(7) Additive Effect of *A* and *E* When Added to *O*, *N*, *R*, and *L*		(8) Additive Effect of *A* and *E* When Added to *O*, *N*, *R*, *L*, *Y*, and *H*		(9) Interaction of *A* and *E* with *O*, *N*, *R*, *L*, *Y*, and *H* Minus Additive Effects of Age and Education	
	Owners	Renters	Owners	Renters	Owners	Renters	Owners	Renters	Owners	Renters
(A_1)	83.74†	36.33†	30.45†	7.28†	25.30†	6.19†	24.00†	4.40†	1.83†	2.23†
(A_2)	20.24†	1.95	58.83†	16.47†	58.68†	14.74†	59.78†	13.96†	1.12	1.48†
(A_3)	49.12†	2.79	39.86†	22.72†	30.22†	17.00†	31.76†	17.40†	2.07†	1.32†
(A_4)	77.26†	1.87	5.57†	1.96	5.21†	1.87	1.07	1.57	1.28*	6.71†
(A_5)	14.20†	13.09†	32.94†	11.25†	29.31†	8.74†	29.80†	8.62†	1.56†	1.42†
(A_6)	39.62†	9.16†	35.17†	17.83†	26.84†	15.79†	24.99†	15.82†	1.51†	1.31†
(A_7)	64.98†	35.34†	8.70†	6.24†	8.11†	5.71†	12.71†	5.89†	2.13†	1.52†
(A_f)	70.97†	6.80†	14.59†	7.39†	13.41†	5.34†	11.90†	5.14†	2.57†	1.87†
(T)	11.89†	7.19†	2.67*	2.84*	2.64*	2.87*	1.86	2.07	1.14	1.01
(M)	185.94†	13.32†	86.06†	1.36	76.79†	1.36	139.96†	1.25	2.14†	1.41†
(I)	0.67	2.12†	28.21†	9.32†	24.55†	8.45†	24.24†	8.68†	1.44†	1.34†
(C)	75.04†	80.63†	14.07†	9.59†	10.90†	6.84†	5.15†	5.00†	1.43†	2.18†
(Z)	525.25†	1880.00†	44.68†	20.68†	44.75†	21.84†	10.37†	45.35†	2.35†	3.73†
(H)	-0-	-0-	70.69†	14.46†	67.78†	29.84†	-0-	-0-	-0-	-0-
D.f.	2/4555	2/3810	5/4562	5/3817	5/4557	5/3812	5/4555	5/3810	130/4425	130/3680

Note: * denotes significance at 0.05 level;
† denotes significance at 0.01 level.

form, and the regressions are fitted to the whole tenure class. Tables 8 to 20 show, for two of the "pooled" regressions, regression coefficients, their respective estimated standard errors, the standard deviation of residuals (S_u), and R^2 (coefficient of multiple determination). One of the regressions (I) includes Y and H, and the other (II) omits them; both include Age, Education, Occupation, Family Size, Region, and Community Size.

Table 8 Regression Coefficients for Furniture (A_1)

Independent Variable	I		II	
	Home Owners	Renters	Home Owners	Renters
E-2	37.48 (11.24)	25.06 (12.78)	59.15 (11.31)	39.55 (12.77)
E-3	36.08 (15.92)	36.86 (18.42)	93.42 (15.55)	64.55 (18.30)
A-2	−11.48 (13.31)	25.25 (12.86)	5.74 (13.48)	34.75 (12.93)
A-3	−77.91 (14.20)	−13.67 (14.89)	−46.52 (14.24)	4.06 (14.88)
A-4	−104.10 (15.02)	−30.57 (16.66)	−74.96 (15.11)	−19.16 (16.75)
O-1	27.34 (20.11)	57.91 (23.20)	43.95 (20.40)	69.18 (23.37)
O-2	4.72 (13.77)	23.21 (17.52)	47.99 (13.59)	46.64 (17.46)
O-3	−5.16 (15.17)	17.91 (17.47)	2.29 (15.42)	24.02 (17.60)
O-5	−19.87 (14.14)	−16.04 (15.25)	−31.25 (14.35)	−20.94 (15.38)
O-6	−41.55 (16.58)	−68.88 (16.78)	−60.98 (16.80)	−83.28 (16.85)
1	552.17 (22.31)	359.50 (23.73)	608.40 (21.60)	442.10 (21.74)
N	6.49 (3.38)	13.96 (3.81)	9.80 (3.38)	15.58 (3.84)
R-2	−16.66 (11.86)	−72.61 (12.69)	−32.86 (12.00)	−80.87 (12.76)
R-3	60.08 (10.50)	−51.18 (12.70)	55.73 (10.68)	−51.57 (12.81)
L-2	−11.95 (10.75)	37.94 (14.31)	−4.50 (10.92)	40.50 (14.44)
L-3	−4.00 (12.48)	−17.68 (14.60)	−17.52 (12.65)	−24.29 (14.71)
Y/1000	10.73 (1.70)	6.25 (1.83)	—	—
H/1000	7.98 (0.97)	131.18 (21.66)	—	—
S_u	303.63	312.58	309.03	315.46
R^2	0.105	0.078	0.072	0.060

Note: All coefficients are in dollars. Estimated errors in parentheses.

Table 7 gives the impression that nearly everything is significantly related to everything else—as any good general equilibrium model suggests. A word of deflation seems in order and for this it is probably sufficient to call attention to the R^2's and S_u's in Tables 8 to 20. Only in the case of Insurance Premiums has as much as 20 per cent of the variation been explained. The explanation is that tests based upon large samples are quite powerful and variables which are statistically significant may have very little ability to predict individual cases.

Among the stocks, Deep Freeze (A_4) and Automobile (T) were least related to the set of independent variables. The reasons for the poor

Table 9 Regression Coefficients for Kitchen Appliances (A_2)

Independent Variable	I Home Owners	I Renters	II Home Owners	II Renters
E-2	−8.56 (4.51)	−6.52 (6.06)	−6.85 (4.48)	−7.69 (6.00)
E-3	1.57 (6.39)	−16.34 (8.73)	7.94 (6.16)	−17.92 (8.60)
A-2	−61.47 (5.34)	−34.36 (6.10)	−59.78 (5.34)	−34.99 (6.08)
A-3	−82.25 (5.70)	−49.73 (7.06)	−79.50 (5.64)	−50.71 (6.99)
A-4	−91.21 (6.03)	−46.79 (7.90)	−89.12 (5.98)	−47.78 (7.87)
O-1	2.37 (8.07)	−1.94 (11.00)	1.83 (8.08)	−3.18 (10.98)
O-2	9.40 (5.53)	−12.81 (8.31)	12.86 (5.38)	−14.57 (8.20)
O-3	1.41 (6.09)	−1.08 (8.28)	0.89 (6.11)	−1.96 (8.27)
O-5	9.68 (5.67)	1.19 (7.23)	9.58 (5.68)	1.48 (7.23)
O-6	10.22 (6.65)	−15.51 (7.95)	8.19 (6.65)	−14.60 (7.92)
1	272.54 (8.96)	188.48 (11.25)	275.43 (8.55)	182.00 (10.21)
N	−5.17 (1.36)	5.40 (1.81)	−3.54 (1.34)	5.36 (1.80)
R-2	12.16 (4.76)	17.49 (6.01)	10.68 (4.75)	17.74 (5.99)
R-3	17.36 (4.22)	13.04 (6.02)	16.55 (4.23)	12.77 (6.02)
L-2	−4.08 (4.32)	11.61 (6.78)	−4.28 (4.32)	11.40 (6.78)
L-3	11.58 (5.01)	23.98 (6.92)	11.47 (5.01)	24.25 (6.91)
Y/1000	4.33 (0.68)	0.77 (0.87)	—	—
H/1000	−0.89 (0.39)	−18.35 (10.27)	—	—
S_u	121.86	148.17	122.37	148.19
R^2	0.078	0.036	0.070	0.035

Table 10 Regression Coefficients for Laundry Appliances (A_3)

Independent Variable	I Home Owners	I Renters	II Home Owners	II Renters
E-2	1.72 (3.10)	2.80 (3.31)	6.33 (3.10)	3.86 (3.28)
E-3	7.96 (4.39)	5.21 (4.78)	20.12 (4.26)	7.17 (4.70)
A-2	−18.15 (3.67)	−10.96 (3.34)	−14.50 (3.69)	−10.27 (3.32)
A-3	−33.71 (3.92)	−25.64 (3.86)	−27.04 (3.90)	−24.39 (3.83)
A-4	−43.58 (4.14)	−31.08 (4.32)	−37.37 (4.14)	−30.24 (4.31)
O-1	−3.34 (5.54)	4.85 (6.02)	0.24 (5.58)	−3.99 (6.01)
O-2	1.72 (3.80)	−0.98 (4.54)	10.93 (3.72)	0.73 (4.49)
O-3	0.12 (4.18)	−4.12 (4.53)	1.74 (4.22)	−3.63 (4.52)
O-5	−6.16 (3.90)	−5.08 (3.96)	−8.60 (3.93)	−5.43 (3.95)
O-6	−6.71 (4.57)	−16.19 (4.35)	−10.83 (4.60)	−17.22 (4.33)
1	67.26 (6.15)	44.44 (6.15)	85.07 (5.91)	50.49 (5.59)
N	5.61 (0.93)	8.74 (0.99)	6.28 (0.92)	8.85 (0.99)
R-2	0.73 (3.27)	−4.26 (3.29)	−2.72 (3.29)	−4.83 (3.28)
R-3	9.59 (2.90)	7.56 (3.29)	8.67 (2.92)	7.57 (3.29)
L-2	−2.10 (2.97)	12.28 (3.71)	−0.49 (2.99)	12.47 (3.71)
L-3	1.86 (3.44)	4.82 (3.79)	−1.04 (3.46)	4.36 (3.78)
Y/1000	2.20 (0.47)	0.32 (0.48)	—	—
H/1000	1.74 (0.27)	10.47 (5.62)	—	—
S_u	83.72	81.05	84.60	81.09
R^2	0.087	0.065	0.067	0.064

Table 11 Regression Coefficients for Deep Freeze (A_4)

Independent Variable	I Home Owners	I Renters	II Home Owners	II Renters
E-2	−0.74 (1.93)	1.44 (1.20)	2.72 (1.94)	1.65 (1.18)
E-3	1.69 (2.74)	3.18 (1.72)	11.19 (2.67)	3.67 (1.70)
A-2	1.98 (2.29)	2.13 (1.20)	4.79 (2.32)	2.29 (1.20)
A-3	0.80 (2.45)	1.12 (1.39)	5.86 (2.45)	1.44 (1.38)
A-4	−2.47 (2.59)	3.32 (1.56)	2.14 (2.60)	3.47 (1.55)
O-1	−6.02 (3.46)	0.04 (2.17)	−3.72 (3.51)	0.16 (2.17)
O-2	6.39 (2.37)	2.38 (1.64)	13.30 (2.34)	2.74 (1.62)
O-3	−1.39 (2.61)	1.61 (1.63)	−0.41 (2.65)	1.64 (1.63)
O-5	−1.39 (2.43)	0.26 (1.43)	−3.05 (2.47)	0.17 (1.43)
O-6	−3.92 (2.85)	−0.65 (1.57)	−7.11 (2.89)	−0.89 (1.56)
1	−11.14 (3.84)	−3.92 (2.22)	1.44 (3.72)	−2.71 (2.02)
N	−1.06 (0.58)	0.46 (0.36)	−0.27 (0.58)	0.50 (0.36)
R-2	4.74 (2.04)	0.97 (1.19)	2.11 (2.06)	0.79 (1.18)
R-3	7.38 (1.81)	3.40 (1.19)	6.60 (1.84)	3.35 (1.19)
L-2	0.93 (1.85)	0.70 (1.34)	1.97 (1.88)	0.73 (1.34)
L-3	3.30 (2.15)	−0.74 (1.37)	1.32 (2.18)	−0.87 (1.36)
Y/1000	2.37 (0.29)	0.28 (0.17)	—	—
H/1000	0.99 (0.17)	0.71 (2.03)	—	—
S_u	52.28	29.24	53.15	29.25
R^2	0.064	0.009	0.032	0.008

Table 12 Regression Coefficients for Miscellaneous Appliances (A_5)

Independent Variable	I Home Owners	I Renters	II Home Owners	II Renters
E-2	7.73 (2.26)	5.36 (2.64)	9.05 (2.24)	7.04 (2.63)
E-3	9.47 (3.21)	7.73 (3.81)	13.00 (3.08)	11.14 (3.76)
A-2	−12.83 (2.68)	2.06 (2.66)	−11.78 (2.67)	3.20 (2.66)
A-3	−23.30 (2.86)	−10.60 (3.08)	−21.38 (2.82)	−8.41 (3.06)
A-4	−26.26 (3.03)	−12.48 (3.45)	−24.48 (3.00)	−11.17 (3.44)
O-1	0.57 (4.05)	−0.20 (4.80)	1.55 (4.04)	1.01 (4.80)
O-2	1.48 (2.78)	−7.33 (3.63)	4.12 (2.69)	−4.58 (3.59)
O-3	0.05 (3.06)	−3.53 (3.61)	0.48 (3.06)	−2.93 (3.62)
O-5	1.04 (2.85)	−14.41 (3.16)	0.35 (2.85)	−15.01 (3.16)
O-6	−9.48 (3.34)	−17.74 (3.47)	−10.68 (3.33)	−19.48 (3.46)
1	65.77 (4.50)	37.94 (4.91)	70.78 (4.28)	47.58 (4.47)
N	0.20 (0.68)	2.67 (0.79)	0.43 (0.67)	2.88 (0.79)
R-2	−2.00 (2.39)	−13.27 (2.62)	−2.99 (2.38)	−14.35 (2.62)
R-3	9.64 (2.12)	3.85 (2.63)	9.37 (2.12)	3.72 (2.63)
L-2	8.74 (2.17)	4.88 (2.96)	9.18 (2.17)	5.18 (2.97)
L-3	2.08 (2.52)	6.03 (3.02)	1.27 (2.51)	5.19 (3.03)
Y/1000	0.72 (0.34)	1.09 (0.38)	—	—
H/1000	0.46 (0.20)	13.01 (4.48)	—	—
S_u	61.19	64.66	61.28	64.87
R^2	0.060	0.060	0.056	0.053

Table 13 Regression Coefficients for Radio-Phonograph (A_6)

Independent Variable	I		II	
	Home Owners	Renters	Home Owners	Renters
E-2	2.01 (2.51)	0.96 (2.74)	4.92 (2.50)	2.19 (2.73)
E-3	9.33 (3.56)	10.00 (3.96)	17.70 (3.44)	12.73 (3.90)
A-2	−7.11 (2.98)	−6.52 (2.76)	−4.67 (2.99)	−5.64 (2.76)
A-3	−12.90 (3.17)	−16.21 (3.20)	−8.58 (3.15)	−14.44 (3.18)
A-4	−30.16 (3.36)	−25.23 (3.58)	−26.32 (3.35)	−24.30 (3.57)
O-1	−0.88 (4.49)	4.20 (4.99)	0.68 (4.52)	4.97 (4.99)
O-2	0.45 (3.08)	3.14 (3.77)	6.28 (3.01)	5.21 (3.73)
O-3	3.45 (3.39)	3.10 (3.75)	4.05 (3.42)	3.39 (3.75)
O-5	−1.84 (3.16)	0.05 (3.28)	−3.08 (3.18)	−0.42 (3.28)
O-6	0.91 (3.71)	0.24 (3.61)	−1.88 (3.72)	−1.12 (3.60)
1	37.78 (4.99)	47.24 (5.10)	47.61 (4.78)	54.34 (4.64)
N	2.43 (0.76)	1.78 (0.82)	3.38 (0.75)	1.97 (0.82)
R-2	7.85 (2.65)	−1.37 (2.73)	5.60 (2.66)	−2.31 (2.72)
R-3	12.76 (2.35)	3.23 (2.73)	12.00 (2.37)	3.02 (2.73)
L-2	−2.03 (2.40)	−0.81 (3.07)	−1.32 (2.42)	−0.60 (3.08)
L-3	14.07 (2.79)	14.09 (3.14)	12.60 (2.80)	13.38 (3.14)
Y/1000	2.72 (0.38)	1.29 (0.39)	—	—
H/1000	0.52 (0.22)	6.55 (4.66)	—	—
S_u	67.87	67.17	68.45	67.31
R^2	0.078	0.042	0.062	0.038

Table 14 Regression Coefficients for Television (A_7)

Independent Variable	I		II	
	Home Owners	Renters	Home Owners	Renters
E-2	−4.83 (4.81)	13.24 (5.15)	2.91 (4.82)	17.83 (5.15)
E-3	−27.63 (6.81)	−4.91 (7.43)	−6.15 (6.63)	5.21 (7.38)
A-2	−4.78 (5.69)	−3.08 (5.19)	1.55 (5.74)	0.21 (5.22)
A-3	−20.56 (6.07)	−10.17 (6.01)	−9.19 (6.07)	−3.61 (6.00)
A-4	−40.50 (6.43)	−21.44 (6.72)	−30.19 (6.44)	−17.98 (6.76)
O-1	−13.09 (8.60)	−13.11 (9.36)	−8.13 (8.69)	−10.23 (9.42)
O-2	−5.19 (5.89)	8.05 (7.07)	10.31 (5.79)	15.74 (7.04)
O-3	−4.60 (6.49)	−9.93 (7.04)	−2.52 (6.57)	−8.82 (7.10)
O-5	−11.79 (6.05)	−2.33 (6.15)	−15.43 (6.12)	−4.10 (6.20)
O-6	−20.99 (7.09)	−21.78 (6.77)	−28.21 (7.16)	−26.85 (6.79)
1	104.60 (9.54)	76.83 (9.57)	132.41 (9.20)	103.32 (8.77)
N	1.58 (1.45)	3.37 (1.54)	3.49 (1.44)	4.08 (1.55)
R-2	−28.01 (5.07)	−46.88 (5.12)	−33.91 (5.11)	−50.36 (5.15)
R-3	−46.67 (4.49)	−50.03 (5.12)	−48.48 (4.55)	−50.77 (5.16)
L-2	0.70 (4.60)	−0.10 (5.77)	2.94 (4.65)	0.70 (5.82)
L-3	−77.40 (5.34)	−68.58 (5.89)	−81.73 (5.39)	−71.22 (5.93)
Y/1000	5.69 (0.73)	4.68 (0.74)	—	—
H/1000	2.05 (0.42)	25.16 (8.74)	—	—
S_u	129.85	126.09	131.67	127.22
R^2	0.130	0.122	0.105	0.105

Table 15 Regression Coefficients for Total Durables (A_f)

Independent Variable	I Home Owners	I Renters	II Home Owners	II Renters
E-2	53.32 (21.99)	51.19 (19.25)	36.01 (22.07)	55.44 (19.11)
E-3	26.41 (31.15)	41.02 (27.76)	−35.79 (30.35)	44.05 (27.37)
A-2	−80.74 (26.05)	18.31 (19.39)	−97.46 (26.31)	20.03 (19.34)
A-3	−128.71 (27.79)	−54.75 (22.45)	−156.21 (27.79)	−53.10 (22.26)
A-4	−171.52 (29.40)	−39.04 (25.11)	−193.02 (29.50)	−35.12 (25.06)
O-1	106.52 (39.34)	18.91 (34.97)	109.63 (39.81)	24.80 (34.95)
O-2	48.36 (26.95)	20.31 (26.41)	13.32 (26.52)	26.18 (26.11)
O-3	22.22 (29.69)	14.83 (26.32)	26.07 (30.10)	19.72 (26.32)
O-5	−29.39 (27.66)	−22.19 (22.99)	−27.40 (28.02)	−22.79 (23.01)
O-6	−82.44 (32.44)	−108.49 (25.28)	−62.45 (32.80)	−110.81 (25.20)
1	970.12 (43.66)	537.61 (35.76)	936.13 (42.16)	560.63 (32.52)
N	26.11 (6.61)	42.57 (5.74)	11.33 (6.59)	42.30 (5.74)
R-2	−30.36 (23.21)	−120.12 (19.12)	−15.64 (23.43)	−119.30 (19.08)
R-3	17.82 (20.55)	−70.90 (19.14)	25.46 (20.85)	−68.66 (19.15)
L-2	−7.61 (21.04)	79.92 (21.56)	−6.58 (21.32)	80.71 (21.59)
L-3	−77.70 (24.42)	−28.23 (22.00)	−75.38 (24.68)	−28.12 (22.00)
$Y/1000$	−39.55 (3.32)	−8.34 (2.76)	—	—
$H/1000$	7.06 (1.90)	100.18 (32.65)	—	—
S_u	594.12	471.08	603.18	471.80
R^2	0.053	0.056	0.024	0.053

Table 16 Regression Coefficients for Automobile (T)

Independent Variable	I Home Owners	I Renters	II Home Owners	II Renters
E-2	59.04 (32.12)	11.58 (28.11)	71.16 (31.83)	25.98 (27.88)
E-3	118.51 (45.49)	56.04 (40.51)	140.05 (43.76)	80.28 (39.94)
A-2	59.50 (38.05)	79.89 (28.29)	67.21 (37.95)	88.65 (28.23)
A-3	40.71 (40.58)	62.71 (32.76)	56.72 (40.07)	78.03 (32.49)
A-4	43.74 (42.94)	62.82 (36.64)	61.19 (42.53)	74.54 (36.57)
O-1	−54.47 (57.46)	70.06 (51.04)	−34.65 (57.41)	82.93 (51.01)
O-2	90.77 (39.36)	144.41 (38.54)	114.67 (38.25)	167.05 (38.11)
O-3	97.70 (43.36)	78.53 (38.41)	108.18 (43.40)	86.60 (38.41)
O-5	−27.67 (40.40)	3.09 (33.55)	−38.60 (40.40)	−1.25 (33.58)
O-6	−60.45 (47.38)	16.41 (36.91)	−68.44 (47.30)	3.33 (36.78)
1	−44.32 (63.76)	−77.36 (52.19)	23.12 (60.80)	3.95 (47.47)
N	2.77 (9.66)	−6.33 (8.37)	−3.18 (9.50)	−5.20 (8.38)
R-2	−4.72 (33.90)	−52.65 (27.90)	−12.64 (33.79)	−58.77 (27.86)
R-3	13.40 (30.01)	−21.26 (27.93)	13.63 (30.07)	−20.13 (27.96)
L-2	19.71 (30.73)	33.22 (31.47)	28.37 (30.74)	35.78 (31.51)
L-3	75.04 (35.67)	51.61 (32.11)	62.03 (35.59)	46.35 (32.12)
$Y/1000$	−13.91 (4.85)	−0.35 (4.04)	—	—
$H/1000$	13.10 (2.78)	170.20 (47.65)	—	—
S_u	867.72	687.48	869.79	688.61
R^2	0.019	0.022	0.014	0.018

Table 17 Regression Coefficients for Mortgage Debt (*M*)

Independent Variable	I		II	
	Home Owners	Renters	Home Owners	Renters
E-2	180.95 (93.24)	36.58 (29.21)	423.76 (95.85)	52.34 (29.02)
E-3	382.65 (132.08)	−18.39 (42.10)	953.26 (131.81)	2.72 (41.57)
A-2	−635.26 (110.46)	−33.02 (29.40)	−455.40 (114.27)	−24.56 (29.38)
A-3	−1537.63 (117.82)	−0.66 (34.04)	−1196.43 (120.68)	12.35 (33.82)
A-4	−2085.66 (124.65)	−44.79 (38.08)	−1751.13 (128.09)	−31.37 (38.06)
O-1	334.26 (166.82)	30.02 (53.04)	592.50 (172.89)	46.84 (53.09)
O-2	−146.33 (114.28)	47.75 (40.04)	336.52 (115.19)	71.45 (39.67)
O-3	428.76 (125.87)	−16.64 (39.92)	555.40 (130.70)	−4.53 (39.98)
O-5	53.02 (117.30)	−11.81 (34.86)	−105.75 (121.66)	−15.67 (34.95)
O-6	−116.26 (137.56)	−6.12 (38.35)	−314.28 (142.44)	−18.41 (38.28)
1	1042.97 (185.13)	−109.27 (54.24)	2118.63 (183.09)	−21.58 (49.40)
N	93.63 (28.03)	10.76 (8.71)	77.37 (28.62)	11.20 (8.72)
R-2	−12.32 (98.42)	11.70 (29.00)	−186.14 (101.75)	8.45 (28.99)
R-3	127.23 (87.14)	112.26 (29.02)	96.67 (90.54)	115.98 (29.10)
L-2	140.45 (89.22)	−0.92 (32.70)	254.69 (92.57)	1.93 (32.80)
L-3	−474.24 (103.55)	−21.25 (33.37)	−663.08 (107.19)	−24.83 (33.43)
Y/1000	−15.96 (14.09)	−11.17 (4.19)	—	—
H/1000	148.52 (8.08)	251.65 (49.52)	—	—
S_u	2519.11	714.44	2619.35	716.74
R^2	0.199	0.015	0.133	0.009

Table 18 Regression Coefficients for Installment Debt (*I*)

Independent Variable	I		II	
	Home Owners	Renters	Home Owners	Renters
E-2	−12.10 (3.85)	−3.38 (4.79)	−11.55 (3.80)	−2.92 (4.75)
E-3	−17.75 (5.45)	−10.76 (6.91)	−16.15 (5.23)	−9.28 (6.80)
A-2	−32.05 (4.56)	−21.40 (4.82)	−31.58 (4.53)	−20.97 (4.81)
A-3	−43.82 (4.86)	−27.84 (5.58)	−43.00 (4.79)	−26.86 (5.53)
A-4	−54.07 (5.14)	−32.52 (6.25)	−53.35 (5.08)	−32.23 (6.22)
O-1	0.27 (6.88)	−11.26 (8.70)	0.53 (6.86)	−11.20 (8.68)
O-2	−14.37 (4.71)	−15.13 (6.57)	−13.28 (4.57)	−14.26 (6.49)
O-3	−3.27 (5.19)	−2.30 (6.55)	−3.18 (5.18)	−2.47 (6.54)
O-5	1.85 (4.84)	5.84 (5.72)	1.63 (4.83)	5.58 (5.72)
O-6	1.43 (5.67)	−8.65 (6.29)	0.89 (5.65)	−9.33 (6.26)
1	58.78 (7.64)	44.42 (8.90)	60.56 (7.26)	47.20 (8.08)
N	2.42 (1.16)	4.40 (1.43)	2.63 (1.14)	4.53 (1.43)
R-2	15.50 (4.06)	10.23 (4.76)	15.08 (4.04)	9.59 (4.74)
R-3	16.57 (3.59)	0.59 (4.76)	16.42 (3.59)	0.30 (4.76)
L-2	2.62 (3.68)	−3.46 (5.36)	2.74 (3.67)	−3.38 (5.36)
L-3	−7.84 (4.27)	−1.98 (5.47)	−8.10 (4.25)	−2.43 (5.47)
Y/1000	0.57 (0.58)	1.39 (0.68)	—	—
H/1000	0.07 (0.33)	−3.03 (8.12)	—	—
S_u	103.92	117.18	103.91	117.22
R^2	0.043	0.023	0.043	0.022

Table 19 Regression Coefficients for Cash in Bank (C)

Independent Variable	I		II	
	Home Owners	Renters	Home Owners	Renters
E-2	67.73 (92.39)	102.62 (61.28)	219.25 (92.81)	164.60 (61.99)
E-3	181.33 (130.87)	48.12 (88.33)	612.47 (127.63)	204.42 (88.80)
A-2	162.93 (109.45)	78.64 (61.69)	288.78 (110.66)	127.21 (62.76)
A-3	245.00 (116.75)	194.92 (71.42)	468.98 (116.86)	297.13 (72.22)
A-4	585.18 (123.51)	380.40 (79.89)	785.75 (124.04)	424.98 (81.30)
O-1	172.51 (165.30)	178.08 (111.27)	258.60 (167.42)	207.11 (113.39)
O-2	262.24 (113.24)	116.85 (84.04)	565.71 (111.54)	224.55 (84.73)
O-3	−156.10 (124.73)	204.81 (83.76)	−121.99 (126.56)	208.01 (85.39)
O-5	−161.89 (116.23)	−85.13 (73.15)	−228.45 (117.81)	−112.24 (74.65)
O-6	−85.33 (136.31)	−138.37 (80.47)	−299.36 (137.93)	−214.13 (81.76)
1	137.99 (183.45)	218.94 (113.80)	660.37 (177.29)	581.33 (105.52)
N	−141.09 (27.78)	−107.48 (18.27)	−95.65 (27.71)	−95.06 (18.63)
R-2	−67.60 (97.52)	−9.40 (60.83)	−184.20 (98.53)	−68.81 (61.92)
R-3	80.83 (86.34)	−36.49 (60.89)	42.75 (87.68)	−55.60 (62.15)
L-2	16.47 (88.41)	76.90 (68.61)	55.77 (89.64)	87.58 (70.05)
L-3	136.02 (102.61)	−29.44 (70.02)	57.03 (103.79)	−72.90 (71.40)
Y/1000	131.92 (13.96)	102.19 (8.80)	—	—
H/1000	31.13 (8.01)	103.52 (103.89)	—	—
S_u	2496.18	1498.92	2536.41	1530.80
R^2	0.073	0.080	0.042	0.040

Table 20 Regression Coefficients for Insurance Premiums (Z)

Independent Variable	I		II	
	Home Owners	Renters	Home Owners	Renters
E-2	9.11 (8.79)	12.30 (5.96)	44.40 (9.64)	39.67 (8.31)
E-3	77.67 (12.46)	37.45 (8.59)	181.12 (13.26)	107.89 (11.91)
A-2	15.72 (10.42)	9.90 (6.00)	45.58 (11.49)	31.64 (8.42)
A-3	28.09 (11.11)	16.74 (6.94)	80.70 (12.14)	62.87 (9.69)
A-4	12.49 (11.75)	16.61 (7.77)	58.87 (12.88)	36.14 (10.90)
O-1	27.14 (15.73)	27.68 (10.82)	44.16 (17.39)	39.78 (15.21)
O-2	2.67 (10.78)	−3.90 (8.17)	73.44 (11.59)	43.94 (11.36)
O-3	24.97 (11.87)	16.83 (8.14)	31.10 (13.15)	17.37 (11.45)
O-5	1.84 (11.06)	7.65 (7.11)	−12.35 (12.24)	−4.56 (10.01)
O-6	5.32 (12.97)	14.94 (7.82)	−29.05 (14.33)	−19.04 (10.97)
1	−54.42 (17.45)	−69.90 (11.06)	61.22 (18.41)	90.46 (14.15)
N	8.59 (2.64)	3.18 (1.78)	21.41 (2.88)	8.87 (2.50)
R-2	1.42 (9.28)	14.67 (5.91)	−26.07 (10.23)	−12.47 (8.31)
R-3	−27.28 (8.22)	−27.92 (5.92)	−36.91 (9.11)	−37.02 (8.34)
L-2	−9.19 (8.41)	1.31 (6.67)	−1.33 (9.31)	6.01 (9.40)
L-3	−4.16 (9.76)	6.79 (6.81)	−20.98 (10.78)	−12.97 (9.58)
Y/1000	36.45 (1.33)	47.97 (0.85)	—	—
H/1000	4.76 (0.76)	28.42 (10.10)	—	—
S_u	237.53	145.73	263.45	205.33
R^2	0.280	0.531	0.114	0.069

performance in the case of A_4 are obscure. Clearly it is not simply because the deep freeze was a "new" product in 1950; the same was true for television. It may be that the purchase and use of a deep freeze requires a quite discontinuous change in habits and routine besides a heavy capital expenditure and that adaptability in this sense is poorly represented among the set of explanatory variables. Many other rationalizations are possible of course; a purely statistical one is that a relatively small proportion of the sample owned a deep freeze. Perhaps there are too few of them to warrant any general conclusion.[1] For T the fault may well be a technical one rather than a basic weakness in the notion that the automobile is a prime symbol of status and hence explainable in terms of education, occupation, etc. The variable T was derived by imputing a value to the end of year inventory and deducting auto purchases made during the year. It has become apparent that either the values imputed to the inventory were too small or the purchases were exaggerated because mean values of T for many age × education × occupation classes are very small and some indeed are negative. Although a simple bias which leaves relative magnitudes unaltered should not erase the hypothesized relationships, it is possible that some more complex error has done so.

On the subject of the low R^2's generally for durable goods, it must be remembered that such goods are only durable relative to cottage cheese and shoeshines. They do wear out or become obsolete and require replacement in a fairly regular cycle. Thus, even if it were possible to predict closely the rate and/or quality of consumption of services of durable goods, a large amount of variability would remain simply because consumers stand at different points in their inventory cycle. This phenomenon will obviously be more important for specific items than for aggregates. The same principle can be applied to installment debt if households make time purchases and then generally wait until they are repaid before incurring more debt.

An examination of the coefficients of the education variables makes it clear that, in general, more education implies larger stocks of assets and correspondingly lower debt. The two exceptions are Mortgage Debt and Television. Since mortgage debt is usually directly offset by an asset of greater value and, unlike installment debt, has an "inventory cycle" closely related to the life cycle, the observed result is not really contrary.[2] The

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[1] This consideration really implies that a more appropriate model for analysis of deep freeze ownership would be the probit regression model. See Tobin: "Estimation of Relationships for Limited Dependent Variables" *Econometrica*, Vol. 26, No. 1 (Jan. 1958), pp. 24–36.

[2] In the whole sample of home owners the correlation between M and H is equal to 0.294, and probably is much higher within age classes.

case of television is not so easily dismissed. The result is, however, consistent with findings of an intensive study of television ownership by Dernburg. Using 1950 census tract statistics Dernburg found support for the hypothesis that television is an inferior good with respect to education.[3] Total Durables (A_t) shows a weak tendency to level off at least for the highest education class; perhaps this is due to the influence of television on the total. The finding that durable inventories are positively related to education is consistent with the notion that education enhances income prospects and that the education coefficients are really coefficients of expected income. This notion is, however, contradicted by the finding that C and minus I are also positively related to education; apparently high education implies higher saving inclusive of durables.

The coefficients of the age dummies seem to follow fairly regular patterns. Values of durable stocks decline with age excepting Deep Freeze (A_4) and Automobile (T). Older households, in other words, have older durable goods on the average. They also have less mortgage debt and installment debt; the former is attributable to the coincidence of the mortgage and life cycles; the latter is consistent with the concomitant additional pattern of increasing cash balances. The pseudo-stock, insurance premiums, appears to level off or even fall for the oldest age class, although the evidence is thin when Y and H are controlled. This may well be a result of the completion of the payment periods on terminal life and endowment policies. The general pattern of age coefficients meshes nicely with a life cycle interpretation. The lower levels of durable consumption of older households can be attributed in part to lower expected incomes. It is very hazardous, however, to generalize about life cycle patterns from cross-section data in an expanding economy.

The pattern of coefficients of occupational variables is not nearly as consistent and regular as is the pattern for the age variables. If the occupations are ranked by mean income level, the order is O-2, O-1, O-3, O-4, O-5, and O-6. In several of the regressions the coefficients follow the order an expected income hypothesis would suggest. Where there is significant divergence from this pattern, as in the cases of Automobile and Mortgage Debt, the status symbol character of automobile and house (or neighborhood) may be involved. Another kind of divergence is the low value of Insurance Premiums for self-employed—perhaps businessmen seek security from business and other assets instead of from insurance. Within the household furnishings category, professional workers appear to be relatively more interested in furniture than in appliances, compared to

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[3] Thomas F. Dernburg, "Consumer Response to Innovation," *Studies in Household Economic Behavior*, (New Haven: Yale University Press, 1958), pp. 28–31.

self-employed and to the other groups. Skilled workers and self-employed are the biggest TV owners.

The family size coefficients are significant in most regressions. Surprisingly, in the television regressions the effect of *N* is weak. The results show most emphatically that larger households have less cash and more durables—particularly laundry equipment.

The region coefficients are significant as a group in most of the household durable goods regressions but seem to add little in the *T*, *M*, and *C* regressions. The general tendencies indicate that western home owners hold more durables, and southern and western renters less, than their northern counterparts. In addition there was definitely less television ownership in the south and west; presumably because of the scarcity of stations in those areas in 1950. The renter difference noted above is perhaps partly a difference in custom regarding furnishings in rented dwellings and partly the result of some basic difference in the status value and permanence of rental arrangements between the regions. As for the positive effect in the case of western home owners, it may also be attributable to differences in local custom and styles of living.

The community size variables similarly are of major value only for durables. Non-metropolitan renters appear to supply relatively more of their own durable goods. The Small Cities class, both owners and renters, have larger stocks of radios and phonographs than the other two classes, but less TV, again the result of differences in station availability.

The preceding variables collectively account for a great deal, but by no means all, of the systematic variation among households in economic status. Even among households alike in age, education, occupation, family size, and location, there remain considerable differences. Two direct measures of economic status are used here: current income and housing level. Both may be regarded as representing imperfectly the series of past and expected incomes that determine the level and structure of a household's present possessions. Probably housing level better reflects the economic status to which the household has in the past adjusted its holdings of durable goods and other assets. Since moving is a major and expensive decision, housing level will remain the same through temporary fluctuations of income and will be adjusted only for lasting changes. But housing level is probably slow to adjust to permanent changes, and thus for some households with steadily growing income it may be an outdated indicator of economic status. Because of short-term fluctuations, to which the household would not adjust its whole pattern of asset holdings, current income is not a reliable indicator of future economic status. However, over a group of households, even when all the other variables including housing level are held constant, there is probably a correlation between current incomes and expected future incomes. The relative strength of Y in determining the demand for insurance suggests that Y contains some permanent elements that H does not. Indeed for some consumers, insurance and home investment may be substitute ways of providing security. For these reasons it would be an overstatement to identify H with variations in "permanent income," and Y for given levels of H as variations in "temporary income." Moreover, both H and Y have relationships of complementarity with certain assets or debts, and these relationships confound their influences as measures of economic status. The strengths of the effects of H on furnishings, and of Y on cash holdings (for transactions purposes, presumably) are probably to be interpreted in this way.

Nevertheless, it is interesting to compute the effects on each stock of a change in income accompanied by the appropriate change in housing level; this represents a long-run income coefficient, which can be compared with the short-run coefficient of Y alone for given H. For this purpose a maximum adjustment of H is taken to be one which maintains the H/Y ratio constant. If the marginal propensity to consume housing is lower than the average propensity, then the long-run income coefficient will be correspondingly closer to the short-run coefficient. The average H/Y ratios used for computing the long-run coefficients were estimated as the ratio of mean H to mean Y for the middle two age classes. For home owners the value was approximately 2.07; for renters it was 0.15. Table 21 shows the calculated long- and short-run income coefficients. The housing coefficient is multiplied by 2.07 or 0.15 to obtain "adjusted" housing coefficients which are commensurable with current (short-run) income coefficients. The current income coefficient is then added to the adjusted housing coefficient to obtain long-run income coefficients.

The negative current or short-run income coefficients in the A_f and T regressions seem to call for special comment. So far as T is concerned, it was noted earlier that the method of computing the variable is somewhat suspect. Here, if there is a tendency for a positive amount of automobile investment in years of positive transitory income, then households that purchased during the year will be likely to have understated beginning-of-the-year T. A_f was also computed by deducting purchases from year-end stocks, and it is possible that the same kind of bias has distorted its relation to income.

Correlations among sets of stock variables are shown in Tables 22 to 25. For a given set of n stock variables, the correlations are shown in an $n \times n$ matrix. The ith diagonal element of the matrix shows the multiple correlation of the ith variable with the remaining $n - 1$ variables. An above-diagonal element (i,j), $i < j$, is the simple correlation between the ith

Table 21 Computations of Long- and Short-Run Income Coefficients for Stocks

Dependent Variables	Housing Coefficient	"Adjusted" Housing Coefficient	Short-Run Income Coefficient*	Long-Run Income Coefficient*
Home Owners				
A_1	$7.98	$16.52	$10.73	$27.25
A_2	−0.89	−1.84	4.33	2.49
A_3	1.74	3.60	2.20	5.80
A_4	0.99	2.05	2.37	4.42
A_5	0.46	0.95	0.72	1.67
A_6	0.52	1.08	2.72	3.80
A_7	2.05	4.24	5.69	9.93
A_f	7.06	14.61	−39.55	−24.94
T	13.10	27.12	−13.91	13.21
M	148.52	307.43	−15.96	291.47
I	0.07	0.14	0.57	0.71
C	31.13	64.44	131.92	196.36
Z	4.76	9.85	36.45	46.30
Renters				
A_1	131.18	19.68	6.25	25.93
A_2	−18.35	−2.75	0.77	−1.98
A_3	10.47	1.57	0.32	1.89
A_4	0.71	0.11	0.28	0.39
A_5	13.01	1.95	1.09	3.04
A_6	6.55	0.98	1.29	2.27
A_7	25.16	3.77	4.68	8.45
A_f	100.18	15.03	−8.34	6.69
T	170.20	25.53	−0.35	25.18
M	251.65	37.75	−11.17	26.58
I	−3.03	−0.45	1.39	0.94
C	103.52	15.53	102.19	117.72
Z	28.42	4.26	47.97	52.23

* Per $1000 of income

and the jth variables. The corresponding below-diagonal element (j, i), $j > i$, is the partial correlation between the same two variables, account having been taken of the remaining $n - 2$ variables. The general schema of this correlation matrix is shown in Figure 1. For each set of stock variables, two matrices are shown for home owners and two for renters. One matrix of each pair represents the correlations of deviations from the over-all mean, the other represents the correlations of deviations from regressions of Type I as shown in Tables 8 to 20. The purpose of presenting

Before Regression

	A_1	A_2	A_3	A_4	A_5	A_6	A_7	T	M	I	C	Z
A_1	349	136	204	079	187	192	078	036*	162	051	074	122
A_2	076	238	150	034*	139	123	-0-	-0-	077	072	-0-	-0-
A_3	130	105	304	095	168	108	069	-0-	139	039	-0-	117
A_4	-0-	-0-	058	192	061	088	-0-	034*	029*	-0-	057	147
A_5	117	091	105	-0-	228	140	048	-0-	121	038*	-0-	058
A_6	140	076	040	057	088	279	−061	-0-	066	071	039	099
A_7	055	−039	041	-0-	031*	−094	197	049	102	035*	-0-	113
T	-0-	-0-	-0-	-0-	-0-	-0-	041	085	048	-0-	-0-	-0-
M	110	034*	081	-0-	069	-0-	077	039	294	130	−111	105
I	-0-	052	-0-	-0-	-0-	062	035*	-0-	109	180	−074	−030*
C	072	-0-	-0-	040	-0-	-0-	-0-	-0-	−126	−063	184	073
Z	061	-0-	069	122	-0-	071	096	-0-	080	−048	062	257

After Regression

	A_1	A_2	A_3	A_4	A_5	A_6	A_7	T	M	I	C	Z
A_1	235	106	130	-0-	134	130	040	-0-	049	041	032*	-0-
A_2	074	180	109	-0-	099	080	-0-	-0-	-0-	033*	-0-	-0-
A_3	103	089	196	051	117	038*	032*	-0-	031*	-0-	-0-	-0-
A_4	-0-	-0-	045	091	034*	046	-0-	-0-	−031*	-0-	-0-	045
A_5	101	072	089	-0-	204	097	031*	-0-	040	-0-	-0-	-0-
A_6	113	056	-0-	039	076	198	−079*	-0-	-0-	052	-0-	-0-
A_7	043	-0-	-0-	-0-	031*	−087	126	052	-0-	031*	-0-	-0-
T	-0-	-0-	-0-	-0-	-0-	-0-	052	063	-0-	-0-	-0-	-0-
M	044	-0-	-0-	−033*	032*	-0-	-0-	-0-	202	106	−156	-0-
I	-0-	-0-	-0-	-0-	-0-	051	034*	-0-	097	135	−049	-0-
C	036*	-0-	-0-	-0-	-0-	-0-	-0-	-0-	−154	−037*	174	−045
Z	-0-	-0-	-0-	042	-0-	-0-	-0-	-0-	-0-	-0-	−048	078

Note: In matrices above -0- has replaced correlations not significant at 0.05, asterisks denote non-significance at 0.01.

Before Regression

	A_1	A_2	A_3	A_4	A_5	A_6	A_7	T	M	I	C	Z
A_1	406	250	196	100	213	180	173	047	066	097	–0–	136
A_2	199	350	230	043	107	115	–0–	–0–	–0–	149	–0–	–0–
A_3	087	188	329	060	199	107	091	–0–	046	081	–0–	052
A_4	070	–0–	035*	136	–0–	049	048	032*	045	–0–	032*	043
A_5	137	–0–	145	–0–	295	133	093	–0–	061	037*	–0–	101
A_6	127	044	047	032*	086	249	–0–	037*	–0–	103	–0–	071
A_7	153	−082	067	–0–	049	−068	246	057	–0–	–0–	040*	128
T	–0–	–0–	–0–	–0–	–0–	–0–	048	104	–0–	–0–	–0–	060
M	042*	–0–	–0–	037*	042	–0–	–0–	–0–	098	–0–	–0–	–0–
I	045	115	034*	−042	–0–	079	–0–	–0–	–0–	199	−062	–0–
C	–0–	–0–	–0–	–0–	–0–	–0–	–0–	–0–	–0–	−059	192	174
Z	087	–0–	–0–	–0–	058	048	097	049	–0–	–0–	169	260

After Regression

	A_1	A_2	A_3	A_4	A_5	A_6	A_7	T	M	I	C	Z
A_1	370	272	168	090	169	160	120	–0–	055	103	–0–	032*
A_2	224	346	218	048	101	098	–0–	–0–	–0–	129	–0–	048
A_3	080	172	288	055	161	070	078	–0–	034*	060	–0–	038*
A_4	067	–0–	034*	125	–0–	044	049	–0–	040*	–0–	–0–	–0–
A_5	115	–0–	122	–0–	238	100	070	–0–	048	033*	–0–	044
A_6	122	037*	–0–	032*	070	209	–0–	–0–	–0–	093	–0–	–0–
A_7	112	−056	062	039*	048	−054	173	052	–0–	–0–	–0–	–0–
T	–0–	–0–	–0–	–0–	–0–	–0–	052	083	–0–	–0–	−042	–0–
M	037*	–0–	–0–	035*	036*	–0–	–0–	–0–	092	–0–	–0–	046
I	056	098	–0–	−038	–0–	073	–0–	–0–	–0–	179	−050	–0–
C	–0–	–0–	–0–	–0–	–0–	–0–	–0–	−042	–0–	−048	076	–0–
Z	–0–	036*	–0–	–0–	–0–	–0–	–0–	–0–	042	–0–	–0–	088

Note: In matrices above –0– has replaced correlations not significant at 0.05, asterisks denote non-significance at 0.01.

Table 24 Home Owners, Correlations among Stocks

Before Regression

	A_f	T	M	I	C
A_f	169	–0–	149	078	−073
T	–0–	057	048	–0–	–0–
M	133	048	216	130	−111
I	057	–0–	115	155	−074
C	−054	–0–	−094	−057	157

After Regression

	A_f	T	M	I	C
A_f	129	–0–	057	130	−035*
T	–0–	030	–0–	–0–	–0–
M	105	–0–	212	106	−156
I	049	–0–	095	122	−049
C	–0–	–0–	–0–	−059	070

Note: In matrices above –0– has replaced correlations not significant at 0.05, asterisks denote non-significance at 0.01.

Table 25 Renters, Correlations among Stocks

Before Regression

	A_f	T	M	I	C
A_f	146	–0–	057	130	−035*
T	–0–	040	–0–	–0–	–0–
M	054	–0–	062	–0–	–0–
I	127	–0–	–0–	144	−062
C	–0–	–0–	–0–	−059	070

After Regression

	A_f	T	M	I	C
A_f	140	–0–	049	128	−034*
T	–0–	046	–0–	–0–	−042*
M	046	–0–	053	–0–	–0–
I	126	–0–	–0–	137	−050
C	–0–	−041*	–0–	−046	070

Note: In matrices above –0– has replaced correlations not significant at 0.05, asterisks denote non-significance at 0.01.

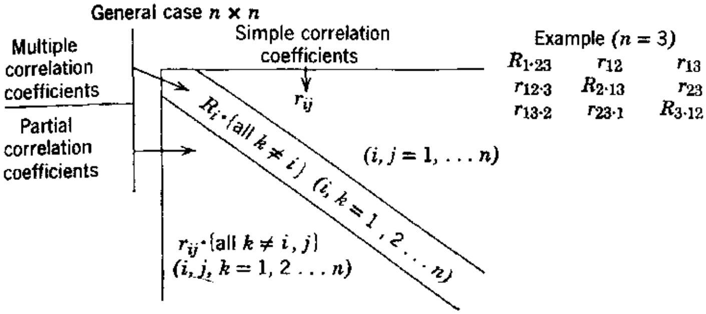

Figure 1 Format of correlation matrices.

both matrices is to see in what way the common dependence of the stock variables on the demographic and economic explanatory variables alters their association with each other. The four matrices are presented for the following two sets of variables:

1. Twelve stocks (A_1, A_2, A_3, A_4, A_5, A_6, A_7, T, M, I, C, Z) in Tables 22 and 23.
2. Five stocks (A_f, T, M, I, C) in Tables 24 and 25.

Two general impressions, confirmatory of the basic hypothesis, emerge from inspection of these correlation matrices:

1. In general, the correlations are positive between assets and negative between assets and debts. The exceptions have fairly obvious specific explanations; for example, the negative correlation between radio-phonograph and television holdings indicates substitutability between these recreational goods. The general pattern is that those who have more have more of all assets—households advance on all fronts together, keeping some balance among accumulations of different assets and reductions of debt. The same impression, with the same type of exceptions, is given by the regressions themselves. As between demographic and socio-economic groups, as well as within groups, those who have more tend to have more quite generally.

2. Much, but by no means all, of the interdependence among stocks when expressed as deviations from over-all means turns out to be due to the common dependence of stocks on the explanatory variables of the regressions.

THE FLOW CALCULATIONS

The analysis of the flow variables is almost parallel to the stock analysis. The same types of calculations have been made except that the flows take

Table 26 "*F*"-tests for Flow Regressions

	(1) Simple Effects of Occupation		(2) Effects of *N*, *R*, *L*, *Y*, *H*, and Σ when Added to Occupation		(3) Additive Effects of Age and Education when Added to Occupation		(4) Additive Effects of Age and Education when Added to *O*, *N*, *R*, *L*, *Y*, *H* and Σ		(5) Interaction of Age and Education with *O*, *N*, *R*, *L*, *Y*, *H*, Σ minus the Additive Age, Education Effects	
Variable	Owners	Renters	Owners	Renters	Owners	Renters	Owners	Renters	Owners	Renters
Durable goods purchases (E_t)	14.33†	10.65†	479.61†	571.57†	20.58†	11.64†	64.43†	17.93†	2.95†	2.79†
Auto purchase (ΔT)	10.75†	10.60†	1057.30†	598.10†	1.58	8.11†	6.12†	15.83†	1.29*	2.93†
Mortgage debt change (ΔM)	2.81*	1.99	36.10†	850.56†	24.70†	1.18	81.51†	1.39	3.03†	2.60†
Installment debt change (ΔI)	1.04	1.25	126.41†	191.06†	0.51	1.67	0.43	1.98	2.18†	1.69†
Change in cash balances (ΔC)	0.93	0.34	47.66†	291.47†	1.80	1.93	4.34†	6.20†	3.84†	21.57†
Change in assets (ΔA)	8.02†	1.03	41.62†	60.22†	14.46†	1.45	30.23†	1.34	1.56†	9.08†
Change in debts (ΔD)	1.78†	1.34	134.76†	261.20†	17.63†	0.79	43.87†	5.72†	2.66†	15.95†
Saving (S)	11.50†	1.22	151.60†	503.91†	6.14†	2.10	2.71*	5.95†	3.58†	4.71†
Degrees of freedom: used	5	5	12	12	5	5	5	5	185	185
remaining	4567	3822	4555	3810	4562	3817	4550	3805	4365	3620

Note: * denotes significance at 0.05 level; † denotes significance at 0.01 level.

the role of the stocks, and five stock variables (A_f, T, M, I, C) are added to the list of independent or explanatory variables. The F-Ratios for five analysis of variance tests are shown in Table 26. The regression coefficients, standard errors, S_U and R^2 for the "pooled" regression of each flow on the whole list of independent variables are shown in Tables 27 to 30.

A cursory glance at Table 26 discloses many more nonsignificant relationships than were found for the stocks. In general the demographic dummy variables are of less importance for flows than for stocks, although there are several notable exceptions. It is worth pointing out that the factors represented by Age and Education, where those variables are significant, are not at all well represented among the other independent variables. A comparison of tests (3) and (4) shows that the significance of A and E is almost always enhanced by controlling Family Size, Region, Community Size, Income, Housing Level, and the five stock variables. Furthermore, test (5) shows that even where there is no significant additive effect of A and E, there is evidence of significant interaction with at least some of the other independent variables. The specific nature of such interaction has not yet been explored.

The R^2's for flows in Tables 27–30 are somewhat higher than those found for stocks. Values below 0.20 are almost the exception instead of the rule; some are as high as 0.70. Apparently flows are easier to predict than stocks partly because stocks themselves can be used as predictors.

Turning to the regressions and examining the education coefficients, one notes at all age levels a tendency to dissave more by borrowing as education is increased. In the discussion of stocks it was proposed that the generally high levels of observed assets attributed to education was evidence of *higher* past saving by the relatively highly educated. A possible reconciliation is that the saving measure adopted does not include purchases of durables and automobiles while the high asset position noted above included the stocks of such goods. Among renters there was a further significant tendency for the higher education classes to purchase more autos at the expense of C and I.

The main effect of Age on the flows is to diminish the rate of purchase of T and A_f, entirely consistent with the smaller stock of these items noted in the preceding section. Older home owners seem to pay off mortgage debt more rapidly, as well as increase cash balances. No similar behavior is apparent for renters—perhaps their balances are nearer to a stationary equilibrium. The only significant coefficients in the saving equations are the negative ones for the 45 to 54 age class. The reasons for the unusually high spending in that age class are obscure.

Among the Occupation coefficients there are few significant relationships. Between wage and salary groups (all but O-2) there is some tendency

Table 27 Flow Regression Coefficients for E_f and ΔT

Independent Variable	Durable Good Purchase (E_f)		Auto Purchase (ΔT)	
	Home Owners	Renters	Home Owners	Renters
E-2	14.62 (20.42)	1.05 (13.09)	39.24 (25.74)	40.42 (22.30)
E-3	27.78 (28.95)	10.31 (18.86)	7.52 (36.49)	82.52 (32.12)
A-2	−81.15 (24.34)	−37.70 (13.22)	10.16 (30.69)	−8.47 (22.50)
A-3	−198.18 (26.40)	−79.88 (15.31)	6.34 (33.28)	−31.68 (26.07)
A-4	−272.50 (28.32)	−131.55 (17.16)	−34.70 (35.70)	−101.72 (29.22)
O-1	−35.30 (36.49)	26.02 (23.76)	25.83 (46.00)	27.92 (40.46)
O-2	−1.37 (29.98)	−1.80 (17.98)	8.68 (37.79)	47.50 (30.62)
O-3	−13.41 (27.55)	−9.86 (17.89)	−46.37 (34.72)	0.68 (30.47)
O-5	−17.36 (25.63)	−19.04 (15.61)	−61.73 (32.31)	−41.04 (26.58)
O-6	−38.58 (30.07)	−52.91 (17.22)	−123.95 (37.91)	−84.44 (29.32)
1	680.01 (42.79)	322.28 (25.07)	147.95 (53.94)	159.61 (42.69)
N	1.14 (6.15)	2.99 (3.94)	−25.12 (7.76)	−25.23 (6.72)
R-2	−10.67 (21.54)	−26.55 (13.06)	35.39 (27.15)	0.65 (22.25)
R-3	60.36 (19.08)	−15.83 (13.04)	86.77 (24.06)	90.14 (22.21)
L-2	−7.47 (19.50)	3.16 (14.67)	45.12 (24.58)	64.26 (24.98)
L-3	−19.77 (22.70)	−15.76 (14.95)	40.58 (28.62)	45.57 (25.45)
Y/1000	42.74 (3.16)	20.41 (1.91)	44.72 (3.98)	21.55 (3.26)
H/1000	9.74 (1.84)	82.76 (22.30)	10.50 (2.32)	87.42 (37.98)
A_f	−0.6143 (0.0138)	−0.2143 (0.0111)	0.0662 (0.0174)	0.0783 (0.0189)
T	0.0086 (0.0094)	0.0153 (0.0075)	−0.6591 (0.0118)	−0.6246 (0.0128)
M	−0.0004 (0.0033)	0.0172 (0.0072)	−0.0111 (0.0042)	0.0142 (0.0124)
I	0.1226 (0.0790)	0.1616 (0.0446)	−0.1256 (0.0996)	−0.0796 (0.0760)
C	0.0100 (0.0033)	0.0079 (0.0035)	0.0082 (0.0042)	0.0217 (0.0059)
S_u	550.20	319.76	693.57	544.49
R^2	0.602	0.184	0.740	0.665

Note: All coefficients are in dollars. Estimated errors in parentheses.

Table 28 Flow Regression Coefficients for ΔM and ΔI

Independent Variable	Mortgage Debt Change (ΔM)		Installment Debt Change (ΔI)	
	Home Owners	Renters	Home Owners	Renters
E-2	90.61 (72.19)	4.20 (29.71)	5.72 (11.60)	8.23 (12.26)
E-3	223.25 (102.32)	−39.49 (42.79)	11.70 (16.44)	34.34 (17.66)
A-2	−649.60 (86.05)	−13.28 (29.98)	4.01 (13.82)	3.62 (12.37)
A-3	−1250.19 (93.32)	7.89 (34.74)	−4.30 (14.99)	7.68 (14.33)
A-4	−1387.62 (100.11)	8.20 (38.93)	−6.60 (16.08)	−13.53 (16.06)
O-1	243.40 (128.98)	38.66 (53.90)	−14.71 (20.72)	0.98 (22.24)
O-2	−12.83 (105.97)	0.29 (40.80)	40.09 (17.03)	26.10 (16.84)
O-3	−58.19 (97.37)	20.31 (40.60)	29.93 (15.64)	22.55 (16.75)
O-5	−33.00 (90.60)	15.51 (35.42)	22.07 (14.56)	6.12 (14.61)
O-6	−17.82 (106.31)	−11.63 (39.06)	0.72 (17.08)	6.80 (16.12)
1	1588.21 (151.26)	44.88 (56.87)	22.53 (24.30)	1.64 (23.47)
N	−15.61 (21.75)	−1.00 (8.95)	−3.16 (3.49)	−7.45 (3.69)
R-2	−16.48 (76.13)	−2.76 (29.64)	16.04 (12.23)	−8.77 (12.23)
R-3	206.08 (67.45)	−12.25 (29.59)	9.77 (10.84)	14.84 (12.21)
L-2	−30.16 (68.91)	25.25 (33.28)	10.82 (11.07)	−7.70 (13.73)
L-3	−187.88 (80.25)	−13.50 (33.91)	−11.43 (12.89)	19.63 (13.99)
Y/1000	−61.81 (11.15)	3.30 (4.34)	−0.25 (1.79)	0.93 (1.79)
H/1000	60.10 (6.51)	−74.71 (50.59)	1.55 (1.05)	73.59 (20.88)
A_f	−0.4664 (0.0489)	−0.0193 (0.0252)	0.0093 (0.0078)	0.0094 (0.0104)
T	0.0443 (0.0332)	−0.0019 (0.0171)	−0.1787 (0.0053)	−0.2661 (0.0071)
M	−0.2174 (0.0117)	−0.8569 (0.0165)	0.0025 (0.0019)	0.0052 (0.0068)
I	0.6348 (0.2794)	−0.0009 (0.1012)	0.0317 (0.0449)	0.0115 (0.0418)
C	0.0500 (0.0117)	−0.0004 (0.0079)	−0.0019 (0.0019)	−0.0035 (0.0032)
S_u	1944.89	725.41	312.47	299.34
R^2	0.153	0.730	0.251	0.378

Table 29 Flow Regression Coefficients for ΔC and ΔA

Independent Variable	Change in Cash Balances (ΔC)		Change in Assets (ΔA)	
	Home Owners	Renters	Home Owners	Renters
E-2	−0.38 (69.45)	−148.06 (75.83)	43.20 (119.92)	16.52 (75.51)
E-3	45.72 (98.45)	−249.68 (109.24)	168.81 (169.98)	174.31 (108.77)
A-2	26.86 (82.79)	−149.39 (76.53)	−754.63 (142.95)	102.11 (76.21)
A-3	271.29 (89.78)	−232.05 (88.68)	−1528.49 (155.02)	69.05 (88.30)
A-4	294.70 (96.32)	11.19 (99.38)	−1492.05 (166.32)	131.56 (98.96)
O-1	2.84 (124.10)	−113.14 (137.60)	410.42 (214.27)	272.75 (137.01)
O-2	−82.69 (101.96)	−295.61 (104.15)	60.95 (176.05)	93.66 (103.71)
O-3	54.51 (93.69)	7.92 (103.63)	−17.74 (161.76)	36.74 (103.19)
O-5	−4.18 (87.17)	103.19 (90.41)	122.61 (150.51)	−12.61 (90.03)
O-6	−38.59 (102.29)	249.94 (99.71)	216.85 (176.61)	81.96 (99.29)
1	−430.24 (145.54)	−966.32 (145.17)	1127.21 (251.29)	347.27 (144.56)
N	−51.51 (20.93)	−75.18 (22.84)	−139.29 (36.14)	−2.88 (22.74)
R-2	86.86 (73.25)	174.94 (75.67)	64.49 (126.47)	−68.37 (75.35)
R-3	−2.01 (64.90)	71.82 (75.53)	279.26 (112.06)	35.61 (75.21)
L-2	−14.38 (66.30)	−29.08 (84.96)	−108.82 (114.48)	−6.69 (84.60)
L-3	6.67 (77.22)	157.10 (86.56)	−194.97 (133.32)	−98.87 (86.19)
$Y/1000$	117.32 (10.73)	479.15 (11.09)	282.34 (18.53)	−34.45 (11.04)
$H/1000$	−31.48 (6.27)	−845.45 (129.15)	−0.41 (10.82)	−671.64 (128.60)
A_f	0.2414 (0.0471)	−0.0252 (0.0643)	−0.2983 (0.0813)	0.1578 (0.0640)
T	0.1300 (0.0320)	0.1659 (0.0437)	0.3974 (0.0552)	0.1612 (0.0435)
M	0.0078 (0.0113)	0.1028 (0.0421)	−0.2176 (0.0194)	−1.1485 (0.0419)
I	−0.2105 (0.2688)	−0.4377 (0.2585)	0.4619 (0.4641)	0.4094 (0.2574)
C	−0.2199 (0.0113)	−0.2020 (0.0201)	0.0563 (0.0194)	−0.0280 (0.0200)
S_u	1871.29	1851.83	3231.01	1843.95
R^2	0.116	0.523	0.135	0.227

Table 30 Flow Regression Coefficients for ΔD and S

Independent Variable	Change in Debts (ΔD)		Savings (S)	
	Home Owners	Renters	Home Owners	Renters
E-2	138.61 (98.30)	171.15 (92.16)	−95.41 (73.80)	−154.63 (70.99)
E-3	306.59 (139.34)	411.87 (132.76)	−137.78 (104.61)	−237.57 (102.27)
A-2	−686.51 (117.18)	183.80 (93.02)	−68.12 (87.98)	−81.70 (71.65)
A-3	−1358.66 (127.08)	269.20 (107.78)	−169.82 (95.41)	−200.15 (83.02)
A-4	−1534.51 (136.33)	115.09 (120.78)	42.46 (102.36)	16.46 (93.04)
O-1	278.69 (175.64)	267.48 (167.23)	131.73 (131.87)	5.26 (128.82)
O-2	53.32 (144.31)	299.60 (126.58)	7.63 (108.35)	−205.94 (97.50)
O-3	−32.21 (132.60)	118.36 (125.95)	14.47 (99.56)	−81.62 (97.02)
O-5	−32.48 (123.38)	−61.50 (109.88)	155.08 (92.63)	48.89 (84.61)
O-6	−22.37 (144.77)	258.61 (121.18)	239.22 (108.69)	176.65 (93.35)
1	1928.63 (206.00)	1017.39 (176.44)	−801.42 (154.66)	−670.13 (135.91)
N	46.92 (29.62)	76.61 (27.76)	−186.21 (22.24)	−79.48 (21.38)
R-2	−14.13 (103.67)	−153.14 (91.96)	78.61 (77.84)	84.77 (70.84)
R-3	246.04 (91.86)	43.34 (91.80)	33.22 (68.97)	−7.73 (70.71)
L-2	−85.80 (93.85)	71.00 (103.25)	−95.02 (70.46)	−77.70 (79.53)
L-3	−316.20 (109.29)	−211.48 (105.20)	121.23 (82.05)	112.62 (81.03)
$Y/1000$	−83.89 (15.19)	−505.77 (13.48)	366.23 (11.40)	471.32 (10.38)
$H/1000$	63.80 (8.87)	942.53 (156.97)	−64.21 (6.66)	−1614.17 (120.91)
A_f	−0.6903 (0.0666)	0.1573 (0.0782)	0.3921 (0.0500)	0.0005 (0.0602)
T	−0.1377 (0.0452)	−0.3701 (0.0531)	0.5351 (0.0340)	0.5313 (0.0409)
M	−0.2203 (0.0159)	−0.8968 (0.0511)	0.0027 (0.0120)	−0.2517 (0.0394)
I	0.2868 (0.3805)	0.1822 (0.3141)	0.1751 (0.2857)	0.2272 (0.2420)
C	0.0576 (0.0159)	0.0724 (0.0244)	−0.0013 (0.0120)	−0.1005 (0.0188)
S_u	2648.55	2250.64	1988.50	1733.62
R^2	0.073	0.485	0.326	0.617

for the blue-collar end of the scale to refrain from purchases of durables and to increase assets of other kinds, including cash, as evidenced by the saving coefficients. Businessmen seem to raise funds by increasing debts and reducing cash. Since there seems to be no offsetting increase in the observed assets, it is possible that the funds were spent on business investment.

Table 31 Computations of Long- and Short-Run Income Coefficients for Flows

Dependent Variables	Housing Coefficient	"Adjusted" Housing Coefficient	Short-Run Income Coefficient*	Long-Run Income Coefficient*
Home Owners				
E_f	\$9.74	\$20.16	\$42.74	\$62.90
ΔT	10.50	21.73	44.72	66.45
ΔM	60.10	124.40	−61.80	62.60
ΔI	1.55	3.20	−0.25	2.95
ΔC	−31.48	−65.16	117.32	52.16
ΔA	−0.41	−0.85	282.34	281.49
ΔD	63.80	132.06	−83.89	48.17
S	−64.21	−132.91	366.23	233.32
Renters				
E_f	82.76	12.41	20.41	32.82
ΔT	87.42	13.11	21.55	34.66
ΔM	−74.71	−11.20	3.30	−7.90
ΔI	73.59	11.03	0.93	11.96
ΔC	−845.45	−126.81	479.15	352.34
ΔA	−671.64	−100.73	−34.45	−135.20
ΔD	942.53	141.37	−505.77	−364.40
S	−1614.17	−242.12	471.32	229.20

* Per \$1000 of income.

Most of the effects of Region and Community Size that were noted in the stock section are substantiated by the flow relations. Where smaller stocks were observed before, smaller flows tend to maintain stocks at a relatively low level. An exception to this appears for T in the case of suburban dwellers. They did not show significantly higher auto stocks than metropolitan households, but they appear to be increasing at a faster rate.

The Income and Housing Level coefficients again are highly significant, accounting in large measure for the relatively high R^2's. The only exception is for Change in Installment Debt—it appears to be as unrelated to Y and H as was the stock of installment debt. The long- and short-run income coefficients have been computed for the flows exactly as they were for the stocks. The calculations are shown in Table 31. It is interesting to note the implication that for home owners short-run increases of income result in debt reduction while long-run changes result in debt expansion. For renters, both kinds of income change reduce debt but the effects of short-run changes are more marked. The negative income effect on asset change for renters may indicate some substitutability between present wealth and future income; in the case of home owners, the same effect may operate but, if so, it is offset by home investment. The differences between short- and long-run coefficients for saving are definitely in the direction, if not in the amount, predicted by the permanent income hypothesis.

Finally there are the five stock variables, A_f, T, M, I, and C, which were introduced in the flow regressions. The hypothesis was that there is a balance among stocks which households tend to maintain; that, in other words, when an asset is above its equilibrium level changes will tend to reduce it and/or increase other assets. Reduction of debt will, of course, imply reduction of assets. This should show up in negative coefficients for an asset when it appears in "its own" flow regression and positive coefficients in other regressions. Making necessary allowances for the negative nature of debts, one can derive a pattern of signs for the five stock coefficients. The estimated coefficients show little statistically significant divergence from this pattern of signs. Indeed, for home owners there is only one exception to the pattern—the positive effect of cash balances on mortgage debt change. For renters, there are three exceptions, but two of them relate to mortgage debt and the hypothesis really is barely applicable in this case. The third exception indicates a positive effect of installment debt on durable purchases.

Correlation matrices were computed as before; Tables 32 and 33 show a set for variables E_f, ΔT, ΔM, ΔI, ΔC, and S. The lower part of each table shows correlations between residuals from regressions listed in Tables 27 to 30. In most cases the interrelationships among the flows have been substantially reduced by allowing for their common dependence on a set of independent variables. In the case of saving, however, the exclusion of E_f and ΔT from the saving concept is strongly underlined by the negative correlations between S and both E_f and ΔT. This substitutability between purchases of durable goods and autos and other forms of investment is even more apparent when considering the correlation of residuals. Furthermore, after regression the partial correlation shows that E_f and ΔT themselves are substitutes at least for the renters.

Table 32 Home Owners, Correlations among Flows

Before Regression

	E_f	ΔT	ΔM	ΔI	ΔC	S
E_f	255	078	222	–0–	–121	–0–
ΔT	101	528	–0–	513	–063	–175
ΔM	206	–048	300	–0–	–217	–103
ΔI	–058	500	–0–	526	–0–	–184
ΔC	–077	–036*	–176	052	355	288
S	034*	–085	–052	–119	272	352

After Regression

	E_f	ΔT	ΔM	ΔI	ΔC	S
E_f	261	055	159	–0–	–122	–214
ΔT	–0–	308	–0–	238	–037*	–216
ΔM	135	–034*	230	–0–	–179	–092
ΔI	–030*	222	032*	250	–0–	–105
ΔC	–044	–0–	–153	043	320	273
S	–179	–189	–0–	–068	250	389

Note: In matrices above –0– has replaced correlations not significant at 0.05, asterisks denote nonsignificance at 0.01.

Table 33 Renters, Correlations among Flows

Before Regression

	E_f	ΔT	ΔM	ΔI	ΔC	S
E_f	135	045	–0–	–0–	040*	–045
ΔT	062	624	–0–	611	–064	–224
ΔM	–0–	–0–	236	–0–	–0–	138
ΔI	–075	586	035*	622	–0–	–186
ΔC	102	042	–190	119	732	705
S	–099	–126	232	–132	729	752

After Regression

	E_f	ΔT	ΔM	ΔI	ΔC	S
E_f	370	057	–0–	–0–	–180	–354
ΔT	–084	463	–0–	273	–222	–383
ΔM	–0–	039*	117	–0–	–047	067
ΔI	–038*	249	–0–	296	–0–	–125
ΔC	–050	–109	–077	108	420	392
S	–328	–316	104	–070	313	580

Note: In matrices above –0– has replaced correlations not significant at 0.05, asterisks denote nonsignificance at 0.01.

CONCLUSION

The elementary hypotheses expressed at the outset have, on the whole, been sustained by the statistical results. There is evidence that households tend to maintain some sort of balance in their capital accounts both between assets yielding direct services and financial assets, and between liquid funds and liabilities. Furthermore, the precise nature of the preferred portfolio toward which adjustments are made seems to be related to the explanatory variables employed, and presumably therefore, to the more fundamental but unobserved measures of a household's social, economic, biological, and environmental characteristics. The flow regressions have also shown that adjustments in capital account items tend to eliminate rather than perpetuate deviations from a basic or preferred portfolio pattern.

Some of the specific results pertaining to automobile and durable goods stocks have been clouded by inadequacies of the method used for evaluating such stocks. Whether an attempt at direct measurement of the value of, say, a nine-year-old refrigerator would provide more conclusive results is at least problematical. Each of the variables for which dollar values were assigned on the basis of one-digit codes has, no doubt, added to the crudeness of the analysis.

The handicap of working with only a part of the household's balance sheet has lent some inconclusiveness to the findings. There is no way of assuring, for instance, that the separate relationships estimated for the several stocks and flows are consistent with each other in view of the accounting structure within which those relationships must operate. Because of the ambiguities of durable goods accounting in imperfect markets this would be difficult at best. But if complete or almost complete household balance sheets were available, advantageous use could be made of the structure imposed by accounting identities.

Almost by definition a one period cross-section analysis is drastically limited in its ability to provide generalizations about the dynamics of capital account changes in response to altered external or life-cycle situations. A panel study is much better for this purpose. The results obtained in this study must definitely be viewed as suggestive rather than conclusive in this regard.

To close on a more positive note, despite the obvious reservations the investigation has at least shown that analysis of household capital accounts is a promising source of insights about household economic behavior. It can provide insights relevant to the household sector's impact on the economy's flows via household investment in durable goods as well as to the household's impact on the various financial asset markets.

2

*Consumer Debt and Spending: Some Evidence from Analysis of a Survey**

JAMES TOBIN

THE APPROACH AND THE DATA

A survey of the consumer debt position of a sample of households at the beginning and end of a year provides an opportunity for statistical analysis of variables associated with the size of a household's consumer debt and with the amount and direction of change in that debt during the year. The objective of such analysis is to assist in the estimation of stable economic behavioral relationships which can serve as tools in forecasting and in assaying the effects of alternative policies. As will become amply clear in the course of the paper, this objective is a difficult one to achieve; the results of statistical analysis of cross-section data are likely to be susceptible to a variety of possible interpretations. Still the attempt must be made; the ambiguities of econometric analysis of aggregate time series are, if anything, even greater than those confronting the analyst of cross sections of individual economic units.

* SOURCE: Reprinted from National Bureau of Economic Research, *Consumer Instalment Credit*, Part II, Volume 1 (Washington: U.S. Government Printing Office, 1957).

I am indebted to the Social Science Research Council for a Faculty Research Fellowship under which the research, of which this is a part, was begun; to the Board of Governors of the Federal Reserve System and the Survey Research Center of the University of Michigan for cooperation in making the data available and in guiding their use; to Donald Hester and Harold Watts for making the computations; to George Katona, Ruth Mack, and Guy Orcutt for useful comments on the first version of this paper presented at the Conference on Consumer Credit Regulation October 12–13, 1956.

Households differ from each other in economic behavior for a great variety of reasons, some of which are measured in surveys and some of which are not. Many of the relevant differences among consumers—e.g., age of head, location, occupation, personality—may be of very little interest to the economist. His central interest is in the effects on economic behavior of differences in economic variables such as income and wealth. Yet he ignores the other variables at his peril. Expenditure on some commodity, for example, may appear to be positively related to income. But suppose it is also positively related to size of family, age, size of city, and educational attainment. Income happens to be positively related to all these things too. Perhaps the apparent positive effect of income on expenditure is only an illusion, mirroring the effects of the demographic variables with which income is associated. If so, the economist will be fooled when national income rises the next year. He will expect a rise in expenditure that does not occur; it does not occur because, even though income fluctuates, the basic demographic determinants change very little from year to year.

To avoid this kind of pitfall, the approach of the analyst of survey data must be resolutely multivariate. Two- and three-variable frequency tables are interesting and suggestive. But it is *net* or *ceteris paribus* effects rather than gross associations that we wish to estimate. For this reason, the present paper relies heavily on the technique of multiple regression. An attempt is made to estimate, by this technique, the effects of the size of existing debt on three kinds of subsequent behavior, holding constant a variety of other variables relevant to this behavior. Likewise, the *net* effects of a variety of factors on change in consumer debt are estimated.

The Nature of the Sample

The data for the calculations reported in this chapter came from the 1952 and 1953 Surveys of Consumer Finances conducted by the Survey Research Center, University of Michigan, for the Board of Governors of the Federal Reserve System. The sample used in this analysis consists of spending units who were interviewed both in the 1952 Survey in early 1952 and in the 1953 Survey a year later. The number of spending units reinterviewed was 1,036, roughly a third of the entire Survey in either year. The reinterview sample is somewhat unrepresentative of the national population of spending units. Certain kinds of units are systematically excluded from the sample: units which were formed or dissolved during the year, and in this case, units which moved from one dwelling unit to another. This disadvantage is outweighed, for the purpose of studying behavior relationships, by the analytic advantages of having two observations of each unit. Reinterviewing increases the accuracy of relevant financial data. Income in 1951, and such stock variables as asset holdings and outstanding debt as of January 1, 1952, can be obtained more reliably in February 1952 than in February 1953. Accordingly, financial flow variables for 1952 can be estimated, with less reliance on respondents' memory, by comparing the stock reported in the 1953 interview with the stock reported by the same respondent a year earlier.

For the purpose of the statistical analysis, farm spending units and secondary spending units are excluded. (A secondary spending unit is a unit of one or more persons who maintains his own finances but shares the dwelling unit of some related or unrelated primary spending unit.) In addition, spending units who did not give responses on one or more of the relevant variables are excluded. The remaining units are then divided into two groups for separate analytic treatment, as follows:

1952 income greater than $1,000	652
1952 income less than $1,000	55

The reason for treating spending units with low incomes separately is as follows: In general, it is desirable, for statistical and economic reasons, to use as variables ratios in which income is the denominator. Income is a powerful variable, with which both the dependent variable and the other independent variables in a regression are likely to be highly correlated. The use of ratios to income focuses attention on explaining, by means of other variables, the share of income devoted to some particular purpose. From a statistical point of view, the use of ratios to income diminishes *heteroskedasticity* in a sample of households; the variance of the dependent variable, expressed in dollars, is roughly proportional to income, and dividing by income tends to make the variance homogeneous. This procedure, however, leads to extreme values when the income denominator is small or negative. Consequently the low-income spending units are here analyzed in terms of dollar variables, rather than fractions of income.

The spending units in this sample did not have equal probabilities of being included. Some were deliberately given a greater probability of selection than others. These differentials in sampling rate were designed to compensate for anticipated differentials in the variance of the attributes the sample was intended to measure. Thus high-income households had a greater probability of selection than low-income households, because it was believed to require more observations to get an estimate with given accuracy for high- than for low-income units. In addition to deliberate differentials in sampling rate, there are unintended differences due to failures to obtain responses from spending units drawn for the sample. As a consequence, each observation in the sample stands for a different number of spending units in the population; an observation of a low-income unit represents more unobserved households than an observation of a high-income unit. For some purposes, it is important to weight the observations in the sample accordingly. It is important to do so whenever the sample is used to estimate a population parameter which might be expected to differ among the differentially sampled population groups. This will be true of almost all characteristics of single-variable distributions: averages and frequencies of income, expenditure, debt, liquid-asset holdings, and other financial and economic variables. It is also important to use the weights whenever the sample is used to estimate a parameter of the distribution of a variable whose variance is in fact inversely proportional to the weights. If the observations are not weighted in such a case, the less reliable observations will have too great an influence on the estimate.

In the calculations of the present chapter, the weights were not used. The objective was to estimate regression coefficients and other characteristics of multivariate distributions, not to estimate parameters of univariate distributions. Thus the single-variable means and frequencies calculated here as by-products are unweighted and, therefore, biased estimates of population means and frequencies; this should be remembered in interpreting any single-variable statistics. This bias does not extend, it is believed, to the regression coefficients and other multivariate parameters. While expenditures for durable goods, for example, are obviously different for high-income than for low-income groups, the marginal propensity to spend for durable goods is not necessarily different for one group than for the other. If it is, the remedy is not weighting to obtain a properly averaged slope but fitting a nonlinear relationship that allows for differences in slope. The other reason for weighting—to avoid heterogeneity of variances—also does not apply, provided other measures to avoid this malady are employed. As explained above, the use of ratios to income is an attempt to produce homogeneity of variance. It is, in effect, a more systematic and, for many observations, a more drastic weighting scheme than the use of the sampling weights; to use the sampling weights also would be to make an overcorrection for heterogeneity of variance.

Regression Variables

The variables used in the analysis are as follows:

Y	1952 income of the spending unit, after estimated Federal tax liability, as reported in 1953 Survey.
Y_{-1}	1951 income of the spending unit, after estimated Federal tax liability, as reported in 1952 Survey.

E	Expenditure, net of trade-ins and sales, of the spending unit on cars and major household goods during 1952, as reported in 1953 Survey, regardless of how financed.
E_{-1}	The same for 1951, as reported in the 1952 Survey.
L	Total holding of liquid assets January 1, 1952, reported by the spending unit in the 1952 Survey, including checking accounts, savings accounts, and savings bonds.
L_{+1}	The same for January 1, 1953, as reported in the 1953 Survey.
$\Delta L = L_{+1} - L$	Change in liquid-asset holding during 1952.
D	Outstanding personal debt (debt other than business and real estate indebtedness) as of January 1, 1952, as reported in the 1952 Survey.
D_{+1}	The same for January 1, 1953, as reported in the 1953 Survey.
$\Delta D = D_{+1} - D$	Change in outstanding personal debt during 1952.
$N = L - D$	"Net asset position" at January 1, 1952.
$\Delta N = \Delta L - \Delta D$	Change in "net asset position" during 1952.
A	Age of the head of the household as reported in the 1953 Survey, on the following scale: Age 18–24 $A = 1$ 25–34 $A = 2$ 35–44 $A = 3$ 45–54 $A = 4$ 55–64 $A = 5$ 65– $A = 6$
M	Marital status of the head of household: $M = 1$ if married and spouse present, $M = 0$ otherwise.

In the analysis of spending units with incomes over \$1000, the three dependent variables are as follows:

E/Y	Ratio of expenditure on durable goods to disposable income.
$\Delta L/Y$	Ratio of change in liquid-asset holding to disposable income.
$\Delta D/Y$	Ratio of change in personal debt to disposable income.

In the analysis of the units with incomes under \$1000, the three dependent variables are simply E, ΔL, ΔD.

The Regression and Correlation Calculations

Regressions of the three dependent variables on a common set of independent variables were calculated, and the correlations among the three dependent variables were examined. The purpose is (1) to estimate the effects of certain predetermined variables on the durable-goods spending, liquid saving, and debt behavior of households, and (2) given these effects, to determine the pattern of association among these three kinds of behavior. Results of the regression calculations for the 652 primary spending units with income above $1000 are given in Table 1, and regressions for the 55 units with lower income are shown in Table 2.

In Table 1 income change enters each regression in two forms: as a continuous variable, and as a three-way principle of classification. The reason for introducing it in the second form is to allow for interaction effects between income change and the other explanatory variables, as well as additive effects.

Table 3 presents coefficients of correlation among the three dependent variables, computed for the households with incomes above $1000. The correlations were first computed on the variables as reported "before" regression; then they were computed on the residuals from the regressions of Table 1. Both simple and partial correlations are presented; the partial correlations are net of the third variable in every case. Table 3 shows that debt accumulation and durables expenditure are significantly positively correlated; this correlation is greater on the residuals than on the original variables. However, this is the only pair among the three kinds of behavior for which a significant association exists. The apparent correlations among other pairs turn out to reflect no more than the common effects of the independent variables, removed by the regressions.

DIFFICULTIES IN THE INTERPRETATION OF CROSS-SECTION DATA

Does large personal indebtedness deter consumers from buying durable goods, from further borrowing, and from depleting their liquid reserves? Given their incomes and their other circumstances, are consumers more likely to make net reductions in their indebtedness and to curtail their spending when their existing debt is large than when it is small? Are they more likely to borrow, and to buy durable goods, when they are relatively debt free?

Answers to these questions would greatly contribute to an appraisal of the economic consequences of a given volume of consumer debt. If the answers are affirmative, a high ratio of debt to income would have to be interpreted as a deflationary sign, an indication that consumer spending

Table 1 Primary Nonfarm Spending Units with 1952 Incomes $1000 or Greater

Dependent Variable	Income Change	Regression Coefficients (Estimated Standard Errors): M	A	L/Y: $Y_{-1}/Y < 0.8$	L/Y: $0.8 \leq Y_{-1}/Y < 1.3$	L/Y: $1.3 \leq Y_{-1}/Y$	D/Y: $Y_{-1}/Y < 0.8$	D/Y: $0.8 \leq Y_{-1}/Y < 1.3$	D/Y: $1.3 \leq Y_{-1}/Y$	Y_{-1}/Y: $Y_{-1}/Y < 0.8$	Y_{-1}/Y: $0.8 \leq Y_{-1}/Y < 1.3$	Y_{-1}/Y: $1.3 \leq Y_{-1}/Y$	Constants: $Y_{-1}/Y < 0.8$	Constants: $0.8 \leq Y_{-1}/Y < 1.3$	Constants: $1.3 \leq Y_{-1}/Y$	R^2	Standard Error of Estimate
E/Y	Up			−0.003 (0.010)			+0.056 (0.093)			+0.026 (0.077)			* +0.113 (†)				
	Little change	+0.020 (0.014)	* −0.020 (0.004)		−0.0004 (0.001)			+0.010 (0.029)			* −0.117 (0.052)			* +0.240 (†)		0.23	0.125
	Down					+0.012 (0.010)			+0.006 (0.097)			* +0.032 (0.008)			* +0.070 (†)		
$\Delta L/Y$	Up			* −0.311 (0.082)			* −2.64 (0.58)			−0.113 (0.633)			* +0.377 (†)				
	Little change	* −0.213 (0.082)	* +0.072 (0.023)		* −0.289 (0.031)			−0.075 (0.200)			−0.097 (0.270)			* +0.186 (†)		0.38	0.768
	Down					* −0.214 (0.095)			−0.212 (0.232)			* +0.367 (0.044)			* −0.560 (†)		
$\Delta D/Y$	Up			* −0.027 (0.009)			* −0.733 (0.059)			* −0.070 (0.041)			+0.117 (†)				
	Little change	+0.019 (0.012)	* −0.006 (0.002)		−0.011 (0.007)			* −0.573 (0.051)			−0.032 (0.023)			+0.093 (†)		0.35	0.155
	Down					−0.024 (0.020)			* −0.886 (0.104)			+0.010 (0.011)			+0.104 (†)		

* Significant at 10-per cent level.
† The significance of the 3 constants may be considered jointly, by testing the hypothesis that they are, except for sampling variation, equal: i.e., that classification by income change does not really affect the level of the relationship. This hypothesis would be rejected for E/Y (F-ratio of 5.2 with 2 and 638 degrees of freedom) and $\Delta L/Y$ (F-ratio of 7.3, 2 and 638 degrees of freedom). But it cannot be rejected for $\Delta D/Y$ (F-ratio of 0.05).

Table 2 Primary Nonfarm Spending Units with 1952 Incomes under $1000

Dependent Variable	Regression Coefficients (Estimated Standard Errors) M	A	L	D	Y_{-1}	Y	R^2	Standard Error of Estimate
E	−6.04 (14.61)	−3.53 (3.95)	*+0.005 (0.002)	−0.079 (0.067)	*+0.043 (0.007)	−0.092 (0.263)	†0.68	$53.5
ΔL	+370.0 (348.0)	−21.9 (94.1)	*−0.153 (0.044)	+1.28 (1.60)	*−0.778 (0.160)	+3.73 (6.27)	†0.65	1273
ΔD	*+79.5 (15.6)	+2.07 (4.21)	−0.002 (0.002)	*−0.672 (0.076)	*+0.068 (0.007)	*−1.04 (0.28)	†0.82	56.8

* Significant at 10-per cent level.
† These represent the proportions of the variances of the dependent variables *about zero* explained by the regressions, which include no constant term. Of these same variances about zero, the means of the variables would explain the following proportions: 0.05, 0.04, and 0.00.

would decline. If there is no such relationship between debt and consumer spending and borrowing, a student of business cycles could not view a high debt level as itself a cause of subsequent recession. He might, however, wonder about the longer run social and economic consequences of heavy debt in case a recession developed from other causes. If there is no automatic tendency for debt to deter further borrowing and spending, consumers and their expenditures will be highly vulnerable to drastic reductions of income.

Surveys of cross sections of households, such as the survey which is the basis for the calculations of this chapter, may help to answer these questions. But the essential limitations of single-time cross sections must be borne in mind. The use of cross-section data for the estimation of

Table 3 Correlations among Dependent Variables

	ΔL/Y Before regression	ΔL/Y After regression	ΔD/Y Before regression	ΔD/Y After regression	
E/Y	†0.219	0.028	†0.212	†0.305	Simple
	†0.206	0.026	†0.199	†0.305	Partial
ΔL/Y			*0.089	0.011	Simple
			0.044	0.002	Partial

* Significant at 10-per cent level.
† Significant at 1-per cent level.

economic relationships depends on a crucial assumption. The assumption is that economic behavior in response to changes in circumstances over time can be inferred from differences in observed behavior among individuals in differing circumstances at the same moment of time. For many purposes this assumption is justified, especially when account can really be taken of the many relevant respects in which the circumstances of individuals differ. But the assumption can be a treacherous one in attempting to estimate relationships between stocks and flows, as in the present case, where we seek to estimate the dependence of spending, debt change, and liquid-asset change on outstanding debt. The reason that the assumption may be treacherous in such a case is that stocks are the resultant of the past behavior of households and flows represent their current behavior. Any correlation, positive or negative, between the past behavior and current behavior of individual households will tend to be reflected in a correlation between stocks and flows in a cross section of households. There are several possible sources of such correlations.

Periodicity in Durable Goods Expenditure

Since some durable goods purchases are large "lumpy" expenditures, they do not occur every year for a given household. In a year when such a purchase does occur, the household's total expenditure for durable goods is large; but in the following year it is small. Suppose that the large purchase is financed by incurring instalment debt. Then debt will rise in the year of the lumpy purchase and fall in the subsequent year. A cross-section "snapshot" of households at a single year will find some making a large lumpy purchase and other households repaying debt incurred for such purchases in the previous year. In the cross section, therefore, small current expenditure and debt repayment will tend to be associated with high levels of outstanding debt, while large expenditure and large additions to debt will be associated with low levels of debt. But it would be a mistake to conclude from these negative relationships between D and E and between D and ΔD that *for the economy as a whole*, debt is a deterrent to durable-goods expenditure and to further increase in debt. That conclusion would be justified only if it could be shown that the negative correlations still exist among households at the same phase in the lumpy-expenditure cycle; e.g., that, within the group of households who are making a large lumpy purchase, more is spent by those who are relatively free of debt than by others.

This kind of nuisance correlation would be more likely to occur the narrower the range of commodities included in the category of expenditures E. The variety covered by the category in the present survey means that the household has considerable scope for smoothing even within a single year.

It should also be remembered that expenditure is measured *net* of trade-ins, and includes expenditure for secondhand as well as new items. Thus there is a greater divisibility in E than one might conclude from concentrating his attention on periodic purchases of new automobiles. The personal-debt concept of the survey is also quite comprehensive, so that the relations of D, ΔD, and E should not be dominated by the mechanical correlation due to periodicity in lumpy expenditures.

Fortunately the data of the reinterview survey on durable-goods expenditure in the previous year E_{-1} make it possible to guard against this kind of correlation. If we find that, holding E_{-1} constant, there is a negative relationship between D and E or ΔD, we can conclude that this is not due merely to periodicity in durable-goods purchases.

Persistent "Personality" Differences among Households

It is reasonable to expect that there are persistent differences among households in respect to a set of attributes suggested by such words as thriftiness, foresight, conservatism, self-restraint, venturesomeness. People differ in the degree of calculation and care with which they arrive at decisions. They differ also in the contingencies that they foresee and attempt to allow for, from obsessive concern with improbable catastrophies at one extreme to a happy-go-lucky disregard of the future at the other. These differences are reflected in their behavior towards consumers' goods and personal debt. Some households regard such debt as a convenience to be continuously exploited in order to increase their collection of durable goods at the fastest possible rate. Households of a more "thrifty" disposition, at the other extreme, regard buying on time as sinful. Most households, of course, are located at intermediate positions of a continuous spectrum. Differences in location along the spectrum—let us call them "personality differences"—are not directly measured in the usual economic survey of households. (There is no insuperable obstacle to measuring them, and recent Surveys of Consumer Finances have made attempts in this direction.) Neither are "personality differences" adequately represented by the variables that economic surveys generally do measure.

These persistent "personality differences" tend to produce a positive correlation between existing debt, D, and either change in debt, ΔD, or expenditure on durable goods, E, and a negative correlation between D and liquid-asset change, ΔL. The same attitudes and values that led a household to accumulate a large debt in the past in order to buy durable goods continue to dispose the household to borrow and to spend in the current year. The same scruples that kept a family out of debt before continue to inhibit it from going into debt, and possibly also to give the accumulation of liquid reserves priority over the acquisition of consumers' durables.

Correlations of this kind between stocks and flows—let us call them "personality correlations"—are of interest in the broadest contexts of the study of human behavior. But for such a purpose as appraising the economic effects of the burden of consumer debt over time, they are quite irrelevant. For a given family, or within a group of families of common personality traits, the economic behavior relationship may go in the opposite direction—the more debt the less borrowing and spending, and the more repayment and liquid saving. But the "behavior relationship" may be partially or completely obscured, in a single-time cross section, by the "personality correlations."

EFFECTS OF OUTSTANDING DEBT ON EXPENDITURES ON DURABLE GOODS

According to Tables 1 and 2, the regression coefficients representing the effect of debt on durable-goods expenditure are insignificantly different from zero. For households with 1952 incomes under $1000 (Table 2), the coefficient is negative in sign; this is the only one of the four coefficients that is greater in absolute value than its estimated standard error. The three coefficients of D/Y in the E/Y regression, for households with incomes greater than $1000, are all small positive numbers. But the significance of the regression would have been increased by the omission of D/Y; the F-ratio for testing the significance of its inclusion is 0.17 (3 and 638 degrees of freedom).

In order to eliminate any effect due to periodicity in lumpy purchases of durable goods, E_{-1}/Y was introduced as an additional independent variable in the E/Y regression. The net relationship of E/Y to E_{-1}/Y turned out to be positive rather than negative, and insignificantly different from zero. The estimated coefficients of D/Y were moved somewhat closer to zero.

These results can be interpreted to mean that there may be in fact a negative behavior relationship between debt and durable-goods expenditure, a relationship which has been prevented from displaying itself in this cross section of households by the positive personality correlation. To this interpretation two objections might be made.

First, it might be objected that the "personality correlation," if at all important, would have shown up in a significantly positive relation of E/Y to E_{-1}/Y. However, E_{-1}/Y is a very imperfect representative of personality. There are many reasons other than its location on the thriftiness spectrum for a household to have made high or low durable-goods expenditures in the previous year. It would be better to have, as an indicator of position on this spectrum, the residual of E_{-1}/Y_{-1} from a regression for 1951 similar to the one shown for 1952 in Table 1, but the data do not permit calculation of such a regression. In any case, the relevant personality traits would be better measured by a summary of a considerable range of past behavior than by behavior in the immediately preceding year alone.

Second, it might be objected that the variable D may stand not only for the stock of debt but also for the stock of durable goods, since the acquisition of durable goods is associated with going into debt. Any negative relationship between D and E which we detect may, according to the objection, represent the deterrent effect of a large stock of durable goods on further purchases of durables rather than the deterrent effect of consumer debt per se. It is unfortunate that a direct measurement of the stock of durable goods could not be included in the regression, so that "saturation effects" could be estimated separately and disentangled from other relationships. But even so, the objection does not seem too serious. Although it is true that there is positive correlation between debt change, ΔD, and expenditure on durables, E (see Table 2), this correlation is too loose to permit the summation of ΔD over a period of past years, which is D, to represent the stock of durable goods, which is the summation of E less depreciation over the past period. Age, A, and marital status, M, almost certainly constitute together a better proxy for the stock of durable goods than D. Saturation effects, if any, have probably entered the regression through these variables rather than through debt.

EFFECTS OF OUTSTANDING DEBT ON CHANGE IN PERSONAL DEBT

The regressions reported in Tables 1 and 2 indicate a highly significant negative relationship between change in debt, ΔD, and initial debt, D. Other things equal, households with large debts tend to reduce, and households with small or zero debts to increase, their indebtedness. According to these results, there are certain average equilibrium debt levels, to which households tend to adjust their debt if their circumstances remain unchanged.[1] For example, consider households with stable incomes above \$1000, in which the head is married and in the 35 to 44 age group. Suppose that the household holds liquid assets equal to three months' income. According to the second of the three $\Delta D/Y$ regressions in Table 1, inserting the values $M = 1$, $A = 3$, $L/Y = \frac{1}{4}$, $Y_{-1}/Y = 1$,

$$\frac{\Delta D}{Y} = 0.059 - 0.573\frac{D}{Y}.$$

[1] Mr. Orcutt has pointed this out very effectively in his illuminating comments on this paper.

The equilibrium ratio of debt to income—the level at which $\Delta D/Y$ will be zero—is thus 0.059/0.573, or about 0.10. If the existing debt is greater or smaller than 10 per cent of income, the household will move about 57 per cent of the distance to the equilibrium level in the course of a year.

However, we must use caution in interpreting the negative coefficients in these regressions. There are several reasons why such results might be expected. One is the possible periodicity in debt-financed expenditure, discussed above. Such periodicity would result in a cross-section pattern showing repayment by last year's heavy borrowers and large additions to debt by households who enter this year relatively free of debt. There is no evidence of this pattern in the data. The variable E_{-1}/Y does not make a significant addition to the $\Delta D/Y$ regression reported in Table 1, and its inclusion would not change the values of the coefficients of D/Y.

A second reason for a negative relation between D and ΔD may be found in the constraints within which households operate, rather than in behavior reflecting their own choices. A household does not have an unlimited line of credit. Households whose debt is the maximum available to them have only one direction in which to move, though it is conceivable that some of them would gladly increase their debt if more credit were available.[2] At the other end, debt is by definition a non-negative quantity; one cannot pay off more debt than he owes. Indeed in some cases repayment of debt ahead of the schedule of instalments may be difficult or impossible, or the possibility may not occur to the household. Thus among households who are inclined by circumstances and preferences to reduce debt, there are mechanical reasons why the size of the reduction will be positivelly reated to the size of the initial debt.

The upper limit, imposed by the line of credit, does not appear to have a serious influence on our results. Since the credit limit depends on income, it should apply least to households with rising incomes. These households, even if they were previously in debt to the limit of their credit line, should now be able to borrow more if they choose. In fact, however, they show a greater tendency to reduce their debt (a coefficient of $\Delta D/Y$ on D/Y of -0.733) than households of stable income (coefficient of -0.573).

The effect of the lower limit on the statistical pattern displayed by a cross section is more difficult to evaluate, but it does not seem sufficient to account for the observed negative coefficients relating ΔD to D. Those negative coefficients evidently reflect both a greater willingness

[2] I am again indebted to Mr. Orcutt for pointing out the possible statistical consequences of this upper constraint.

to add to debt and a willingness to add larger amounts when initial debt is low than when it is high; they do not reflect merely the mechanical fact that households who reduce debt have greater repayments to make when their initial debt is high. Of the 322 spending units who had no personal debt at the beginning of 1952, about 25 per cent added to debt during 1952 (Table 4). Of the 330 spending units who began the year in debt, 41 per cent added to debt during the year. However, as Table 4 shows, these additions were concentrated in spending units with low initial debt ratios; those with initial debt higher than 10 per cent of income were not likely to add to debt. It must also be remembered that other variables (age, income, "personality," etc.) are more likely to be favorable to use of debt by the group already in debt than by the debt-free group. Therefore these figures do not support the conclusion that willingness to add to debt is independent of initial debt level. Further evidence is provided by the regressions of Table 5. For households who are already in debt and are not short of gross liquidity, category IV, the regression shows an even stronger negative relationship of ΔD to D than the regression for the whole sample, shown in Table 1. The coefficient is too high to reflect merely the mechanical relation of repayments to initial debt among the debt reducers.

Table 4 Primary Nonfarm Spending Units with 1952 Incomes Greater Than $1000 (Number of Spending Units)

Change in Debt During 1952	Debt at Beginning of 1952 as Ratio of 1952 Income				
	$D/Y = 0$	$0 < D/Y < 0.1$	$0.1 \leq D/Y < 0.3$	$0.3 \leq D/Y$	All
Decrease in debt		93	69	27	*189
No change in debt	245	1	1	1	248
Increase in debt	77	105	28	5	215
All	322	199	98	33	652

* Of these 189 spending units, 81 made complete repayment of their debt.

The conclusion is that there is a real behavioral relationship between outstanding debt and subsequent change in debt. High initial debt deters further use of debt, while low initial debt encourages borrowing. This conclusion is indicated by the regression coefficients, whose significant negative values do not appear to be due, in any great degree, to irrelevant special characteristics of the cross section sample.

Table 5 Primary Nonfarm Spending Units with 1952 Incomes $1000 or Greater

Category	Number of Cases	Dependent Variable	Regression Coefficients (Estimated Standard Errors)						R^2	Coefficients of Correlation between $\Delta D/Y$ and $\Delta L/Y$	
			M	A	L/Y	D/Y	Y_{-1}/Y	Constant		Before Regression	After Regression
I. $D/Y = O$, L/Y below median	103	$\Delta L/Y$	+0.064	+0.026	−0.782		*−0.065	+0.030	0.068	−0.005	−0.021
			(0.058)	(0.018)	(0.473)		(0.039)	(0.097)			
		$\Delta D/Y$	−0.010	−0.000	−0.484		+0.006	+0.092	0.019		
			(0.049)	(0.014)	(0.395)		(0.032)	(0.081)			
II. $D/Y = O$, L/Y above median	232	$\Delta L/Y$	*−0.395	*+0.127	†−0.358		†+0.425	−0.179	0.375	+0.046	+0.037
			(0.190)	(0.061)	(0.057)		(0.037)	(0.310)			
		$\Delta D/Y$	0.007	0.003	−0.005		+0.002	+0.007	0.007		
			(0.015)	(0.005)	(0.004)		(0.003)	(−0.024)			
III. $D/Y > O$, L/Y below median	223	$\Delta L/Y$	−0.016	†+0.011	+0.159	†−0.863	*−0.026	†+0.168	0.794	−0.031	†+0.355
			(0.017)	(0.004)	(0.105)	(0.031)	(0.013)	(0.023)			
		$\Delta D/Y$	+0.034	*−0.022	*+0.614	†+0.297	−0.035	+0.008	0.084		
			(0.048)	(0.011)	(0.294)	(0.086)	(0.038)	(0.066)			
IV. $D/Y > O$, L/Y above median	94	$\Delta L/Y$	+0.074	+0.029	*−0.431	*−0.380	*+0.395	−0.397	0.581	†+0.286	+0.090
			(0.183)	(0.053)	(0.042)	(0.183)	(0.220)	(0.331)			
		$\Delta D/Y$	+0.014	−0.008	*−0.024	†−0.766	−0.063	+0.160	0.659		
			(0.062)	(0.018)	(0.014)	(0.062)	(0.074)	(0.112)			

* Significant at 10 per cent level.
† Significant at 1 per cent level.

INTERRELATIONS BETWEEN DEBT AND LIQUID-ASSET HOLDINGS

The regressions and correlations in Tables 1 to 3 indicate that liquid-asset holdings and debt are virtually independent in consumer decisions. Only in the highest income-change group does initial debt seem to affect significantly the value of change in liquid-asset holdings ΔL. That group is also the only one for whom initial liquid-asset holdings influence measurably the subsequent change in debt. The correlation between $\Delta D/Y$ and $\Delta L/Y$ is very low even before any account is taken of their joint dependence on a common set of independent variables. Between residuals from the $\Delta D/Y$ and $\Delta L/Y$ regressions there is no correlation at all. The impression of independence given by these calculations suggests the desirability of a closer look at the interrelations between debt and liquid-asset holdings, both initial stocks and changes in stocks.

Some Theoretical Considerations

A given net asset position N for a household is consistent with a range of alternative amounts of liquid-asset holdings, L, and debt, D. For example, a net asset position of +\$100 may represent \$100 in liquid assets and \$0 of debt, or \$1000 of liquid assets and \$900 of debt, or \$550 of liquid assets and \$450 of debt. What factors may be expected to determine one of these alternatives rather than the others?

The costs of borrowing a dollar are greater than the earnings on a dollar of liquid assets. The financial costs of borrowing are reinforced, for many individuals, by psychological costs. These cost considerations would lead a household with a given net asset position to minimize its debt. However, the minimum would by no means always be at zero debt. There are minimal requirements of *gross* liquid-asset holdings, transactions balances to handle normal expenditures in between periodic income payments and precautionary balances to meet contingencies requiring extraordinary expenditures or entailing losses of expected income. These requirements may make it worthwhile to incur the cost of simultaneous holding of liquid assets and debt. They will make it worthwhile to the extent that the opportunity to borrow is not always available when a contingency that requires extra liquidity occurs. It is, for many households, easier to borrow at the time of purchasing new durable goods than later, because "easy" credit is offered by the seller to facilitate the sale; if the opportunity is passed up, borrowing to obtain needed liquidity later may be impossible, or may entail much greater costs.

If calculations of this nature lay behind a household's behavior, there would be an optimal level of gross liquid-asset holdings for the household.

Since the household's income could stand as a measure of the scale of the transactions and contingencies for which liquidity is required, this optimum could be expressed as a proportion of income. Some households would set the optimum ratio higher than others, because of differences in striking the subjective balance between costs of borrowing and risks of illiquidity. By and large, the optimum gross liquid-asset ratio would be

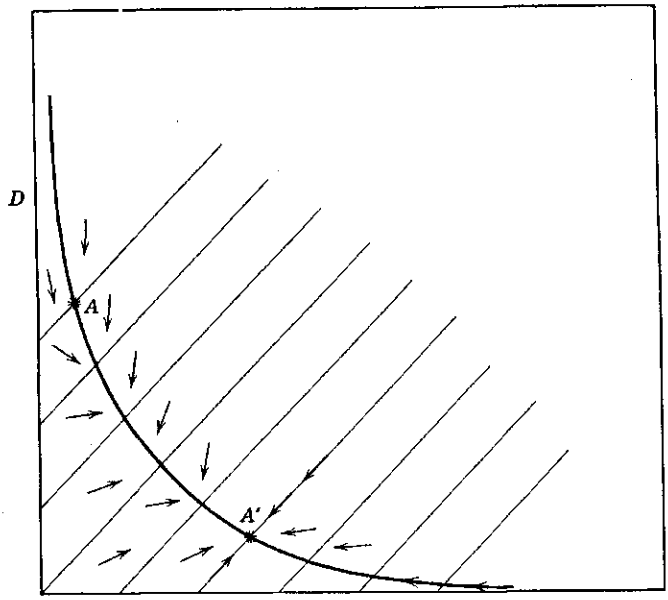

Figure 1

higher, the greater the net asset position of the household. Households who have to borrow to obtain liquidity would settle for less gross liquidity than wealthier spending units.

This pattern of behavior would have some observable consequences, depicted in idealized fashion in Figure 1. For households similar to each other in income and in other respects, Figure 1 shows debt outstanding, D, on the vertical axis and liquid asset holding, L, on the horizontal axis. A set of parallel 45° lines is shown; each line represents a locus of combinations L and D such that the net asset position $N = L - D$ is constant. A line lower and to the right represents a higher net asset position. Points A and A' and other points on the curve connecting them represent optimal combinations of D and L. As argued above, the optimal gross liquid-asset holding L will be greater the higher the household's net asset position. Strictly speaking, since the optima differ for different households, the locus AA' describes the average of optimum positions. There will be, according to the hypothesis, a general tendency for actual observations of D and L to cluster about the locus AA' However, there will always be some households who, by virtue of changes in income or other circumstances, are out of adjustment. These will move towards AA'.

If households were always satisfied with their *net* asset position, these movements toward AA' would always be along a given 45° line, like the arrows toward A' in the figure. But presumably changes in net asset positions will be occurring at the same time as adjustments in the balance between debt and liquidity. Suppose that households with negative or low net asset positions seek to improve them and that households with high net asset positions reduce them in favor of consumers' durables and other expenditures. Then the adjustments of D and L will be in the general directions indicated by the arrows in Figure 1.

This pattern of behavior may, however, be less important than some irrational elements in household debt behavior. Households may be unaware of the costs of borrowing, or may consider them to be of minor importance. At the same time, they may find instalment debt a desirable means of self-discipline. If they use up liquid assets to buy a washing machine, they will never restore their net asset position; income will be frittered away in current luxury expenses rather than saved. But if they hang on to the liquid assets and go into debt to get the washing machine, the pressure of paying instalments will prevent the frittering away of income and restore their net asset position. This implies that somehow the liquid assets are less accessible for these dispensable expenditures than current income. Once segregated as a contingencies fund, say, savings deposits and bonds are untouchable except for real emergencies. It requires a deliberate decision to violate this self-imposed restraint, and this makes the restraint more enforceable.

If this trend of behavior is significant, the pattern of rational behavior may be completely canceled or even reversed. The possession of large liquid assets may be an encouragement to acquire debt, rather than a stimulus to its repayment. If one has assets, one can afford to buy things with debt financing, because certain contingencies that might otherwise compete with the instalment payments are already provided for.

The Empirical Test

To test for the presence of the "rational" pattern of behavior of which Figure 1 is an idealized representation, the 652 observations with incomes greater than $1000 have been divided into four classes. The median ratio L/Y of liquid assets to income was determined, and those below the median were separated from those above the median. Then each of these categories was divided between those who had no debt at the beginning of the year and those who had some positive debt. Let us consider what Figure 1 would lead us to expect for each of these classes.

No Debt, Low Liquidity Ratio. These households should show predominantly positive changes in debt, ΔD, and in asset holdings, ΔL, positively correlated in amount with each other and inversely related in amount to the initial liquid asset holding, L.

No Debt, High Liquidity Ratio. These households should show predominantly negative changes in asset holdings, ΔL, inversely related in amount to the initial liquid asset holding, L. They should show little if any change in debt, and little systematic relation of ΔD to L or correlation between ΔL and ΔD.

Positive Debt, Low Liquidity Ratio. These households will be dominated by the need to improve their net asset position, largely by repayment of debt. The amount of debt change will depend negatively on the initial amount of debt, D, and will bear little relation to L. These households will show little systematic relation of ΔL to D and L.

Positive Debt, High Liquidity Ratio. Households in this position will tend to diminish their costs by using their liquid assets to reduce their debt. This tendency will overshadow any tendency to change the *net* asset position. Thus both ΔD and ΔL will be negatively related to D and L, and ΔD and ΔL will be positively correlated with each other.

On the whole, the calculations reported in Table 5 conform to *a priori* expectations derived from the "rational" pattern.

The 103 spending units in category I increased their debt by an average of 6.7 per cent of their incomes, and their asset holdings by an average of 7.7 per cent of income. As Table 5 shows, there is some evidence that the amounts of increase of debt and asset holdings were inversely related to initial asset holdings, but the coefficients are not significant. There was, moreover, no significant correlation between $\Delta D/Y$ and $\Delta L/Y$. The 232 households in category II showed, as expected, an inverse relation of $\Delta L/Y$ to initial liquid-asset position L/Y and, again as expected, no significant effect of L/Y on $\Delta D/Y$. These spending units showed little tendency to change debt; the average change was an increase of 2.2 per cent of income. They also added to liquid assets an average of 7.9 per cent of income. The fact that the average increase in liquid-asset holdings is greater in category II than in I may reflect some "personality correlation" effects, even though such effects are not evident within the categories.

Spending units in category III sought to improve their net asset position, increasing liquid assets an average of 5 per cent of income while leaving debt virtually unchanged, on the average. However, the expected inverse relation between existing debt and subsequent debt change did not materialize; perhaps because of "personality correlation" effects, the relationship was the other way. The most striking result for category III is the inverse relation between liquid asset change and initial debt. Households with high initial debt were more likely to borrow than small debtors, but evidently the large debtors borrowed for expenditure purposes while the small debtors borrowed to improve their liquidity. The pattern of borrowing to improve liquidity is reflected in the positive correlation between the residuals of $\Delta D/Y$ and $\Delta L/Y$. The force of the desire to improve liquidity, within this group, was independent of the initial liquidity position. Households in category IV seem to behave as expected, and this is the most crucial test of the "rational" pattern. As anticipated, both $\Delta D/Y$ and $\Delta L/Y$ were inversely related to D/Y and L/Y; the four coefficients are all significant. Both debt and asset holdings were decreased by this group, debt by an average of 7.7 per cent of income and assets by an average of 19.1 per cent.

It may fairly be concluded that the hypothesis of "rational" behavior with respect to debt and liquid assets is not refuted. If "personality correlation" effects could be eliminated, the hypothesis should stand up even better. The "irrational" self-discipline pattern does not show up in these results. The initial impression, from the overall regressions, that debt and liquid assets are treated independently in consumer decisions has to be revised. The overall independence conceals several important interrelationships, which are revealed when the sample is broken into the four categories based on initial debt and asset positions.

OTHER FACTORS ASSOCIATED WITH CHANGE IN DEBT

Decisions to increase or reduce debt are, of course, affected not only by the initial debt and liquid-asset levels but also by other economic and demographic circumstances of the household. The present section will discuss estimation of the effects of these other variables.

Income and Income Change

The regressions that have been calculated allow for effects both of current year's income, Y, and previous year's income, Y_{-1}. It is necessary, therefore, to distinguish between long-run and short-run income effects. A "long-run effect" is the change in ΔD associated with a dollar change in Y, or Y_{-1}, on the assumption that the household's income is stable

($Y_{-1} = Y$). A "short-run effect" is the change in ΔD associated with a dollar change in Y, for fixed level of previous year's income, Y_{-1}. The long-run effect is the relevant one for such purposes as projecting the effects of secular growth in income on the propensity to go into debt. The short-run effect is the relevant one for models that attempt to forecast year-to-year changes in business activity.

For spending units with incomes above $1000, the long-run effect can be estimated from the regression coefficients shown for D/Y in Table 1. By definition, Y_{-1}/Y is to be set equal to 1, and this means that the applicable coefficients are the ones for "little change" in income. If we then multiply the regression through by Y, we have:

$$\Delta D = (0.061 + 0.019M - 0.006A)Y - 0.011L - 0.573D$$

For married spending units with the head aged 18 to 24 ($M = A = 1$), this says that every dollar of permanent increase in income leads to an increase of 7.4 cents in ΔD. For single-person spending units in the highest age bracket ($M = 0$ and $A = 6$), however, the long-run income effect would be only 2.5 cents for every dollar of income.

For spending units with incomes below $1000, the ΔD regression shown in Table 2 indicates an income effect in the opposite direction. An increase of a dollar in income is associated with a decline of 97 cents in additions to debt. In this income range, borrowing is evidently often an emergency measure rather than a means of obtaining luxuries; in consequence, additions to debt are greater the worse off the household.

The short-run income effect takes past income Y_{-1} as given and measures the change in ΔD due to change in current income Y alone. The regression for low-income spending units estimates $1.04 more increase in debt for every $1 increase in current income. For units with incomes over $1000, short-run income effects are more complicated. They are plotted in Figure 2, drawn for $M = 1$, $A = 3$, $L = 0$, $D = 0$ and for two alternative assumptions regarding Y_{-1}, $2000 and $3000.

The effects of previous year's income, Y_{-1}, appear to differ in direction depending on current income level. For incomes below $1000, additions to debt will be greater the higher the previous income level; the coefficient is small but significant. Its sign probably reflects differences among households in pressure to maintain accustomed consumption standards and in access to credit, both of which will vary with past income. At current income levels above $1000, Figure 2 illustrates the change in direction of the effect of Y_{-1}. At low current income, additions to debt are smaller when previous income was $2000 than when it was $3000. But the opposite is true for incomes above $2308 ($3000 divided by 1.3). At higher income levels, borrowing is less a symptom of distress than a

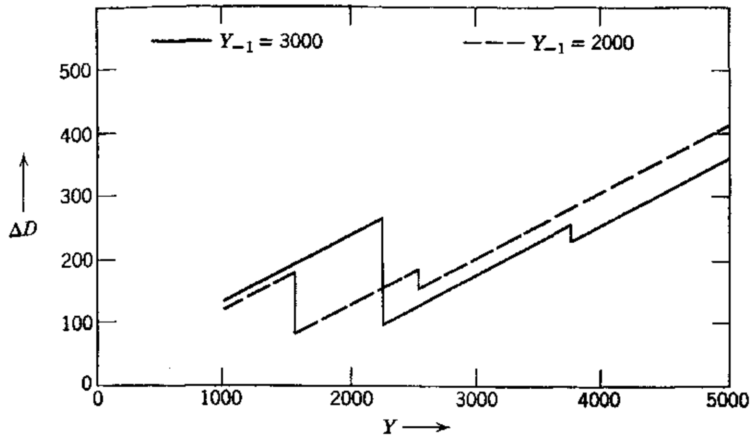

Figure 2 Estimated short-run effects of income on change in debt: spending units with incomes over $1000.

means of speeding the acquisition of worldly possessions appropriate to the household's economic and social status. This is likely to be a more urgent order of business for families for whom this status is newly achieved than for those whose present income represents little increase over previous levels.

Other Independent Variables

The independent variables in the regressions of Table 1 are financial, economic, or demographic characteristics of the spending unit. There are, of course, other characteristics that might be expected to affect the debt behavior of households. Some of these are further details of the economic, demographic, and geographic circumstances of the spending unit. Others are answers to questions designed to elicit the respondent's feelings of optimism or pessimism regarding his personal economic situation and the national economic picture.

Change in debt may appear to be significantly related to one of these variables when we examine the correlation without taking account of any others. But our multivariate approach teaches us to beware of simple correlations. The variable under test may, like change in debt, be related to variables in the regression of Table 1. A more meaningful way of testing the influence of additional variables, either singly or in combination, is to examine their correlation with the residuals from the regressions in Table 1. If there is no significant relationship, one may conclude that the tested variables contain no information relevant to explanation of the dependent variable beyond what is already contained in the regression independent variables. It is still possible, of course, that the candidates under test could substitute for one or more of the regression independent variables. If the test reveals a significant relationship with the residuals, then *a fortiori* the variables tested are significantly related to the dependent variables. To measure this relationship, it would be necessary to recompute the regression, introducing the additional variables and allowing for their correlations with the other independent variables.

A number of tests of this kind, both on the original variables and on the residuals from the regressions of Table 1, have been computed. Table 6 reports the results. The technique used is analysis of variance. That is, the hypothesis under test is that the mean value of the dependent variable (or residual) is the same regardless of the value or class of the independent variable. The test statistic is an F-ratio, and it is this which is reported in Table 6. A high F-ratio indicates that the hypothesis of no influence should be rejected. Cases in which significantly high ratios have arisen are marked with an asterisk (5 per cent level) or a dagger (1 per cent level).

Among the financial, demographic, or geographic variables tested in Table 6, net worth at the beginning of 1953 was significantly related to change in debt during 1952. The lower the net-worth bracket, the higher the ratio of 1952 addition to debt to 1952 income. The phenomenon is more pronounced for the regression residuals than for the raw variable. Unfortunately, it is not possible to tell how much of this relationship is a spurious correlation, due simply to the fact that persons who went into debt during 1952 would automatically tend to have high debt and low net worth at the beginning of 1953. This spurious correlation is probably not the whole story, since one would expect it to have more influence on the original variables than on the residuals. But net-worth information is not available for early 1952; hence the question remains in doubt.

None of the demographic and geographic variables tested proved significant.

Of the attitudinal variables tested, only the question on intentions to buy durable goods during 1952 (II-7) proved to be significantly related to change in debt. Similar calculations for E/Y show that the predictive value of information on intended expenditure is even greater for that variable. Since E/Y and $\Delta D/Y$ are fairly highly correlated, it is not surprising that intended expenditure is also a useful predictor of debt change. It is noteworthy that intentions to buy add significantly to the information contained in the regression variables. Indeed intended expenditure is complementary to the "objective" variables included in the regression; its F-ratio is greater for the regression residuals than for the original variables, indicating that it is a better predictor in combination with the regression variables than alone.

Table 6 Tests of Significance of Relation of $\Delta D/Y$ to Selected Variables

Variable	Number of Classes into Which Observations Were Divided (k)	*F*-ratios: Original Variable (d. f. $k-1$ and $652-k$)	*F*-ratios: Residuals from Table 1 Regression (d. f. $k-1$ and $638-k$)
I. Economic, demographic, geographic variables:			
1. Net worth brackets, early 1953	11	*4.7	†8.0
2. Education of head of household	5	0.8	0.1
3. Occupation of head of household	7	0.7	1.3
4. Region	4	0.5	2.6
5. Size of locality	5	1.1	0.8
II. Attitudinal variables:			
1. Would you say you folks are better off or worse off financially now than you were a year ago? Asked in 1952	4	0.4	0.1
2. Are you folks making as much money now as you were a year ago, or more or less? Asked in early 1952	4	1.2	0.6
3. How about a year from now—do you think you people will be making more money or less money than you are now, or what do you expect? Asked in early 1952	4	1.5	0.5
4. Same question as 3 but asked in early 1953	4	1.4	1.0
5. Do you think this is a good time or a bad time to buy automobiles and large household items? Asked in early 1952	6	0.9	0.8
6. Now, speaking of prices in general, I mean the prices of the things you buy, do you think they will generally go up during 1952, or go down, or stay about where they are now? Asked in early 1952	9	0.8	0.7
7. Linear regression on ratio of total anticipated 1952 expenditure on cars and large household items to realized 1952 income	‡2	*5.8	†9.5
8. Linear regression on attitudinal index (see text)	‡2	0.5	0.0

* Significant at 5% level.
† Significant at 1% level.
‡ Parameters estimated.

None of the more diffuse attitudinal questions appeared to be significantly related to change in debt. In order to test the possibility that a combination of attitudes, rather than individual attitudes considered singly, might be important for debt behavior, a test (II-8) was made of a 1952 attitudinal index, constructed from questions 1, 2, 3, and 5, as follows: For each question, the answer of a respondent was valued as optimistic (+1), neutral or no answer (0), or pessimistic (−1). These values were summed over the four questions to give each respondent a score, some integer from −4 to +4, inclusive. In Table 6, II-8, a test of linear regression on the index score is reported. A test for the significance of differences in the dependent variable for the nine possible scores was also carried out, with similar results. This index is similar in construction to the index the Survey Research Center has computed to summarize its periodic attitudinal surveys and to indicate the over-all trend of attitudes over time, but the index here tested has fewer components.

It is possible that further tests of attitudinal variables will yield different results. With the exception of II-4, the attitudes here tested were responses to questions at the beginning of the year. Conceivably some households who made optimistic responses in early 1952 may already have acted on their optimism by borrowing in 1951; these optimists may have been repaying debt during 1952, while others were borrowing. Debt behavior might, for this and other reasons, turn out to be more closely related to attitudes expressed at the middle or end of the year, or to some combination of attitudes held during the year. It is also possible that the optimism-pessimism dimension, to which the attitudinal questions of this survey were mainly directed, is not a particularly relevant dimension for debt behavior, whatever its importance may be for other aspects of household economic behavior. While optimism may lead some households to go into debt, secure in their anticipation of their ability to carry the burden, it may lead others to clear up their debts, confident that in the future they can get along without them.

SUMMARY

Calculations on this cross section of households suggest the following conclusions regarding household behavior in relation to consumer debt:

1. The evidence suggests that, other things being equal, high debt levels deter expenditure on durable goods. Otherwise, it is hard to understand why a positive association between these variables, which would be expected in a cross section of households as a result of persistent differences in thriftiness and related characteristics, failed to appear.

2. The evidence is more clear cut that high debt levels deter further use of debt in financing purchases. Household behavior displays a genuine inverse relationship between initial stock of debt and subsequent change in debt.

3. There are important interrelations between debt and liquid assets in consumer behavior. These result from balancing the cost of borrowing against the needs for liquidity to handle normal and emergency transactions. The economic consequences of a given distribution of consumer debt in the population cannot be adequately appraised without considering simultaneously the distribution of liquid assets.

4. Additions to debt are negatively related to current income and positively related to previous income among low-income spending units, where borrowing is frequently an emergency measure. These relationships are reversed at higher income levels. Single individuals are less apt to add to debt than married spending units; and, except among low-income units where distress borrowing reverses the relationship, young heads of households are more disposed to add to debt than older consumers. There may be a negative relationship between net worth and changes in debt, but the absence of ex ante net-worth information leaves this question in doubt. Change in debt is significantly correlated with both actual and anticipated purchases of durable goods. But it does not appear to be significantly related to attitudes of economic optimism or pessimism.

3

*An Empirical Study of Cash, Securities, and Other Current Accounts of Large Corporations**

ALAN W. HESTON

SCOPE AND METHOD OF THE STUDY

Non-financial corporations hold about one-fourth of the currency and demand deposits in the United States and about one-sixth of the total federal government marketable securities. In 1955 this sector created for itself roughly 50 billion dollars in credit as accounts payable. In addition net receivables, i.e., receivables minus payables, of this sector provided another 30 billion dollars in credit to non-corporate businesses, governments, and consumers. An understanding of the short-run fluctuations of these and the other current accounts of corporations is important to an understanding of fluctuations in the economy as a whole.

This study concentrates on explaining short-period movements in cash and security holdings of an important segment of the corporate sector,

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large non-financial corporations. We will also be concerned with variations in the other current accounts of firms, and in particular with short-term bank loans and net receivables. Though some of our results relate to long-run behavior of large corporations, the study is oriented toward explaining short-run fluctuations in these accounts.

Any explanation of cash and security holdings will probably involve the level of transactions and the interest rate. On pages 69–78 a selected group of theoretical and empirical studies concerning the relation of cash balances, transactions, and the interest rate are reviewed. A theoretical discussion of the variables entering into the models of cash and securities is also presented. Pages 78–88 presents empirical tests of propositions about the relationship of cash and securities and the other current accounts. Empirical tests of more detailed models of cash and securities are presented on pages 88–98. On pages 98–107, the empirical results are analyzed and their implications for monetary policy are discussed.

This study is empirically oriented. Because the models are a liberal dose of experimentation with data combined with, we hope, an equal dose of deductive reasoning, it seems appropriate to discuss the data and methodology of the study in this section. For a study of corporate cash and security holdings, quarterly or monthly time series observations for a number of different firms would be desirable. Unfortunately, annual observations were all that could be obtained. Nevertheless, the particular sample of firms used has a number of advantages including eleven observations for each firm. The sample was collected and the accounts standardized by the Board of Governors of the Federal Reserve System.[1] The sample consists of balance sheet and income statement information for 11 years, 1946 to 1956, for each of 209 firms.[2]

For the purpose of this study the sample was split into a group of 44 firms chosen randomly, which will be called the subsample, and the remaining group of 165 firms, which will be referred to as the main sample. Summary data for the subsample and main sample are presented in Table 1, which shows the mean dollar value for 1947 to 1955 of cash, securities, sales, and total assets for the firms. The firms in the main sample are split into four size groups by total assets. Ratios of the variables are also presented by size class and for all firms. The 209 firms studied accounted for about one-sixth of the cash, one-fifth of the marketable securities, and one-sixth of the sales of all United States non-financial corporations.

[1] A discussion of the data is given in the *Federal Reserve Bulletin* (June, 1956), p. 580.

[2] The industries represented by the firms are food, tobacco, rubber, petroleum, chemicals, iron and steel, non-ferrous metals, automobiles, other transportation equipment, machinery including electrical, and retail trade. Also available but not used in this study are data for some 50 firms in electric power and railroads.

Table 1 1947 to 1955 Averages of Cash, Securities, Sales, and Total Assets and Ratios for the Sample of 209 Firms (Dollar Figures in Millions)

	Main Sample						
	Asset Size Groups						
	10 to 70	70 to 180	180 to 500	500 and up	Total	Subsample	Total
Number of Firms	41	42	39	43	165	44	209
(1) Average cash holdings	4.19	9.66	23.40	57.30	23.96	26.68	24.54
(2) Average securities holdings	2.19	6.44	17.60	69.10	24.36	23.44	24.15
(3) Average sales	74.7	134.2	372.2	862.2	365.3	530.5	400.1
(4) Average total assets	33.8	92.2	219.0	746.5	275.3	296.4	282.0
(5) Cash to sales ratio (1)/(3)	0.056	0.072	0.063	0.066	0.066	0.050	0.061
(6) Cash to assets ratio (1)/(4)	0.124	0.105	0.107	0.077	0.087	0.090	0.087
(7) Securities to sales ratio (2)/(3)	0.029	0.048	0.047	0.080	0.067	0.044	0.060
(8) Securities to assets ratio (2)/(4)	0.065	0.070	0.081	0.093	0.089	0.079	0.081
(9) Sales to assets ratio (3)/(4)	2.21	1.46	1.70	1.15	1.33	1.79	1.42

The purpose of using a subsample was to choose from several alternative relationships a form that could in turn be tested on the main sample.[3] Questions arise in empirical work as to the functional form in which to use variables and often neither theory nor conclusions from previous investigations are a helpful guide. Variables may be "deflated" by some size measure such as total assets or used in dollar terms. Theory does not tell which procedure is appropriate. Nor does it generally specify the way in which variables should be dated in relation to one another. A balance sheet item as of December 31, 1960, may in principle be related to a flow variable of 1960 or 1961 or some combination of these flows. Another question is the type of regression analysis to be used when a rectangular array of data such as the present sample is available. Is it necessary to run a separate regression for each firm or can firms be expected to share common values of some or all parameters?

Another advantage of working with a pilot group of observations is that, by reducing the number of relations examined for the main sample, it gives more meaning to relations tested on the main sample. Because a large number of regression equations were estimated using the data of the subsample, some of the relations could appear good by chance rather than because a good formulation of the behavior of firms had been found. The test of whether a good fit on the pilot sample is due to a good description of behavior or to chance must employ an independent group of observations such as those provided by the main sample. The process of hypothesis testing does not end here. As will be indicated, some of the formulations suggested by the subsample did not prove significant on the main sample and in turn the main sample also suggested further hypotheses. The principal conclusions from the subsample are incorporated in the theoretical discussion of the next section and the models presented later.

SOME VARIABLES INFLUENCING CORPORATE CASH AND SECURITY HOLDINGS

The variables discussed in this section are by no means all those that will affect the cash and security holdings of firms. The discussion is mainly concerned with short-run influences on cash and securities of an individual firm. Variables that may cause cash and security holdings to differ among firms are largely neglected in the treatment. Nor will the treatment of short-run influences on a firm's cash and security holdings attempt to be

[3] The use of a subsample when the original sample is large may also economize on computing facilities. In the present case, where the subsample is one fifth of the total, one could, with equal computing time, examine at least 10 relations on the subsample and test the seemingly best relation on the remainder of the sample or estimate three different relationships on all the observations.

exhaustive. The first part of this section discusses the level of transactions and the bill rate, while the second part treats the interrelationships among cash and securities and the other current account items.

The Level of Transactions and the Interest Rate

Interest rates and the volume of transactions have frequently been used to explain cash holdings and, to some extent, security holdings, and there seems no reason to break with tradition. In particular there have been a number of analytical and empirical studies of the relation of cash holdings to the volume of transactions, though the exact form of the relation has not generally been established.[4]

The relation between money and interest rates has also received extensive theoretical investigation; however, this literature will not be discussed here. The general view taken in this study is that corporations hold cash because the transactions costs into and out of short-term assets exceed the return on these assets for the period they will be held.[5] The cost

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[4] An extensive bibliography of empirical studies on the velocity of money is contained in a recent study by Richard T. Seldon, "Monetary Velocity in the United States," in *Studies in the Quantity Theory of Money*, Milton Friedman, ed. (Chicago: University of Chicago Press, 1955), pp. 179–195. A discussion of the relation of velocity to interest rates is contained on pp. 195–199.

William Baumol and James Tobin have argued analytically that cash held for transactions purposes will rise less than proportionately to the volume of transactions. Tobin emphasizes that other short-term assets are suitable for transactions balances, and both Baumol and Tobin emphasize the inverse relation that may be expected between the proportion of cash in transactions balances and the interest rate. See Baumol, "The Transactions Demand for Cash: An Inventory Theoretic Approach," *Quarterly Journal of Economics*, LXVI (November, 1952), pp. 545–556 and Tobin, "The Interest Elasticity of the Transactions Demand for Cash," *Review of Economics and Statistics*, XXXVIII (August, 1956), pp. 241–247.

If the relation between cash holdings and transactions is nonproportional, then estimation of a relation that is additive in the logarithms of the variables will often provide a better fit than estimation of a relation that is additive in the variables. Avram Kisselgoff, for aggregated data on a sample of corporations from 1921 to 1939, has used a relation between corporate cash and transactions that was additive in the variables. See "Liquidity Preference of Large Manufacturing Corporations (1921–1939)," *Econometrica*, XIII (October, 1945) pp. 334–346.

More recently, Friedman has estimated an aggregate relation between cash and income using an equation that was additive in the logarithms of the variables. See "The Demand for Money: Some Theoretical and Empirical Results," *Journal of Political Economy*, LXVII (August, 1959) pp. 327–351. For the economy as a whole cash held for all purposes appears to have risen more than proportionally to income.

[5] It is recognized that firms may hold demand deposits as compensating balances with banks from which they customarily borrow. Although no attempt is made to incorporate compensating balances into the analysis, the possible effect of these balances on our results is discussed on page 105.

of purchasing government securities is quite small, varying from about 5¢ per $1000 to 30¢ per $1000 depending on the thickness of the security market and the size of the purchase.[6] Suppose a firm receives $1 million today and must make a $1 million payment in a week. Even if the costs of buying and selling a government security earning 4% were as high as 60¢ (30¢ in and 30¢ out) per $1000, there would be an excess of return over costs for holding $1 million of that security for a week.

The most important short-term asset that firms buy is Treasury bills. The tax anticipation certificate is a security especially suited to absorbing one type of excess funds of firms. In addition, repurchase agreements with government bond dealers and commercial paper of sales finance companies are especially tailored to the maturity needs of corporate lenders. Large firms are able to earn interest on temporary excess funds for periods as short as a few days by use of either of these arrangements.[7]

Empirical studies employing aggregative time series data have found an inverse relation between cash holdings and the interest rate.[8] Critics of

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[6] Broker's charges begin at $2.50 per $1000 for government securities and decrease fairly quickly with the size of the purchase. When the size of the purchase is $1 million of bills (somewhat less for bonds), it is possible to deal directly with government bond dealers. The implicit transactions costs are the difference between bid and ask yield (for bills) or price (for bonds) of the government security dealers. This may vary according to the state of the money market and the length to maturity of the security. In terms of the purchase price of a bill the difference will frequently run 5¢ to 10¢ per $1000. For other securities the difference may be as high as one-thirty-second of one per cent of the price, or roughly 30¢ per $1000. Contrary to the example above, the implicit transactions cost includes both purchase and sale of securities. For a more detailed discussion of the buying and selling of securities by dealers see Carl H. Madden, *The Money Side of "the Street"* (New York: Federal Reserve Bank of New York, 1959), pp. 47–72.

[7] Repurchase agreements are described by Hyman Minsky, "The Central Bank and Money Market Changes," *Quarterly Journal of Economics*, LXXI (May, 1957), pp. 176–178, and by Madden, *op. cit.*, pp. 61–62. Madden also describes the selling of their own commercial paper by sales finance companies. He says, "While most sales finance companies still market their notes through dealers, nine of the largest now sell them directly to investors, and in doing so have fashioned a new market for themselves. The dealer function—locating buyers and arranging purchase terms—is performed within the finance company organization. In effect the companies make a general offer to sell their IOU's at the various rates of discount, in any desired denomination, for any number of days from 5 to 270, and sometimes more. The notes are thus completely tailor-made for the customer" (p. 69).

[8] Kisselgoff, *op. cit.*, related the interest rate to aggregate cash holdings of a sample of corporations for the period 1921 to 1939. He also found a strong inverse relation between "free" cash and the interest rate. Free cash is defined as current cash holdings minus the product of current cash holdings and the ratio of cash to transactions in 1929, a year when the cash-transactions ratio was at a minimum for the period. This procedure in effect assumes that free cash in 1929 was zero. Kisselgoff used some of

these studies have underlined some of the statistical problems of isolating the effects of interest rates on cash holdings but for aggregative data an inverse relationship appears well established. A statistical difficulty with time series analysis of the effects of interest rates is the typical positive correlation between income and interest rates or the existence of similar trends in income, cash, and interest rates.[9] While it is likely that there will be some positive relationship between interest rates and the level of transactions of individual firms, it is doubtful that the relations will be as strong as for aggregative data. In addition, interest rates and the level of transactions are probably interdependent in the aggregate, and this need not be the case for the individual firm.[10] While there are likely to be estimating difficulties for micro-data not present in macro-data, an objective of this

[9] The study of Kisselgoff, *op. cit.*, was criticized by Acheson J. Duncan, " 'Free Money' of Large Manufacturing Corporations and the Rate of Interest," *Econometrica*, XIV (July, 1946), p. 251, because of a similar trend of both free cash and interest rates in the data that Kisselgoff used. Clark Warburton, "Monetary Velocity and the Rate of Interest," *Review of Economics and Statistics*, XXXII (August, 1950), pp. 256–257, has similarly argued that the results of Tobin's study (see footnote 8) could be interpreted in terms of the correlation of unrelated trends rather than a functional relationship between money and interest rates.

[10] Latané, *op. cit.*, explicitly treats this problem in his study. He regresses the reciprocal of the rate of interest $(1/r)$ on the ratio of money to income (M/Y), and also regresses (M/Y) on $(1/r)$. He uses an average of these regression lines as an approximation of the true relationship among these variables.

the data of a study of businesses by the National Bureau of Economic Research. One of the monographs from this study, *Corporate Cash Balances*, 1914–1941 (New York: National Bureau of Economic Research, 1945), Chapters 4 and 5, by Friedrich Lutz, also employs the concept of free cash and his results support an inverse relation between free cash and interest rates. James Tobin examined the relation between the prime rate and free cash (calculated in a similar manner) for the economy as a whole during the pre-World War II period and found an inverse relationship. See his "Liquidity Preference and Monetary Policy," *Review of Economics and Statistics*, XXIX (May, 1947), pp. 130–131. Andrew Stedry, "A Note on Interest Rates and the Demand for Money," *Review of Economics and Statistics*, XLI (August, 1959), pp. 303–307, has extended Tobin's computations through 1958 and has demonstrated the need for considering wealth in any long-run analysis of the demand for money. L. S. Ritter, "Income Velocity and Anti-inflationary Monetary Policy," *American Economic Review*, XLIX (March, 1959), pp. 120–129, has examined quarterly cash and free cash holdings for the economy as a whole (third quarter of 1957 represents the low point of the ratio of money to real income for the period) for the period 1948 to 1957, finding an inverse relation of cash holdings to the bill rate. Similar results were found by Henry A. Latané, "Cash Balances and the Interest Rate—A Pragmatic Approach," *Review of Economics and Statistics*, XXXVI (November, 1954), pp. 456–460. Phillip Cagan presents related results, "The Demand for Currency Relative to the Total Money Supply," *Journal of Political Economy*, LXVI (August, 1958), pp. 303–329, finding that the interest rate on demand and time deposits has been an important determinant of the ratio of currency to total demand and time deposits that the public wishes to hold.

study is to estimate the effect of interest rates on money holdings in a way that avoids many aggregate time series problems.

The models of cash and security holdings developed below are theoretically concerned with the interest rate on Treasury bills, tax certificates, commercial paper, repurchase agreements, other short-term securities, and short-term bank loans. Unfortunately, the short-term rates earned and paid are not available for the individual firms of the sample. For any particular asset or liability, it is therefore necessary to use the same rate for all firms in each year, and because the rates on short-term assets and liabilities will be highly correlated, a choice must be made as to which rate to use. The bill rate has been chosen because a major concern of this study is the substitution of cash for short-term securities, and a major portion of these securities are Treasury bills. As the bill rate is correlated with other short-term rates, there will not be much harm in using the bill rate as "the interest rate" in applications where it may be that other rates would be more relevant.

The Relationship of Cash and Securities to Other Current Accounts

The current accounts of firms consist of three principal liabilities, accounts payable, taxes due, and short-term bank loans, and four principal current assets, cash, securities, accounts receivable, and inventories. There are other current assets and liabilities that may be more important than some of the above for any particular firm or group of firms, but we will limit the present discussion to the above accounts.

Three of the accounts mentioned are unlikely to be influenced by the levels of cash and security holdings. These are taxes due, accounts receivable, and accounts payable. Taxes due are in effect a short-term interest-free loan of the government to firms making profits. Although firms may always pay their tax liability before it is due, there is no reason for them to do so. The firms should always let the taxes due liability be as large as legally possible, since these funds can always earn the interest rate on tax certificates, and at worst earn zero as cash.[11] Accounts receivable should also be unaffected by the levels of cash and securities. The terms on accounts receivable are set by the firm and are stable in the short-run. If, for example, the interest rate changes, it is not business custom to alter the terms on their accounts receivable.[12] This means that in the short-run a

[11] Firms may hold these funds as cash in the form of compensating balances.

[12] Part of the firms in the present sample are engaged in retail trade and it will be true that some retailers alter the terms on their accounts receivable in relation to business conditions. In particular, installment credit terms are subject to cyclical change, though firms frequently do not finance this credit themselves. While the statement in the text needs to be qualified to take account of installment credit, the fact that a few firms in our sample do alter their terms on receivables over the cycle will not be very important to the subsequent analysis.

firm's receivables are largely determined by the customers of the firm. A firm's customers may be expected to increase their use of receivables as they increase their purchases from firms and as the rate of interest rises.

The relation between receivables and the interest rate occurs because of the stability of the terms on receivables over the cycle.[13] Firms in effect offer a given number of days credit at a zero interest rate no matter what the cost of borrowing funds. When the costs of borrowing rise, this should induce customers who have not charged their purchases to do so. Those customers who have for convenience paid invoices early upon their arrival are led, by the higher costs of cash, to consider delaying payment until the tenth of the month. Some customers might not take the cash discount if paying for purchases by the tenth of the month requires securing a new bank loan.[14] These actions by customers in response to interest rate changes may cause quite a large increase in accounts receivable.[15]

It is possible to test whether the customers of large firms, and large firms as customers, increase their use of trade credit as the interest rate

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[13] Though terms vary widely among firms, probably the most frequent terms on accounts receivable are a 2% discount for cash payment by the tenth day of the month after purchase. Other terms on accounts receivable are presented by Charles W. Gerstenberg, *Financial Organization and Management of Business*, revised edition (New York: Prentice-Hall, 1934), p. 458. Industries where the delivery date is somewhat uncertain often give longer terms on receivables. The striking example is capital goods producers whose turnover of receivables before World War II was almost twice as long as most other industries. The rate of turnover of receivables is given for various industries by Walter Chudson, *Pattern of Corporate Financial Structure* (New York: National Bureau of Economic Research, 1945), pp. 11–43, and Albert Koch, *Financing of Large Corporations, 1920–1939* (New York: National Bureau of Economic Research, 1943), pp. 53–56.

[14] Charles Silberman, in "The Strange Money Shortage," *Fortune* (March, 1957), p. 123, says, "Big companies have had to let their receivables rise for several reasons. Many small firms, for example, have stopped discounting their bills. Why pay in ten days to claim a flat 2 per cent discount, many treasurers reason, if they have to borrow from the banks in order to do so? Similarly, larger companies that still discount their bills now delay payments until the tenth day (or whenever the discount runs out), rather than pay as soon as the invoice is received."

[15] If the terms of receivables are such that a purchase on the first of a month can be delayed to the tenth of the next month, then the maximum length of turnover of receivables is roughly 40 days, assuming the cash discount is taken. Thus the turnover of receivables can range from zero days (no one charges) to 40 days, or from zero to roughly one-ninth of annual sales. Denoting receivables by R, annual sales by S, and the average turnover of receivables by T, $R/S = T/365$. If T moves from 28 to 30 days for a firm with \$500 million in sales, then receivables will increase by \$3.7 million. Silberman reports that, in 1956 and 1957, firms found their receivables lengthening considerably. Continental Can, for example, found its T moving from 26 to 28 days in a year, requiring nearly a \$10 million increase in receivables, while other firms reported 10% or larger increases in T a year. See Silberman, *op. cit.*, p. 258.

rises. Given the level of sales it is expected that the large firms of this sample will find their receivables rising with the interest rate. Also, given the level of purchases of the firms of this sample, it is expected that their accounts payable, i.e., the credit they take as customers, will rise with the interest rate.

Why should firms leave the terms on accounts receivable stable during a cycle? The reason is that the return on increased sales is so high relative to costs of borrowing for large firms that they are quite willing to allow their customers to take whatever credit they wish. If the return from increased sales is high, then the return on inventory investment, if the alternative is lost sales, will also be very high when sales are rising. Since non-financial corporations are selling goods, and the return from increased sales is likely to be high, relative to borrowing costs and also to the bill rate, for large firms, they are likely to give priority to short-run adjustments in inventories. That is, when there is a sales increase, firms will first attempt to adjust their inventories to a higher level and only then worry about adjusting cash and securities to the new level of sales. If this is a reasonable description of firm behavior, then inventories may be assumed to be unaffected in the short-run by the levels of cash and security holdings and the effect of inventories on cash and security holdings may be examined without simultaneously considering the influence of cash and securities on inventories.[16]

The assumption that net receivables and inventories are not influenced in the short-run by the levels of cash and security holdings allows us to use net receivables and inventories as independent variables in regression equations explaining cash and security holdings. An indirect test of this assumption is incorporated in the models used to explain cash and security holdings. These models test whether firms adjust their cash and security holdings to their desired levels immediately or with a lag. If cash and securities are adjusted to desired levels only with a lag, it is evidence consistent with the assumption that short-run inventory adjustments of the firm are given priority in time to adjustments of cash and securities.

Having put the cart before the horse, we can turn now to the more interesting question of why inventories and net receivables might enter into an explanation of cash and security holdings. When a firm's sales increase,

[16] This statement may be amended slightly. Once firms have at least partially adjusted their inventories to a higher level of sales, and firms are beginning to adjust their cash and securities, there may well be some feedback from the cash and security position to the inventory position. Such feedback means that inventories are affected by the levels of cash and securities. However, so long as the influence on inventories of cash and securities comes at a different time from the influence of inventories on cash and securities, it is not necessary to consider these accounts simultaneously.

receivables rise, and the return on inventories, inventory investment, and accounts payable also rise. Since we are here considering large firms, the impact of a sales increase on net receivables is decidedly positive.[17] Thus during a business expansion a source of finance is needed for the increase in net receivables and inventories. One obvious and traditional source of such finance is short-term bank loans. As an alternative to short-term bank loans, firms could borrow long-term and hold funds as securities when sales were low and as inventories and net receivables when sales were high.

It is a hypothesis of this study that firms will find it economical to substitute between the use of securities and short-term bank loans in the finance of these periodic increases in net receivables and inventories. The reason it may be economical for firms to use securities is that the rates on short-term bank loans during the peak of a cycle may be high relative to the long-term rate at the time when firms borrow long-term. The use of securities will also depend on the character of fluctuations in inventories and net receivables, as well as the costs of long-term and short-term borrowing and the bill rate. This hypothesis is consistent with the empirical observation that firms predominantly use long-term sources of finance for their stock of net receivables and inventories.[18]

It is expected, then, that inventories and net receivables will be inversely related to security holdings, and that the causation is one way running from inventories and net receivables to securities. It is also expected that cash holdings will bear the same relation to these variables and that both cash and security holdings will be substitutes for short-term bank loans. Since security holdings of firms do earn a return and can be liquidated without capital loss at fairly short notice, it is expected that the above relations will be much stronger for securities than cash.

These are the relationships between cash and securities and the other current accounts that are expected over a firm's inventory cycle. As the receipts of firms are not particularly stable, it is important that they be held constant if the above relationships are to be observed. Thus if a firm has an unexpectedly large inflow of receipts during an inventory expansion it may be in a position to expand inventories and, in addition, augment its

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[17] In the present sample, on the average, receivables were 13.9% of total assets, payables 6.7%, and hence net receivables 7.2% of total assets. The average annual amount of net receivables for all 209 firms is about $4.3 billion.

[18] The average of the ratio of receivables plus inventories to total assets of the 165 firms is 0.3886, while the average of short-term bank loans to total assets is 0.0237. As short-term bank loans are only 6.1% of the stock of net receivables and inventories, it is clear that large firms prefer or find more readily available other sources of finance than short-term loans.

cash and security holdings. If a measure of unexpected receipts is not included as a variable in the model, we would observe in the above example a positive relation between inventories and cash and security holdings rather than the negative relation that is expected. The variable measuring unanticipated receipts should be positively related to cash and security holdings and negatively related to short-term bank loans.

The reasons that firms may temporarily put receipts into cash and securities are: (*a*) there are no liabilities that may be immediately retired whose borrowing costs are as great as the return on bills (e.g., there is no point in using unexpected receipts to reduce accounts payable since, assuming the cash discount is taken, this liability costs less than the return on bills), and (*b*) the firm has not had time to put money into other more lucrative assets. In short, the firm may get "caught" with an unexpected influx of funds which it must hold in a form yielding a relatively low return. As usual it is argued that the rational firm would hold as much as possible of such receipts in the form of securities rather than cash.

The discussion of this part may be summarized as four propositions about the current accounts of firms. Propositions (1) and (3) are not directly tested and may be considered hypotheses of the study.

1. Short-run fluctuations in accounts payable, accounts receivable, and taxes of firms will not be influenced by the level of cash and security holdings.
2. When interest rates rise, accounts receivable may be expected to rise with the level of interest rates for the same reasons that firms will increase their use of accounts payable, namely, the terms on accounts receivable are stable in the short-run.
3. The inventory position gets first priority in short-run adjustments of firms and any influence of securities and cash on the desired inventory holdings will come at a different point in time from the influence of inventories on cash and securities. Thus, these accounts do not have to be considered as simultaneously determined in the short-run.
4. Securities and, to a lesser extent, cash will be used as a substitute for short-term bank loans in the financing of short-period increases in inventories and net receivables.

This leaves us with an explanation of cash and security holdings involving some of the other current assets and liabilities, the level of transactions, and the interest rate. There are other variables that might be considered, but we have introduced only one, a measure of unexpected receipts. It is felt that such a variable is important because in the short-run unexpected receipts are apt to appear as cash or securities whether or not the firm wishes additional cash and securities. In the next section tests are made of propositions (2) and (4). Later, lagged adjustment models of cash and security holdings are estimated. These estimates should provide some evidence about the inventory assumption, and test the relation of cash and securities and the explanatory variables.

ESTIMATES OF EQUATIONS FOR BANK LOANS AND TRADE CREDIT

Notation and General Description of Tests

This section is divided into three parts. The notation and definitions of variables that are used in all of the empirical work are presented in this part. In the second part we report the results of estimating a canonical correlation, which attempts to test in a very general way the validity of the short-run adjustment model presented in the previous section. The third part reports the results of testing the hypothesis that customers of firms increase their use of accounts receivable as the interest rate rises.

Definitions of Variables: All Variables Are a Ratio to Average Total Assets of the Firm, except the Bill Rate.

Notation	Definition of Variable
T	Expected level of transactions of a firm in year t, measured by current sales.
B	The rate of interest. It is the 90 day treasury bill rate, average of October, November, and December rates in year t.
C	Cash holdings of firms, including demand deposits, time deposits (negligible), and currency.
S	All fixed claim marketable securities. Equities are not included.
D	Accounts payable of firm.
L	Short-term bank loans of maturity under a year.
R	Accounts receivable.
I	Inventories.
P	Retained earnings, i.e., profits after taxes minus cash dividends.
N	Taxes due, a balance sheet item.
"i"	The subscript "i" on a variable is an index running over the number of firms, and for this sample $i = 1, 2, \ldots, 165$.
"t"	The subscript "t" on a variable is an index of time. $t = 48, 49, \ldots, 56$, i.e., there are nine observations on each variable for each firm. A variable subscripted "$t - 1$" will be observations on the variable from 1947 through 1955.

- ″ The symbol ″ indicates an estimate.
- Δ Denotes a one year change in a variable, e.g., for a stock, $\Delta C_{it} = (C_{it} - C_{it-1})$, so ΔC_{455} is the change in the stock of cash between Dec. 31, 1954, and Dec. 31, 1955, for the fourth firm in the sample. Similarly for flow variables, ΔP_{13249} is retained earnings for the year ended Dec. 31, 1949, minus retained earnings for the year ended Dec. 31, 1948, for the one hundred and thirty second firm in the sample.

A few comments should be made about the measures of variables used. Sales is used as a measure of transactions because there appears little difference between the two variables in annual data. It is possible to derive a measure of transactions from balance sheet and income data that includes all but intra-annual purchases and sales of assets. When such a measure of transactions is computed from annual data it is very nearly the same as sales.[19] In the remainder of this study the terms "transactions" and "sales" will be used interchangeably.

The balance sheet information on securities does not provide a breakdown by maturity or type of security. Included in the measure of securities are corporate and government bonds, tax certificates, bills, notes, and commercial paper. A survey by *Fortune* magazine of 276 large corporations indicates that typically the securities held were short-term Treasury obligations.[20]

Finally, all variables for each firm have been divided by a size measure that is constant for each firm over all years but differs among firms. The size measure used was average total assets for each firm for the period 1947 to 1955. This procedure seems advisable because, in cross section data for firms, the variance of the dependent variable among firms is frequently related to the size of the independent variable. The residual term in a linear relationship among variables such as we will be using is likely to be larger for larger values of the independent variable; this violates the assumption of homoskedasticity underlying estimates of the

[19] For the subsample of firms a concept of transactions was used that measured outpayments associated with current production. The correlation (R^2) between the level of sales and the level of transactions was 0.982 and for changes in sales and changes in transactions R^2 was 0.905. When sales and the measure of transactions were used in regressions the coefficients were virtually the same. A more inclusive concept of transactions was used by Lutz and Kisselgoff and is described in Lutz, *op. cit.*, Appendix B. Kisselgoff, *op. cit.*, p. 335, who uses a part of the data used by Lutz, comments that there was little difference between this concept and sales.

[20] Charles E. Silberman, "The Big Corporate Lenders," *Fortune* (August, 1956), pp. 111–114.

standard errors of regression coefficients.[21] For firm data stated in dollar magnitudes, the size of most independent variables is related to the size of the firm. Dividing all variables by a size measure is intended to reduce the size of the true error component of the estimated residuals.

In the following parts the least squares estimates of several regression equations will be presented. For each regression equation the estimates of the coefficients and their standard errors, R^2, and the F ratio for the equation will be presented. The standard errors of the regression coefficients allow us to test whether a coefficient is significantly different from any particular value. For all coefficients it is reported whether the estimated value is different from zero at the 5 and 1% levels of significance.[22]

R^2 is the fraction of variance of the dependent variable of a regression equation that is explained by the independent variables. Contrary to usual usage we will always use correlation and correlation coefficient to refer to the value of R^2. This should not lead to any ambiguity since R, which in conventional usage is the correlation coefficient, is not used in any of the discussion. To test whether R^2 is significantly different from zero we compare the "F" value of a regression equation with the critical value of F at the 5 and 1% levels.[23]

In the use of canonical correlation it is not possible to make the usual tests of significance, and our hypothesis has to be accepted or rejected on the basis of a sign test and to some extent intuitive judgment. Where tests of significance are used, we reject the null hypothesis that a coefficient is equal to zero only if the critical value of F or t we have obtained is greater than the critical value of F or t at the 1% level. Although we report results at the 5% level it is felt the 1% level is appropriate in this study because of the large number of observations.[24]

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[21] The observations on an individual firm over a short period of years may be considered as a sample of observations from the population of all observations that could have been observed for the firm during the period. The true error term in a regression equation estimated for a firm from this population is assumed to be unrelated to the independent variable. If the assumption of homoskedasticity was not met for each individual firm it would be appropriate to divide all variables by a size variable that differed between observations for each firm as well as differing among firms.

[22] Because N is large for the present tests, the critical value of "t" (the ratio of a coefficient to its standard error) is virtually the same for all coefficients in all regression equations, namely 1.96 and 2.58 at the 5% and 1% levels respectively.

[23] The "F" value of a regression equation is the ratio of the explained variance of the dependent variable divided by the degrees of freedom (minus 1) used in estimating the regression equation to the unexplained variance divided by the remaining degrees of freedom.

[24] The computations were carried out at the Yale University Computing Center, and the availability of a computer greatly eased the task. The calculations were further facilitated by the availability of computer programs. I am particularly grateful to

Canonical Correlation Analysis[25]

Proposition 4 on page 77 considered the interrelationships of cash, securities, and short-term bank loans, and net receivables, inventories, and unanticipated receipts. One set of equations that could be used to analyze these relationships is:

$$\Delta C_t = \alpha_{11} + \alpha_{12}\,\Delta I_t + \alpha_{13}\,\Delta(R - D)_t + \alpha_{14}\,\Delta(P - N)_t + u_{1t}, \quad (1)$$

$$\Delta S_t = \alpha_{21} + \alpha_{22}\,\Delta I_t + \alpha_{23}\,\Delta(R - D)_t + \alpha_{24}\,\Delta(P - N)_t + u_{2t}, \quad (2)$$

$$\Delta L_t = \alpha_{31} + \alpha_{32}\,\Delta I_t + \alpha_{33}\,\Delta(R - D)_t + \alpha_{34}\,\Delta(P - N)_t + u_{3t}, \quad (3)$$

where u_1, u_2, and u_3 are residual or error terms, and the α's are parameters. The change in retained earnings plus the change in taxes owed is used in this set of equations as a measure of unanticipated receipts in any year. As we will discuss later, there is no particular reason to suppose that $\Delta(P + N)$ is either a good or bad approximation of unanticipated receipts.

These three equations do not allow us to explore the relationships among securities, cash, and bank loans. We could, it is true, specify a system of equations that would let us take account of the interrelationships among them. A simpler approach which answers our questions about C, S, and L is to use the method of canonical correlation.

We define the variable "q," where $q_t = \beta_1\,\Delta C_t + \beta_2\,\Delta S_t + \beta_3\,\Delta L_t$, and where the β's are weights, and the variable "r," where $r_t = b_1\,\Delta I_t + b_2\,\Delta(R - D)_t + b_3\,\Delta(P - N)_t$, and the b's are weights. The canonical weights are those values of the β's and b's which maximize (or give the canonical) correlation between q and r.[26] We expect that the canonical weights of inventories, net receivables, and short-term bank loans will have the same sign, and those of cash, securities, and unexpected receipts will all have the opposite sign. This pattern of signs is consistent with the substitution of short-term bank loans for cash and securities in the financing of inventories and net receivables, and one test with the canonical correlation is a sign test.

Also some subjective judgment about the hypothesis can be made from examining the correlation coefficients. Let us denote the squared

[25] Canonical correlation theory has been described by Harold Hotelling, "Relations Between Two Sets of Variates," *Biometrika*, Vol. 28 (1936), pp. 321–377.

[26] The canonical weights are invariant up to a linear transformation and the computing method used makes use of this property.

Harold W. Watts and Donald D. Hester of the Cowles Foundation for Research in Economics at Yale University. Watts is to be thanked for his extremely useful set of programs for estimating regression equations, and Hester for his program for canonical correlation.

canonical correlation coefficient as $\underline{R}^2$ and denote the largest R^2 occurring in the three regression equations, (1), (2), and (3), as R_m^2. $\underline{R}^2$ must always be greater than or equal to R_m^2. If $\underline{R}^2$ is not much larger than R_m^2 then the hypothesis may be rejected. If the sign test is passed, and $\underline{R}^2$ is considerably larger than R_m^2, then the hypothesis is accepted. Because the distribution of the differences between $\underline{R}^2$ and R_m^2 is not known, it is not possible to test for a significant difference in these coefficients, and only rough judgments can be formed.

The results of estimating the regression equations and the canonical correlation are presented in Table 2. The "F" values are all significant at

Table 2 Estimated Regression Equations and Canonical Correlation

Variables	Regression Equation 1	Regression Equation 2	Regression Equation 3	Canonical Correlation and Canonical Weights[a]
Intercept	0.0025	0.0060	−0.0050	
	(0.0009)[b]	(0.0012)[b]	(0.0011)[b]	
Change in cash (ΔC)	1.0			1.000
Change in securities (ΔS)		1.0		1.132
Change in short-term bank loans (ΔL)			1.0	−1.460
Change in inventories	−0.0518	−0.1783	0.3084	−0.705
	(0.0134)[b]	(0.0182)[b]	(0.0159)[b]	
Change in net receivables [$\Delta(R - D)$]	−0.0511	−0.1728	0.3159	−0.709
	(0.0208)[c]	(0.0282)[b]	(0.0247)[b]	
Change in retained earnings and taxes [$\Delta(P + N)$]	0.1978	0.3830	−0.1303	0.824
	(0.0162)[b]	(0.0221)[b]	(0.0193)[b]	
R^2	.093[b]	.198[b]	.290[b]	
F	50.64	121.67	201.19	
Degrees of freedom	1481	1481	1481	
Squared canonical correlation coefficient				.440

[a] These weights are based on a weight of 1.000 for cash. Because of the computational method used, these weights will differ by an uninteresting factor of proportionality from the canonical weights.

[b] Significantly different from zero at 1% level.

[c] Significantly different from zero at 5% level.

the 1% level which means that the three regression equations each explain a significant amount of the variance of the dependent variables. The regression coefficients are all significantly different from zero at the 1% level except net receivables for cash and all are of the expected sign.

Examination of the signs of the b's and β's from the canonical correlation show that net receivables, inventories, and short-term bank loans have negative signs, and cash, securities, and unexpected receipts positive signs. Thus when inventories and net receivables rise, short-term bank loans go up, and cash and securities go down. As this is the expected pattern of signs, the sign test is consistent with the conclusion that cash and securities are substitutes for short-term bank loans in the financing of inventories and net receivables. The squared canonical correlation coefficient of .440 exceeds by 15% the value of R_m^2, which was .290 in equation 3. The difference between these coefficients appears substantial and is interpreted as evidence that firms prefer to use combinations of securities, cash, and short-term bank loans for short-term finance, rather than any one of these sources alone.

What of the importance of cash, securities, and bank loans relative to each other in the financing of inventories and net receivables? The canonical weights, the β's, tell us that short-term bank loans are still used more relative to securities and cash, as short-term bank loans have the largest weight. This conclusion is important because it means that large firms do have short-term credit requirements for which they are apparently dependent on bank loans.

Relation to Accounts Payable and Net Receivables to the Bill Rate

In the course of the discussion of the behavior of accounts receivable it was suggested that large firms as customers will tend to increase their use of trade credit as the interest rate rises. The test of this proposition performed here is fairly simple, and should not be considered an attempt to give a complete explanation of accounts payable. It is expected that, given the level of purchases from other firms, a firm would increase its accounts payable as the interest rate rises. This hypothesis may be expressed as

$$D_t^* = \alpha_{41} + \alpha_{42}(T + \Delta I)_t + \alpha_{43}B_t + u_{4t}, \qquad (4)$$

where D_t^* is desired accounts payable, and u_{4t} is the error or residual term. We do not have data on purchases by the firm, but the level of sales plus the change in inventories should be a good approximation. The assumption is made that $D_t = D_t^*$, since we see no reason why, given the terms on which firms can obtain accounts payable, the observed volume of accounts payable of a firm should be different than the amount it desires.

With the substitution of D_t for D_t^* into 4 we have the equation we wish to estimate except for one further modification. The equation to be estimated is

$$D_{it} = \alpha_{41_i} + \alpha_{42}(T + \Delta I)_{it} + \alpha_{43}B_t + u_{4it}, \tag{5a}$$

where u_{4it} is the error or residual term. The subscript "i" on α_{41} indicates that separate intercepts are specified for each firm. The lack of subscript "i" on the interest rate indicates it is a constant for all firms in a particular year. The theoretical argument for specifying separate intercepts for each firm is the same as will be made in the next section with respect to equations for cash and securities. Discussion of this point will be deferred until then.

The estimates of equation 5 are

$$\underset{}{D_{it}} = \alpha''_{41i} + \underset{(0.0016)}{0.0450}(T + \Delta I)_{it} + \underset{(0.0980)}{0.4961}B_t + u''_{4it}, \tag{5b}$$

where $''$ indicates an estimate. R^2 for the regression equation is .832. The critical value of F at the 1% level is 1.33, while the F value for the equation is 39.31.[27] Both of the regression coefficients are significantly different from zero at the 1% level.[28] Our hypothesis that, given the level of purchases, firms increase their use of accounts payable when the interest rate rises is consistent with these results. We turn now to the behavior of the customers of large firms.

Rather than work directly with accounts receivable, net receivables will be examined as a dependent variable in order to find out if large firms on net supply credit to small firms when the interest rate rises. Specifying for the individual firm,

$$(R - D)_t^* = \alpha_{51} + \alpha_{52}T_t + \alpha_{53}B_t + u_{5t}, \tag{6}$$

[27] The number of observations is 1485, the number of parameters estimated is 167 (165 intercepts plus 2 slope coefficients), so the number of degrees of freedom in the numerator of the F ratio is 166, and in the denominator 1318.

[28] It is not necessary to estimate the α_{41i}'s in order to estimate the other coefficients and since there was no particular interest in the α_{41i}'s we did not estimate them. In computing the other coefficients we make use of the fact that the least squares estimate of $\alpha_{41i} = \bar{D}_i = \alpha_{42}(\overline{S + \Delta I})_i - \alpha_{43}\bar{B}$. Substituting this expression for α_{41i} in equation 4 gives us an alternative form of our original regression equation. This alternative form is much simpler to compute when the number of separate intercepts is quite large.

and assuming $(R - D)_t = (R - D)_t^*$, and specifying separate intercepts we have

$$(R - D)_{it} = \alpha_{51i} + \alpha_{52}T_{it} + \alpha_{53}B_t + u_{5it}. \tag{7a}$$

While we have specified accounts payable to be related to purchases, there seems no reason to expect net accounts receivable to be related to purchases Rather, since accounts receivable will be related very closely to sales, it seemed appropriate to use sales in equation 6. The estimate of equation 7 is

$$\underset{}{(R - D)_{it} = \alpha''_{51i} + \underset{(0.0040)}{0.0289T_{it}} + \underset{(0.2415)}{2.1124B_t} + u''_{5it}}. \tag{7b}$$

R^2 is .771 and F is 26.72, the equations and the two slope coefficients being significant at the 1% level.

The estimated coefficients for net receivables are quite large, and there is some reason to expect this may be due to a significant trend in net receivables. While accounts payable and accounts receivable may individually have some trend, cyclical movements, especially in a nine-year time series, are apt to be equally important. However, even if receivables and payables display strong cyclical movements, their difference may still have a large trend over a nine-year period.

To test this conjecture the sum of the estimated residuals $(\sum u''_{5it})$ was calculated for each year for all firms. Examination of the series of these sums of residuals suggested that time might be included in our regression equation for net receivables. The resulting estimates are

$$(R - D)_{it} = \alpha''_{61i} + \underset{(0.0043)}{0.0182T_{it}} + \underset{(0.3040)}{0.9795B_t} + \underset{(0.0008)}{0.0049t} + u''_{6it}, \tag{8}$$

where "t" is now also a variable, u''_{6it} is our estimated residual term in this equation, and α''_{61i} the separate intercepts. The F ratio is 27.48, and R^2 is .777 and significant. Although the sales and interest coefficients are still significant at the 1% level, they are considerably reduced by the inclusion of time. The introduction of time adds virtually nothing to the explained variance of the regression equations, and the significance of the time coefficient results directly from the reduced magnitude of the sales and interest coefficients.

In Table 3 the sums of residuals in each year for the accounts payable regression equation and for the two net receivables equations are presented. Also in Table 3 are the sums of the original variables by year. A casual glance at column 2 suggests that the residuals for the accounts payable equation display a fairly random pattern. However, time was added to the accounts payable equation, anyway, and the results were as expected. The coefficient of time was not significantly different from zero and the coefficients of sales and the bill rate were identical in the fourth decimal place in the two equations.

The sums of residuals ($\sum u''_{51t}$) for each year for equation 7*b* for receivables are presented in column 4, while the sums of residuals ($\sum u''_{61t}$) after time has been introduced are shown in column 5. It appears that

Table 3 Analysis of Residuals for Accounts Payable and Net Receivables by Year

Year	Sum of Accounts Payable[a] (1)	Sum of Residuals for Accounts Payable (2)	Sum of Net Receivables[a] (3)	Sum of Net Receivable Residuals[b] (4)	Sum of Net Receivable Residuals (5)
1948	−2.9858	−0.3918	−4.9840	−1.7713	−0.0250
1949	−3.8164	−0.2676	−5.4166	−1.5483	−0.9039
1950	−1.2662	0.8206	−2.2610	0.0592	0.6316
1951	0.0376	−0.0979	−0.4234	−0.2719	0.4744
1952	1.0250	0.2330	0.7893	−0.3647	0.1902
1953	0.4974	−0.5081	0.9161	0.7470	−0.1033
1954	0.0906	0.2870	0.9236	2.7704	0.1043
1955	2.2445	−0.0233	3.9461	0.4257	−0.2694
1956	4.1733	−0.0579	6.5100	−0.0961	−0.0989

[a] These figures are the sums of the variable as deviations from the mean of the variable for all the observations.
[b] The residuals in column 4 are estimated without the inclusion of time as a variable, while those in column 5 are estimated when time is included in the regression equation.

the pattern of the residuals in column 5 is more random than those in column 4 and it is concluded that the introduction of time has improved the explanation of net receivables.

It should be pointed out that a good part of the explained variance of the regression equations for accounts payable and net receivables is due to the estimation of separate intercepts. If the variance of D_t and $(R - D)$ is measured around the means of these variables for each firm, the values of R^2 (partial coefficients of determination) that measure only the explained variance due to the independent variables may be calculated. This measure of R^2 for accounts payable, when B_t and $(S + \Delta I)_t$ are the independent variables, is .509. For net receivables, when B_t, S_t, and time are the independent variables, R^2 due to these variables is .184.[29] For the sake of completeness, two other regression equations for accounts payable and net receivables have been estimated.

These two equations do not assume that $D_t = D_t^*$, and $(R - D)_t = (R - D)_t^*$, but rather the following relationships are specified for each individual firm,

$$\Delta D_t = \beta_1(D_t^* - D_{t-1}) + u_{7t}, \tag{9}$$

$$\Delta(R - D)_t = \beta_2[(R - D)_t^* - (R - D)_{t-1}] + u_{8t}. \tag{10}$$

Substituting the expressions for D_t^* from equation 4 into equations 6 and 9 for $(R - D)_t^*$ in equation 10, and adding separate intercepts we obtain

$$\Delta D_{it} = \beta_1\underline{\alpha}_{41i} + \beta_1\underline{\alpha}_{42}(T + \Delta I) + \beta_1\underline{\alpha}_{43}B_t + \beta_1(-D_{it-1}) + v_{1it}, \tag{11a}$$

$$\Delta(R - D)_{it} = \beta_2\underline{\alpha}_{51i} + \beta_2\underline{\alpha}_{52}T_{it} + \beta_2\underline{\alpha}_{53}B_t + \beta_2[-(R - D)_{it-1}] + v_{2it}, \tag{12a}$$

where $v_{1it} = (\beta_1 u_{4it} + u_{7it})$ and $v_{2it} = (\beta_2 u_{5it} + u_{8it})$, and where again common slopes are assumed for all firms, but separate intercepts are specified. As the α's from estimating equations 11*a* and 12*a* may differ from equations 5*a* and 7*a*, they are underscored in equations 11*a* and 12*a*.

The estimated regression equation for accounts payable is

$$\begin{aligned}\Delta D_{it} = \underline{\alpha}''_{41i} + &\underset{(0.0016)}{0.0324}(T + \Delta I)_{it} + \underset{(0.0943)}{0.7991}B_t + \underset{(0.0247)}{0.7003}(-D_{it-1}) + v''_{1it}\end{aligned} \tag{11b}$$

and for net receivables is

$$\begin{aligned}\Delta(R - D)_{it} = \underline{\alpha}''_{51i} &+ \underset{(0.0031)}{0.0106}T_{it} + \underset{(0.1871)}{1.1011}B_t \\ &+ \underset{(0.0227)}{0.3078}[-(R - D)_{it-1}] + v''_{2it}.\end{aligned} \tag{12b}$$

[29] It may be useful to define these measures of correlation more precisely. For the regression equation for accounts payable,

$$R^2 = \left[1 - \frac{\sum\sum u_{4it}^{2''}}{\sum\sum (D_{it} - \bar{D})^2}\right],$$

when the variance of D is calculated about the mean of all observations. The second measure of correlation discussed above is

$$R^2 = \left[1 - \frac{\sum\sum u_{4it}^{2''}}{\sum\sum (D_{it} - \bar{D}_i)^2}\right],$$

where the variance of D is calculated about the mean for each firm. In Appendix 2, equation A-3, it is shown why the second R^2 might be considered appropriate for measuring the explained variance due to the estimated slope coefficients on the independent variables. The choice of the term "partial coefficient of determination" may not have been felicitous.

The regression coefficients in both equations are significant at the 1% level and the *F* ratios indicate that a significant amount of the variance of the dependent variable is explained in both equations.[30] R^2 for accounts payable is .442 and R^2 not including the explained variance due to the separate intercepts is .411. For net receivables the corresponding correlations are .266 and .134.

The coefficients in equations 11*b* and 12*b* are fairly comparable in magnitude with equations 5*b* and 8, and the conclusions we wish drawn from these estimates will not depend on which equations are considered. Since it is felt that observed and planned, or expected, accounts payable and net receivables should be equal, equations 5*b* and 8 will be used as the basis for our conclusions.

The results suggest that even though large firms are induced to increase the credit they take from other firms in response to changes in the interest rate, their customers are even more responsive. We would expect the interest coefficient for net receivables to be zero if the customers of large firms showed the same response as do large firms as customers. Quite evidently this is not the case.

The magnitude of the interest coefficient on net receivables indicates that large firms supply a sizable credit stream to other firms, governments, and consumers when interest rates rise. The coefficient of 0.9795 tells us that a rise in the interest rate of 1% (say from 2% to 3%) increases net receivables as a ratio to total assets by nearly 1%. For the sample, this means roughly a $450 million increase in net receivables for a rise of 1% in the bill rate.[31] These results are discussed further below.

ESTIMATES OF REGRESSION EQUATIONS FOR CASH AND SECURITIES

In the first part of this section the models of cash and security holdings previously developed are expressed as regression equations. The estimates of these regression equations are then given. One set of regression equations developed specifies separate intercepts for each firm, and these intercepts have been analyzed by industry and asset size of the firm in Appendix 1. The last part of this section reports the results of analyzing the error terms from certain equations for cash and securities. A complete description of the tests used on the residuals is given in Appendix 2.

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[30] When time was introduced into the equation for net receivables the "*t*" value of the time coefficient was 1.02, so time has not been included above.

[31] Average total assets of the firms of this sample are $275.3 million, so

$$[165 \times 275.3 \times 0.009795] = \$445 \text{ million.}$$

The Regression Models of Cash and Securities

The previous discussion suggests the following relations:

$$C_t^* = \alpha_{60} + \alpha_{61}T_t + \alpha_{62}B_t + \alpha_{63}I_t + \alpha_{64}(R - D)_t + v_{3t}, \quad (13a)$$

$$S_t^* = \alpha_{70} + \alpha_{71}T_t + \alpha_{72}B_t + \alpha_{73}I_t + \alpha_{74}(R - D)_t + v_{4t}, \quad (14)$$

where C_t^* and S_t^* are respectively the desired levels of cash and securities of an individual firm, the α's are parameters, and the v's are residual terms. In addition to the traditional variables, the level of transactions and the bill rate, net receivables, and inventories are included in accord with the previous discussion.

Will C_t equal C_t^* and S_t equal S_t^*? It has been suggested that short-run adjustments in inventories and net receivables will take precedence over adjustments of cash and securities. Another proposition was that firms may have to hold unexpected receipts in the form of cash and securities whether or not they wish to increase these holdings. If this argument is correct then the observed levels of C_t and S_t are unlikely to be their desired levels, and another approach is necessary.

The following identities are used:

$$\Delta C_t = \Delta C_t^p + \Delta C_t^u, \quad (15)$$

and

$$\Delta S_t = \Delta S_t^p + \Delta S_t^u, \quad (16)$$

where the superscript "p" denotes a planned change, and the superscript "u" an unplanned change. Planned changes in cash and securities are written as some proportion of desired changes:

$$\Delta C_t^p = \beta_3(C_t^* - C_{t-1}), \quad (17)$$

$$\Delta S_t^p = \beta_4(S_t^* - S_{t-1}). \quad (18)$$

The coefficient β_3 tells us what portion of a desired change in cash is made in a year, and similarly for β_4 for securities. It is expected that the β's lie between 0 and 1.0. If $\beta_3 = 0.5$, it is interpreted to mean that, because of the many balance sheet adjustments that must be made, a firm can only adjust its cash holdings one-half of the way to the desired level in any year.

Finally unexpected receipts are introduced into the model:

$$\Delta C_t^u = \alpha_{65}\,\Delta N_t + v_{5t}, \quad (19)$$

$$\Delta S_t^u = \alpha_{75}\,\Delta N_t + v_{6t}, \quad (20)$$

where the v's are residual terms. The change in taxes owed is used as the measure of unexpected receipts in the above formulation, while $\Delta(P + N)$ was used earlier. Since the decision as to which of these variables to use as a measure of unanticipated receipts is nontheoretical, discussion of this point is postponed.

Substituting equation 13 into equation 17, and equations 17 and 19 into equation 15, equation 21 is obtained.

$$\Delta C_t = (\beta_3\alpha_{60}) + (\beta_3\alpha_{61})T_t + (\beta_3\alpha_{62})B_t + (\beta_3\alpha_{63})I_t + (\beta_3\alpha_{64})(R - D)_t + \beta_3(-C_{t-1}) + \alpha_{65}\,\Delta N_t + w_{1t}, \quad (21)$$

where $w_{1t} = (\beta_3 v_{3t} + v_{5t})$. Substituting equation 14 into equation 18, and equations 18 and 20 into equation 16, equation 22 is obtained.

$$\Delta S_t = (\beta_4\alpha_{70}) + (\beta_4\alpha_{71})T_t + (\beta_4\alpha_{72})B_t + (\beta_4\alpha_{73})I_t + (\beta_4\alpha_{74})(R - D)_t + \beta_4(-S_{t-1}) + \alpha_{75}\,\Delta N_t + w_{2t}, \quad (22)$$

where $w_{2t} = (\beta_4 v_{4t} + v_{6t})$. Parentheses are put around pairs of coefficients, as $(\beta_4\alpha_{71})$, in these equations to indicate that only the product of the two coefficients can be estimated directly.

Can these two relations be estimated pooling the data for all firms? It is assumed here that the coefficients on the independent variables will tend to share common values. However, work with the subsample of firms suggested that firms frequently may not have common intercepts. That is, $(\beta_3\alpha_{60})$ and $(\beta_4\alpha_{70})$ are likely to differ among firms. Examination of the cash equation may illustrate the problem. Consider the coefficient β_3 on lagged cash $(-C_{t-1})$. If C_{t-1} is more cash than the firm desires this year it is expected that the change in cash will be negative. Suppose for a particular firm $C_{t-1} = 0.10$ this year which was more cash than the firm desired so it decreased its cash holdings. Suppose for some other firm with the same values of T, I, $(R - D)$, B, and ΔN, it is observed that $C_{t-1} = 0.10$. Would it be expected that the second firm would also decrease its cash holdings by the same amount this year, assuming the value of β_3 was the same for both firms? This would be expected to occur only if factors affecting differences in average cash holdings between the two firms were effectively explained by T, I, $(R - D)$, B, and ΔN. It is not believed that these other variables do adequately explain differences in average cash holdings among firms. In addition, work with the subsample of firms was not very suggestive as to other variables that might be related to inter-firm differences in mean cash holdings. While it would be desirable to specify a model that explained differences in the average values of variables among firms, if this is not easily done, why not abstract from these differences by the use of separate intercepts for each firm?

This discussion may also be illustrated graphically. In Figure 1 the marginal relation, given the effects of the specified independent variables, between ΔC_t and C_{t-1} is plotted for two firms A and B. The slope, β_3, is assumed the same for both firms, and the mean values of changes in cash may or may not be equal, though they have been assumed to be zero for both firms in Figure 1. The only difference between the two firms is

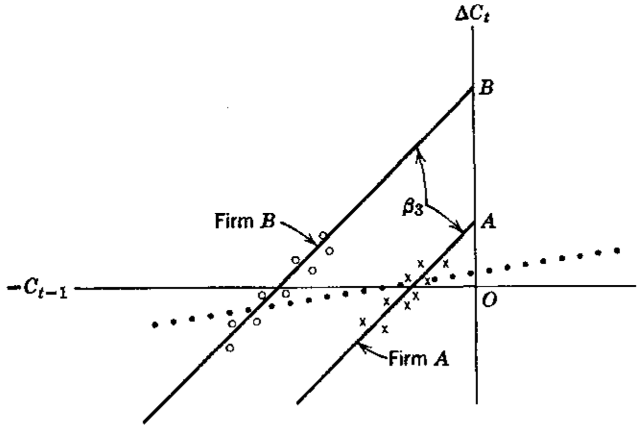

Figure 1 Illustration of the use of separate intercepts.

the mean of $(-C_{t-1})$. If common slopes and intercepts were estimated pooling the data for the two firms, the slope would be some relation like the dotted line in Figure 1, which could differ markedly from the "true" value of β_3. If separate intercepts of OA for firm A and OB for firm B were estimated, the common slope estimate would be β_3, which illustrates why it is desirable to estimate separate intercepts if the mean values of the variables differ in a manner not easily explained.

If separate intercepts are estimated by the method of least squares the slope β_3 is estimated from deviations of ΔC and $(-C_{t-1})$ from the respective means of these variables for each firm. This is illustrated in Figure 2 where the mean of ΔC and $(-C_{t-1})$ for firm A have been removed from A's observations, and similarly for firm B. The same type of reasoning used here is the basis for the estimation of separate intercepts for accounts payable and net receivables. Also it may be recalled that common intercepts were employed in regression equations 1 to 3 above. As all the variables entering those regression equations were changes in stocks and flows, rather than stocks or flows, there is no reason to expect that

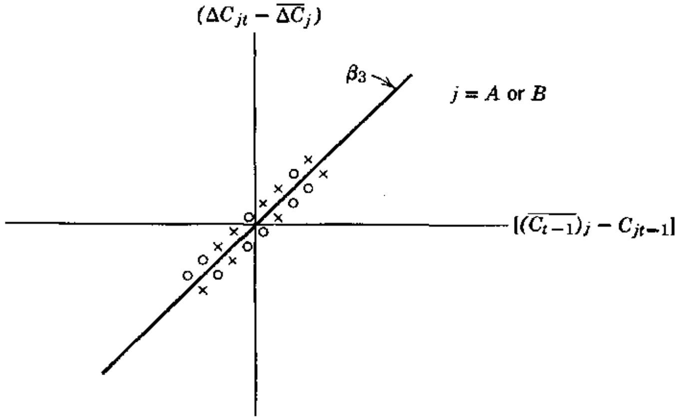

Figure 2 Transformation of variables when separate intercepts are used.

differences in the means of the variables are not explained by the other variables in the equations.

The addition of separate intercepts to equations 21 and 22 gives:

$$\Delta C_{it} = (\beta_3\alpha_{60})_i + (\beta_3\alpha_{61})T_{it} + (\beta_3\alpha_{62})B_t + (\beta_3\alpha_{63})I_{it} + (\beta_3\alpha_{64})(R - D)_{it} + \beta_3(-C_{it-1}) + \alpha_{65}\,\Delta N_{it} + w_{1it}, \quad (23a)$$

$$\Delta S_{it} = (\beta_4\alpha_{70})_i + (\beta_4\alpha_{71})T_{it} + (\beta_4\alpha_{72})B_t + (\beta_4\alpha_{73})I_{it} + (\beta_4\alpha_{74})(R - D)_{it} + \beta_4(-S_{it-1}) + \alpha_{75}\,\Delta N_{it} + w_{2it}. \quad (24)$$

Both equations 21 and 23 for cash and equations 22 and 24 for securities will be estimated to see whether the specification of separate intercepts does help in the explanation of changes in cash and securities.

The Estimates of Regression Equations for Cash and Securities

The estimates of the two cash equations and the two securities equations are presented in Table 4. In Table 4 equation A for cash is equation 21, and equation B is equation 23. Similarly for securities, equation A in Table 4 is equation 22, and equation B is equation 24. An F test is used to determine whether an equation specifying separate intercepts provides a better explanation of changes in cash than does an equation with a common intercept. The addition to explained variance due to the separate intercepts divided by the number of additional intercepts is the numerator. The denominator is the residual variance of the equation with the additional intercepts divided by the remaining degrees of freedom.

Table 4 Estimates of Regression Equations for Cash and Securities[a] (Standard Errors of Regression Coefficients in Parentheses)

Independent Variables	Cash Equation A (21)	Cash Equation B (23)	Securities Equation A (22)	Securities Equation B (24)
Lagged cash $(-C_{it-1})$	0.1672	0.6312		
	(0.0150)[b]	(0.0239)[b]		
Lagged securities $(-S_{t-1})$			0.1235	0.4782
			(0.0140)[b]	(0.0231)[b]
Sales (T)	0.0043	0.0333	0.0017	0.0263
	(0.0008)[b]	(0.0029)[b]	(0.0011)	(0.0042)[b]
Bill rate (B)	−0.0235	−0.3848	−0.2834	0.0008
	(0.1405)	(0.1384)[b]	(0.1996)	(0.2000)
Inventories (I)	−0.0228	−0.0391	−0.0367	−0.1321
	(0.0079)[b]	(0.0120)[b]	(0.0076)[b]	(0.0179)[b]
Net receivables $(R - D)$	−0.0029	−0.0098	−0.0307	−0.0260
	(0.0053)	(0.0153)	(0.0101)[b]	(0.0228)
Change in taxes (ΔN)	0.2199	0.1207	0.4721	0.3237
	(0.0229)[b]	(0.0206)[b]	(0.0322)[b]	(0.0310)[b]
R^{2c}	.140	.423	.191	.390
F	40.15	5.67	58.19	4.95
Degrees of freedom	1478	1314	1478	1314
Sum of squared residuals	1.555416	1.043537	3.066702	2.311055

[a] The intercept term for equation A for cash is 0.0144, and for equation A for securities is 0.0318, both coefficients being significant at the 1% level.
[b] Different from zero at the 1% level of significance.
[c] The variance of ΔC is computed about $\Delta \bar{C}_i$, the mean of ΔC for each firm. R^2 for regression equation B above is .392 and significant. For securities the corresponding R^2 for equation B is .366.

The F ratio for cash is thus

$$F = \frac{1.555416 - 1.043537}{164} \div \frac{1.043537}{1314} = 3.94.$$

With 164 and 1314 degrees of freedom the critical value of F at the 1% level is 1.33, so the hypothesis that separate intercepts add significantly to the explanation of changes in cash is accepted. The test is identical for securities where

$$F = \frac{3.066702 - 2.311055}{164} \div \frac{2.311055}{1314} = 2.62.$$

For securities, the hypothesis that specification of separate intercepts adds significantly to the explanation of changes in securities is also accepted at the 1% level.[32]

This is not quite the final word on the subject of separate intercepts. It is shown in Appendix 2 that the same slope coefficients of the independent variables in the cash and securities equations would result if the independent variables were expressed as deviations from their mean for each firm, and the change in cash and the change in securities were expressed as deviations from the mean of all observations.[33] This formulation uses only one intercept and yields values of R^2 of .371 for cash and .352 for securities, and patterns of significance identical with equations B of Table 4 for cash and securities.[34] It does not really make any difference to the conclusions of the text whether the set of equations just described, or equations B of Table 4 are used, and so we have chosen to work with the latter set because it is slightly less cumbersome to describe. However, in the analysis of residual variance it is not convenient to use the equations with separate intercepts. A complete description of the above set of equations and the analysis of residual variance is contained in Appendix 2.

For cash, all of the coefficients in equation B in Table 4 are of the expected sign, and all but the coefficient on net receivables are significant at the 1% level. For securities, the coefficients in equation B of Table 4

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[32] An assumption of the above test is that the slope coefficients on the independent variables are the same for each firm. The assumption of common slopes has not been tested here. To test for common slopes, equations 21 for cash and 22 for securities would be estimated for each firm separately and the residual variance for the individual regression equations summed over all firms would be compared with the residual variance from a pooled regression. The reason for not making the test of common slopes is that it is a substantial investment in computation that would yield regression equations for individual firms that one would probably not otherwise wish to estimate. That is, the regressions for each firm would only have two degrees of freedom each, which is apt to produce from sampling error some wide but uninteresting variations in coefficients. Since the common slope assumption has not been tested, the above F tests could have the interpretation that has been placed on them or they could have the interpretation that enough of the differences in slope coefficients among firms has shown up as differences in intercepts to allow separate intercepts to add significantly to the explained variance of cash and securities.

[33] The reasons for specifying such a set of equations is implicit in the discussion of separate intercepts in the first part of this section. The reason it is not necessary to actually use separate intercepts for the cash and security equations is that the dependent variables are changes in stocks, and the variations in the means of changes in stocks among firms over a short period is not expected to be, or is not in fact, large.

[34] This statement means that the same variables have significant "t" values in the two sets of equations. The standard errors of the coefficients differ in the two sets of equations, and in particular they are larger for equations B of Table 4.

are of the expected sign, and all but the coefficients on net receivables and the bill rate are significant at the 1% level. One problem in estimating the effect of the bill rate on cash and securities is that we only have the quantities of net receivables and inventories, and not the returns on these assets. Since substitution of inventories for cash and securities is due to the increased return on inventories, the estimates of the effects of the bill rate on cash and securities will be affected by the use of the quantity of inventories. The problem is further complicated by the fact that the bill rate, the return on inventories, and the quantity of inventories are correlated. We cannot really say how the estimates of the bill rate coefficients are affected because we do not know how accurately the quantity of inventories mirrors the return on inventories. In any event it must be concluded that the present estimates yield no significant relation between the bill rate and securities.

The fact that net receivables is not a significant variable in equations B for cash and securities is not too surprising. It is expected that inventories and net receivables would have the same general relationship with respect to all variables but the bill rate. While it was expected that net receivables would be positively related to the bill rate, it turns out that inventories in the sample are also related positively to the bill rate evidently because it has not been possible to hold the rate of return on inventories constant. If there is not much difference in the behavior of two independent variables entering into a regression equation, it may be difficult to distinguish their effects on the dependent variable. The reason for treating the variables separately was to see if cash and securities are used more to finance one or the other of the assets. The answer is either that cash and securities are used predominantly for inventories, or that the model is not sensitive enough to the differences between receivables and inventories to allow an answer to the question. Equations B for cash and securities are not much changed if net receivables is dropped as a variable, or if net receivables is added to inventories as a composite variable, so in analyzing the results in the next section the original equations 23 and 24 will be used.

In previous sections three different regression equations involving the relation of cash and securities to net receivables have been reported. In none of these regression equations for cash was net receivables a significant variable at the 1% level. This suggests that, though a negative relation between these variables is found persistently, the relation is not strong enough to take into account. Again, this conclusion is subject to the reservation above, namely, that the models do not allow us to distinguish very sharply between the effects of inventories and net receivables. For securities, only regression equation B of Table 4, of the three equations examined, yields a relation between net receivables and securities that is not significant at the 1% level. It is concluded that the negative relation found between securities and net receivables is strong enough to take into account, but that equation 23 for securities does not allow a good estimate of this relation.

Changes in taxes due was used as the measure of unanticipated receipts in the regression equations in this section. Four variables had been considered. These were the change in sales, change in profits, change in taxes, and the change in taxes plus profits. In the work with the subsample it appeared that an average of lagged sales was a better measure of expected transactions, the conceptual variable to which firms would adjust their cash and security holdings, than current sales.[35] When this lagged measure of sales was used for transactions, the change of sales was used to measure unexpected receipts. For the main sample it turned out that current sales worked better than a lagged average of sales, and because the change of sales is highly correlated with current sales, the change of sales was no longer considered as a measure of unexpected receipts.[36]

The other three measures of unexpected receipts are not much different in the results they produce. In general it was better to use either the change in taxes or the change in profits plus taxes. Taxes are important because the change in the tax law in 1954 made it necessary for firms to pay one-half of their tax liabilities in the year they accrued and one-half in the following year, instead of all in the following year. This reduced the size of the permissible taxes owed account for any given level of profits, and Silberman reports that this had an appreciable effect on the working

[35] Two other variables that appeared to have explanatory value for the sub-sample, but did not for the main sample, should be mentioned. The first was investment. It was reasoned that if firms were planning large capital expenditures they might build up funds as securities, and perhaps also as cash. A fairly strong negative relation between investment and changes in securities was found for the subsample. While the relation of securities and investment was consistently negative for the main sample, the relation was not generally significant at the 1% level. The second variable was a lagged measure of the liquidity position of the firm. The liquidity position was measured as total fixed claim liabilities minus current assets. It was expected that large values of this liquidity measure would be associated with a subsequent buildup of cash and securities. However, no persistent relationship was found either for cash or securities in the main sample. One reason why these variables might not be important in the model used is that the lagged measure of cash and securities may bury the effects of such variables. Thus a large value of lagged securities means securities decrease next year, whether or not the large value of lagged securities is due to a buildup for investment. Similarly a low value of lagged cash will result in a buildup in cash next year, whether or not the low value of lagged cash was a reflection of a low liquidity position of the firm.

[36] By worked better it is meant that for identical regression equations for cash and securities, the coefficients and their "t" values for current sales were larger than for the lagged average of sales. Two measures of lagged sales were used. The first was $0.5(T_{t-1} + T_{t-2})$, and the second was $0.25(T_t + T_{t-2} + 2T_{t-1})$.

capital of firms in 1955 and 1956.[37] Since profits would not reflect this "unanticipated" drop in receipts for firms, it seemed desirable to use taxes and profits, or taxes alone. In general $(\Delta P + \Delta N)$ did about as much better for cash as (ΔN) did for securities; the difference in R^2's is in the third decimal place. There did not seem any justification for taking the best of both worlds, so the change in taxes was used in both regression equations 23 and 24, as indicated above.[38]

Discussion of the Residuals for Cash and Securities

The regression equations estimated in this study pool observations over industries, asset size groups, and years. The advantage of pooling the data is that it allows us to make more general statements. Since the models used here are of a very simple form and involve some mis-specifications of relationships among the independent variables, the results will be of an inexact character no matter what level of aggregation is used. While the inexact nature of the results may justify our procedure, pooling of data is unlikely to be without costs. These costs may be assessed to some extent by examining the error terms from the regression equations.

Residuals have been estimated for cash and securities from equations with the same slope coefficients as those in equations B of Table 4. The residuals have been classified by year, industry, asset size, and by the size of certain independent variables. There was no significant difference in the means of residuals for cash by year using the homogeneity of means test at either the 5% or 1% level of significance. For securities there was a significant difference in the means by year at either the 5% or 1% level of significance. With only nine annual observations it is difficult to discern cyclical or other patterns in any time series including the present residuals. From examination of the means of the residuals and the independent variables we observe no obvious systematic factors that would explain the apparent differences in the means of residuals of securities by year, and believe the differences are due to circumstances in particular years. There is no trend in the residuals of cash and securities at the 1% level, though there is a trend in the residuals for securities at the 5% level. It is suggested that any importance of time in the explanation of securities is due to the observations for 1948, but other judgments are certainly possible, and the

[37] Charles E. Silberman, "The Strange Money Shortage," *Fortune* (March, 1957), p. 123.

[38] In the regression equations of the previous section $(\Delta P + \Delta N)$ was used as the measure of unexpected receipts. This was considered consistent procedure in the sense that the measure chosen was better for securities which was the criterion above. (ΔN was better in these regressions for cash and short-term bank loans.) It would also have been consistent to use the change in taxes in all regressions. Differences in R^2's between ΔL, ΔS, and ΔC, and ΔN and $(\Delta P + \Delta N)$ are in the third decimal place so that our consistency, or lack of it, will have had little effect on the results.

interested reader may wish to consult Appendix 2, and especially Table A-3.

Classification of the residual variance by the size of sales, inventories, and the lagged values of cash and securities, revealed that there is heteroskedasticity for both cash and securities with respect to some of the independent variables. It appears that dividing variables by total assets may have reduced one cause of heteroskedasticity only to introduce another. This analysis also suggested that nonlinear forms might have been more appropriate for describing certain relationships than the linear forms used here.

The "explained variance" for subgroups of observations, due to the regression equations estimated over all observations, has been examined. The subgroups consist of observations classed by year, industry, and asset size. For each of these subgroups, except 1948 for securities and 1956 for cash, the hypothesis that the "explained variance" is equal to zero is rejected at the 1% level. The quotation marks about "explained variance" indicates that the present usage differs from the usual usage. All of these terms, tests, and conclusions are discussed in more detail in Appendix 2.

THE RESULTS: ANALYSIS, SUMMARY, AND IMPLICATIONS FOR MONETARY POLICY

Analysis of the Estimated Equations for Cash and Securities

The coefficients for cash and securities estimated in the previous section will be discussed in more detail. The estimated regression equation for cash is

$$\Delta C_{it}'' = (\beta_3\alpha_{60})_i'' + 0.0330T_{it} - 0.3838B_t - 0.0391I_{it} - 0.0098(R - D)_{it} + 0.6312(-C_{it-1}) + 0.1207\Delta N_{it} \quad (23b)$$

This is a short-run relationship. Setting ΔC_{it} and ΔN_{it} equal to zero and substituting $C_{it}{}^*$ for C_{it-1}, an estimate of "equilibrium cash holdings" is obtained, which is

$$C_{it}^{*''} = \alpha_{60i}'' + 0.0528T_{it} - 0.6096B_t - 0.0619I_{it} - 0.0155(R - D)_{it} \quad (13b)$$

By identical procedure an estimate of the equation 14 of equilibrium security holdings may be obtained.

The derivation of these equilibrium coefficients whether done as above, or directly from the equations 23*a* and 13*a*, is simple enough, and their interpretation for sales and the bill rate is straightforward. Because the firm is not able to adjust its cash balances to their desired levels immediately, the observed adjustment will be less than the long-run adjustment. To estimate the long-run adjustment we must divide the short-run coefficient by the speed of adjustment coefficient. However, because it is not possible to compartmentalize cash and security holdings, we must assume, for example, that the full adjustment of security holdings to sales takes the same time as the adjustment of security holdings to inventories. Actually the latter adjustments are apt to be very nearly immediate and the equilibrium coefficients for inventories and net receivables are for this reason probably too high, and no conclusions are drawn from the values of these coefficients.

The original coefficients will be referred to as short-run coefficients, and the derived coefficients as long-run or equilibrium coefficients. Both sets of coefficients are presented with their standard errors in Table 5. The

Table 5 Short and Long-Run Coefficients and Elasticities for Cash and Securities (Standard Errors of Coefficients in Parentheses)

Variable	Short-Run Coefficient	Long-Run Coefficient	Short-Run Elasticity	Long-Run Elasticity	Means of Variables
Part A. Cash					
Lagged cash ($-C_{t-1}$)	0.6312	1.0000	0.6312		0.1042
	(0.0239)[a]				
Sales (T)	0.0333	0.0528	0.558	0.885	1.7465
	(0.0029)[a]	(0.0059)[a]			
Bill rate (B)	−0.3848	−0.6096	−0.062	−0.098	0.0167
	(0.1384)[a]	(0.2191)[a]			
Inventories (I)	−0.0391	−0.0619	−0.115	−0.183	0.3075
	(0.0120)[a]	(0.0190)[a]			
Net receivables	−0.0098	−0.0155	−0.008	−0.012	0.0811
($R - D$)	(0.0153)	(0.0242)			
Change in taxes	0.1207		0.093		0.0800[b]
(ΔN)	(0.0206)[a]				
Part B. Securities					
Lagged securities	0.4782	1.0000	0.4782		0.0734
($-S_{t-1}$)	(0.0231)[a]				
Sales (T)	0.0263	0.0550	0.626	1.309	1.7465
	(0.0042)[a]	(0.0097)[a]			
Bill rate (B)	0.0008	0.0017			0.0167
	(0.2000)	(0.4338)			
Inventories (I)	−0.1321	−0.2762	−0.553	−1.156	0.3075
	(0.0179)[a]	(0.0389)[a]			
Net receivables	−0.0260	−0.0544	−0.029	−0.061	0.0811
($R - D$)	(0.0228)	(0.0585)			
Change in taxes	0.3237		0.353		0.0800[b]
(ΔN)	(0.0310)[a]				

[a] Different from zero at the 1% level of significance.
[b] This is the mean of N as a ratio to total assets, not the mean of ΔN. In computing elasticities the means of C, S, and N are used rather than the means of changes in these variables.

standard errors of the derived coefficients are only approximate.[39] There has been no change in the pattern of significance between the short-run and long-run coefficients. The coefficients in Table 1 show the change in cash and securities as a ratio to total assets for a unit change in the independent variable. The coefficients may be easier to interpret if they are expressed as elasticities as in columns 3 and 4 of Table 5. These elasticities are computed at the mean values of the variables, except that for the variables which are changes, as ΔC, the mean value of C is used, rather than the mean of the change in the variable.[40] The mean values of the variables are presented in column 5.

Elasticities of linear relations are frequently not useful because they depend on the initial position chosen. However, the initial values used here, the mean values of the variables for the sample, may provide a reasonable position from which to consider small departures. The estimated elasticities in Table 5 tell us the short-run and long-run percentage change in the dependent variable for a 1% change in the independent variable, given that the other independent variables are at their mean values.[41]

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[39] Using the notation of equation 23*a*, the approximation used is

$$s^2_{\alpha_{6j}} = \frac{s^2_{\beta_3\alpha_{6j}}}{\beta_3^2} + \frac{(\beta_3\alpha_{6j})^2}{\beta_3^4} s^2_{\beta_3} - \frac{2(\beta_3\alpha_{6j})}{\beta_3^3} \operatorname{cov}\,[(\beta_3\alpha_{6j}), \beta_3],$$

where $j = 1, 2, 3$, and 4, for the four long-run slope coefficients, and where s^2 denotes sample variances, and where the variance and covariance terms on the right side are obtained from the covariance matrix of coefficients. This approximation of the variance of a ratio from the parameters of the components of the ratio is given by G. Udny Yule and M. G. Kendall, *An Introduction to the Theory of Statistics*, 13th ed., rev. (London: Charles Griffin and Company, 1947), formulas 16.8 and 16.9, pp. 299–300. The approximation is suitable for the present case because the speed of adjustment coefficients are expected to be between zero and one, and, importantly, are not expected to take on values very close to zero.

[40] The computation of the short-run elasticity of cash with respect to sales may be illustrated. The elasticity formula is $\Delta C/C \div \Delta T/T$, where in this instance, ΔC is the coefficient of sales, and C is the mean of cash, so the numerator is 0.0333/0.1042 = 0.3196. The coefficient of T for cash is for a unit change in T, so $\Delta T = 1.0$, and T is the mean of T, so the denominator is 1/1.7465, and the resulting elasticity is 0.558. The reason for not using the mean of changes in cash is that for most purposes one is interested in the elasticity of cash with respect to sales, not the elasticity of changes in cash with respect to sales.

[41] The effects on the elasticities of other variables entering into the regression equations may be illustrated. The interest elasticity of cash will be less if sales are greater than the mean value. If the value of sales was greater than its mean value then, because of the positive coefficient on sales, the ratio of cash to total assets would be greater than its mean value. In this case any change in cash for a given change in the bill rate would be a smaller percentage change in cash than if sales was equal to its mean value. Thus the interest elasticity of cash would be inversely related to the value assumed for sales, and the elasticity of cash to sales will be positively related to the value assumed for the bill rate.

Kisselgoff's findings, based on aggregated data for a sample of firms during the period 1921–1939, imply an elasticity of cash with respect to transactions of 1.14.[42] Since Kisselgoff's estimates assume that actual cash balances are desired balances, it is probably appropriate to use the long-run elasticity of 0.885 of this study for comparison. If it is assumed the variance of the sample means of cash and sales for each of the two studies is zero, an estimate of the standard errors of these elasticities may be calculated.[43] They are 0.485 for Kisselgoff's elasticity and 0.051 for the equilibrium elasticity of this study. Since differences between the elasticities could be the result of sampling error, there does not seem much point in pursuing the comparison.[44]

It would appear that the estimated long-run sales elasticity here is less than one. This suggests that cash holdings may grow less than proportionately to sales. However, the cross-section statistics in Table 1 indicate that as the sales of firms get larger there is no clear variation in the ratio of cash to sales, which may mean that the sales coefficient for cash is a little low.[45]

The elasticity of securities with respect to sales is greater than 1.0, suggesting the ratio of securities to sales rises with sales. This is in agreement with the pattern found in Table 1 where the ratio of securities to sales in the smallest asset size groups is 0.029 while for the largest it is 0.080.

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[42] Kisselgoff, *op. cit.*, pp. 336–338, presents the data underlying his estimates. The above elasticity was computed using his data and the estimated coefficient on transactions. This elasticity assumes that the interest rate is at its mean value for the period.

[43] The elasticity of cash to sales (long-run) in these studies is $\bar{T}\alpha_{61} \div \bar{C}$. If $\bar{C}$ and $\bar{T}$ are assumed to have zero variance then the variance of the elasticity is $[(\bar{T}/\bar{C})^2 s^2_{\alpha_{61}}]$ and the standard error of the elasticity estimates may be easily calculated.

[44] If the elasticity estimates are normally distributed, then with 95% probability Kisselgoff's elasticity of cash to sales would lie between 0.07 and 2.11. The 95% confidence limits for the elasticity estimate of this study are 0.78 to 0.99. As the limits of the present estimate are contained within the limits of Kisselgoff's elasticity, it is concluded that there is no significant difference in the estimates. The usual test of equality of means is not appropriate here because the variances differ markedly.

[45] As the interest coefficient on cash shows, corporations during the period of this study have been willing to hold less cash as interest rates rose. However, it is unlikely that the interest coefficient has picked up all of the long-run effects of generally rising interest rates during the period, e.g., the development of repurchase agreements between corporations and government bond dealers, and methods of speeding up payments and receipts. If the interest coefficient does not pick up these effects, then the coefficient on sales may be unduly low. This could be called a bias in the present study if the methods of economizing cash developed because of higher interest rates are not retained when, and if, interest rates decline to their early postwar levels. A description of some methods corporations have developed for economizing cash is given by Charles Silberman, "The Big Corporate Lenders," *Fortune* (August, 1956), pp. 111–114.

Kisselgoff has also estimated the elasticity of cash with respect to the interest rate, but it is not very meaningful to compare his estimate with that of the present study.[46] A comparison of the coefficients shows that a 1% increase in the interest rate, say from 2% to 3%, results in an 11.3% decrease in cash ($\Delta C/C$), using Kisselgoff's estimates. For this study the short-run percentage decrease in cash is 3.7% and the long-run decrease is 5.9%. Assuming the mean of cash has a variance of zero the standard deviation of Kisselgoff's estimate is 0.030, and for the long-run coefficient of this study the standard error is 0.021.[47] As the present equilibrium estimate is over two standard deviations from Kisselgoff's estimate, it is likely that there is a significant difference in the coefficients.[48] While it has been suggested that Kisselgoff's estimate may have an upward bias, there is also some reason to suppose the present estimate may also have a bias, though not necessarily downward.[49]

The interest coefficients of Table 5 may be used to examine the proposition of Baumol and Tobin that the proportion of cash in transactions balances is inversely related to the interest rate.[50] The relation between transactions balances, cash, and the bill rate is illustrated in Figure 3. It is

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[46] The reason is that Kisselgoff used the interest rate on two to five year government bonds while the bill rate is used here. Longer term interest rates have a higher mean (Kisselgoff's mean rate was 2.95% as compared with 1.67% for this study) and exhibit smaller fluctuations, in general, than short-term rates. This means that long-term interest rates, everything else being the same, will produce higher interest elasticities. Kisselgoff's elasticity of cash with respect to the interest rate on two to five year bonds was -0.332. Kisselgoff also estimated the elasticity of free cash with respect to the interest rate. Free cash was defined as observed cash in any year minus current sales times the ratio of cash to sales in 1929, a year when the cash sales ratio was at a minimum. The estimated elasticity was -1.26 (*op. cit.*, p. 254). Acheson J. Duncan, *op. cit.*, p. 251, has pointed out that there is a high probability that the close relation between free cash and the interest rate is spurious because the correlation of deviations from the trend of free cash and the interest rate was only $-.03$.

[47] The long-run percentage decrease in cash due to a 1% rise in the bill rate is $0.01\alpha_{62} \div \bar{C}$, and the variance of this estimate, if the variance of $\bar{C}$ is zero, is $0.0001 s^2_{\alpha_{62}} \div \bar{C}^2$, from which the standard error is computed.

[48] The equality of the two estimates of the percentage decrease in cash could be estimated if the variances of these estimates were homogeneous. When the variances of the two estimates were compared using Bartlett's test, the Chi Squared value was over 100 indicating that the variances were not homogeneous. It may be noted that the present long-run estimate is within two standard deviations of Kisselgoff's estimate of the percentage decrease in cash due to a 1% rise in the interest rate. However, because the number of observations is much larger in this study the standard error of the present estimate would get most of the weight in tests of equality of the two estimates.

[49] See footnote 46 for a discussion of Kisselgoff's interest estimates. A source of bias for the present estimates, the use of quantities rather than returns on inventories and net receivables, is discussed on page 95.

[50] See footnote 4.

assumed that the sum of cash and securities are transactions balances, though as some amount of securities (and cash) is set aside as a buffer for changes in inventories and net receivables, this figure will be high. It is also assumed that the other variables in the model are held constant. The ratio of cash plus securities to total assets is plotted on the horizontal axis of Figure 3A, and the bill rate on the vertical axis.

As it is assumed in Figure 3 that all variables are initially at their mean values, one point on Figure 3A is the mean of cash plus securities to total

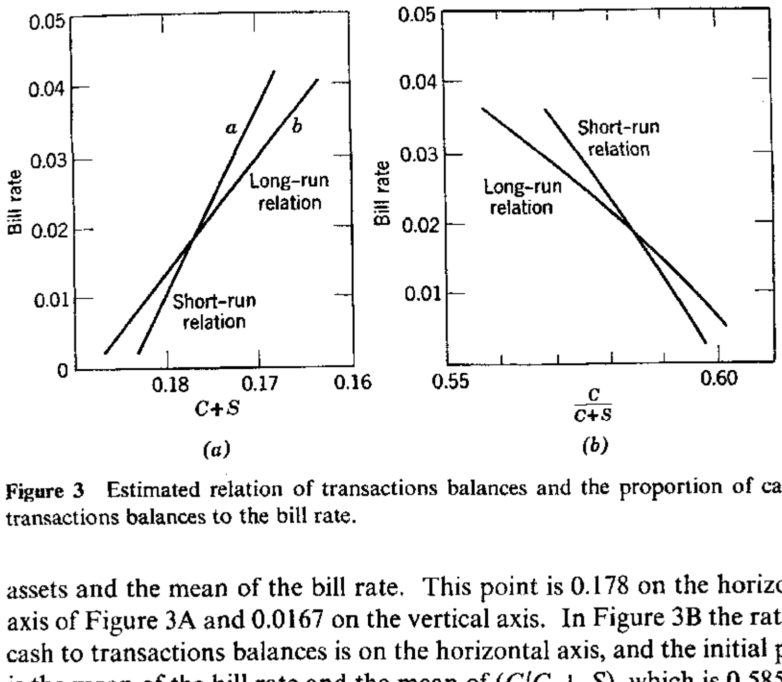

Figure 3 Estimated relation of transactions balances and the proportion of cash in transactions balances to the bill rate.

assets and the mean of the bill rate. This point is 0.178 on the horizontal axis of Figure 3A and 0.0167 on the vertical axis. In Figure 3B the ratio of cash to transactions balances is on the horizontal axis, and the initial point is the mean of the bill rate and the mean of $(C/C + S)$, which is 0.585. In both Figures 3A and 3B the short-run and long-run relations are plotted, the two relations intersecting at the initial points discussed above.

If the interest rate rises from its mean value of 1.67% to say 3%, then in Figure 3A the firm moves up the short-run relation curve to point *a*. If the interest rate stays at 3% for some time then the firm does not stay at point *a*, but rather moves over to point *b* on the long-run curve, since point *b* represents the full adjustment of the firm to a 3% interest rate. If, after the bill rate had remained at 3% for some time, there was another change in the bill rate, the firm would not be on the short-run curve of Figure 3A. Rather the firm would have another short-run curve intersecting the long-run curve at a 3% bill rate, and it would be this curve that would show the short-run movement of the firm from a 3% bill rate. There will thus be a different short-run curve for every point on the long-run relation. The long-run relation is a locus of equilibrium levels of transactions balances in relation to the bill rate. There will also be different long-run relations for values of the other variables that are different from their mean values. If sales were to be above its mean value, for example, the long-run and short-run curves of Figure 3A would shift to the left in an analogous manner to the effects of changes in income in a liquidity preference diagram (in the north-west quadrant).

In Figure 3B the interpretation of the long-run and short-run relations is the same as that in Figure 3A. The long-run relation is a locus of equilibrium ratios of cash to transactions balances in relation to the bill rate, and this relation will be a function of the values assumed for the other variables. The long-run and short-run relations are negatively sloped which is consistent with the proposition of Baumol and Tobin.

The coefficients and elasticities for securities on inventories, net receivables, and the change in taxes due are much larger than those for cash. It would be expected that securities are in all ways a superior asset to hold as a buffer asset for changes in inventories and receivables, and a more profitable way to hold unanticipated receipts, which is what was found. As the variance of changes in securities is over twice as large as the variance of the change in cash, there is additional evidence that securities, rather than cash, absorb most of the shocks from short-run adjustments in the current accounts. Another indication of this is the relative magnitudes of the speed of adjustment coefficients for cash and securities. For cash the estimated proportion of a desired change in cash made in a year is 0.6312, while for securities the figure is 0.4782. A glance at the standard errors of these coefficients indicates that this is a significant difference. The interpretation given to this finding is that securities must absorb much more of the adjustments of the current accounts of firms than cash and it is therefore likely the firm will not be able to adjust securities to their equilibrium level as fast as cash.

Summary and Implications of the Findings

The empirical findings of this study are based on a sample of large non-financial corporations, and for this reason the results are unlikely to have applicability to firms in general. In addition several of the hypotheses of the study are framed with large corporations in mind. While it might be expected that the lagged adjustment part of the models of cash and securities would describe a large class of firms, it is doubtful whether the relationship between securities and inventories suggested for large corporations would have much applicability to smaller firms.

A serious limitation on the analysis is that it is partial. Because the models are not simultaneous, and because there are relationships among the independent variables, it is not possible to describe the total short-run impact on cash and securities of the explanatory variables. With at least these reservations in mind the results of this study may be summarized.

The firms in this sample maintain about 10% of their total assets as cash, while the ratio of cash to sales is about 6%. The long-run elasticity of cash with respect to sales was estimated at 0.885. The other component of transactions balances, securities, is about 7.3% of total assets and 4.2% of sales. The long-run elasticity of securities with respect to sales was estimated to be 1.31, which is consistent with the finding that the ratio of securities to sales increases with the absolute level of sales. Securities may rise more than proportionately with sales because large firms are more likely to find it economical to use securities as a substitute for bank loans in the finance of inventory and net receivable fluctuations.

The expected negative relation between the bill rate and cash holdings was found. Measuring transactions balances as cash plus securities, it was also found that the proportion of cash in transactions balances is inversely related to the bill rate. The estimates of the relation between the bill rate and cash holdings may have some bias (positive or negative) because the quantities of inventories and net receivables and not their returns were used as variables. The model of security holdings did not produce a significant relation between the bill rate and securities.

Lagged adjustment models of cash and securities appear to give a reasonable description of the behavior of large firms. One reason that firms may adjust cash and securities with a lag is that they give priority in the short-run to the adjustment of inventories. It was found that securities tend to be adjusted to their equilibrium position more slowly than cash. One reason suggested for this is that securities, relative to cash, tend to bear the brunt of short-run adjustments of the firm. In this study it has not been possible to distinguish cash holdings held as compensating balances in banks where firms customarily borrow. If large firms do hold compensating balances this might account for the relative stability of cash holdings that has been found.

Canonical correlation analysis suggested that firms substitute between the use of short-term bank loans, and securities and cash in financing temporary increases in inventories and net receivables. Using a more complete model to describe cash and securities it was again found that securities and cash are negatively related to inventories. Cash does not appear to be significantly related to net receivables, but some negative relation between securities and net receivables appears to exist.

Allowing for the effects of purchases by firms, it was found that increases in the interest rate induce large corporations to expand the credit they take in the form of accounts payable. However, the relation between the interest rate and net trade credit taken by the customers of these firms, given the effects of time and sales, is even more striking. The estimates suggest that net receivables as a percentage of total assets increase by about 1% in response to a rise in the bill rate of 1%, say from 2% to 3%. In addition the net receivables of large corporations do increase with the sales of firms which means that during an expansion of business activity there will be a sizeable amount of credit offered by large firms to their customers. During a business expansion interest rates and inventories will also be rising. In response to the higher interest rates, large firms reduce their cash holdings significantly, and some part of the increase in net receivables and inventories is financed by running down security and cash holdings.

These results suggest that during an inflationary period large corporations are in a position to finance some of their credit needs internally, and to extend credit to smaller businesses and consumers.[51] As these large corporations do use short-term bank loans to finance a substantial part of their increase in net receivables and inventories during an expansion, there is clearly scope for restraining their activity. However, if, because of earnings, low risk, or other reasons, large firms are more likely to be accommodated by the banking system in periods of tight money than smaller borrowers, the scope for restraining their activity is substantially reduced. Assuming it is true that large corporations are somewhat removed from the impact of monetary policy because they maintain internal sources of finance and are accommodated readily by the banking system, how can their behavior be influenced? In attempting to answer this question the results of this study are interpreted more liberally than is probably justified.

The problem could be attacked from the standpoint of the availability of short-term credit to large firms, but this approach appears to involve discriminatory controls on bank lending. In addition, firms, in the face of tight money, are able to expand their activity by the sales of securities to the extent that they have adequate long-term credit. During a business expansion it would probably require a very high bill rate to induce firms to retain their security holdings instead of increasing net receivables and

[51] Alan Meltzer, on the basis of aggregative data for firms of various sizes, draws inferences directly related to the above discussion. Meltzer suggests that, because large firms extend sizable amounts of trade credit to small firms in periods of tight money, small firms are able to obtain credit from banks indirectly, even though credit rationing directly favors large firms. See "Mercantile Credit, Monetary Policy and the Size of Firms," *Review of Economics and Statistics*, XLII (November, 1960), pp. 429–437.

inventories. Another approach to the problem is to view large corporations for present purposes as a type of financial intermediary. As it may be difficult to control the source of funds of large corporations, attention is focused on the control of their lending.

An alternative method of restraining large corporations is to curtail the trade credit they offer their customers. If the terms on accounts receivable were subject to control, such as specification of the minimum terms that could be offered, the monetary impact of large corporations might be significantly reduced. If monetary restraint on some portion of the customers of large firms is effective, then the effect of tightening terms on receivables will be to reduce the sales of all firms including large corporations. This will in turn reduce the demand for inventories of large corporations, and result in a lower level of activity. Symmetrically, if the monetary authorities reduced the terms in recessions, it might prove a stimulant to sales and inventory investment. These comments are intended to be provocative of further thought and research. Much more study is needed to determine whether large corporations are fairly insulated from the effects of monetary policy, and whether the trade credit offered by large firms allows their customers to make purchases they would not otherwise have been able to finance. Also some judgment must be made as to the desirability of the use of selective controls of the type suggested.

APPENDIX 1: ANALYSIS OF FIRM INTERCEPTS

The firm intercepts for equations 23*a* and 24 for cash and securities have been estimated. Examination of these equations reveals that the estimated intercepts are a product of two coefficients, $\beta_3\alpha_{60}$ for cash and $\beta_4\alpha_{70}$ for securities. To obtain an estimate of α_{60} and α_{70}, which are the intercepts in the equations for desired cash (equation 13*a*) and desired securities (equation 14), the calculated intercepts for each firm are divided by the estimate of β_3 for cash and β_4 for securities. The purpose of estimating these coefficients was to see if they exhibited any pattern by industry or asset size.

In Table A-1, in column 1 the mean of average cash holdings by industry is presented, in column 2 the mean of α_{60}'' by industry, in column 3 the mean of average cash holdings by industry divided by the standard deviation, and in column 4 the mean of α_{60}'' by industry divided by its standard deviation. In columns 5 to 8 the same statistics for securities are presented.

Table A-1 Means and Coefficients of Variation (V) of Cash and Security Holdings and Firm Intercepts by Asset Size and Industry

	Mean of Cash (1)	Mean of α_{60}'' (2)	V for Cash (3)	V for α_{60}'' (4)	Mean of Securities (5)	Mean of α_{70}'' (6)	V for Securities (7)	V for α_{70}'' (8)
Asset size classes								
1. $10 to 40 million	0.1222	0.0432	2.23	0.97	0.0548	0.0324	0.79	0.33
2. $40 to 65 million	0.1080	0.0089	2.65	0.10	0.0671	0.0234	1.17	0.18
3. $65 to 100 million	0.1414	0.0921	2.03	1.51	0.0528	0.0658	0.71	0.75
4. $100 to 150 million	0.1071	0.0560	2.65	0.86	0.0581	0.0819	1.08	1.06
5. $150 to 200 million	0.0849	0.0388	3.64	1.37	0.1101	0.1315	0.89	0.90
6. $200 to 400 million	0.1027	0.0424	2.59	0.88	0.0654	0.0546	1.08	0.55
7. $400 to 700 million	0.1040	0.0518	1.75	0.65	0.0769	0.0916	1.32	0.87
8. Over $700 million	0.0742	0.0339	2.13	1.25	0.0979	0.0962	1.37	1.13
Industry								
1. Food and tobacco	0.1114	0.0077	1.68	0.06	0.0473	0.0102	0.68	0.07
2. Petroleum and rubber	0.0729	0.0366	2.40	1.20	0.0591	0.0483	1.37	0.88
3. Steel and non-ferrous	0.0821	0.0445	2.68	1.21	0.0940	0.1066	1.24	1.20
4. Chemicals	0.1048	0.0717	3.25	1.80	0.0993	0.1160	1.55	1.64
5. Machinery	0.1020	0.0680	2.46	1.89	0.0843	0.1262	1.00	1.25
6. Transportation	0.1131	0.0637	3.48	2.40	0.0920	0.1155	0.95	1.39
7. Retail trade	0.1326	0.0275	2.04	0.41	0.0522	0.0045	0.82	0.05
Total	0.1042	0.0446	2.32	0.71	0.0734	0.0710	0.98	0.66

These same statistics are presented for the firms classified by asset size. The mean intercepts for cash, and even more so for securities, do tend to exhibit a pattern similar to that of the means of average cash and security holdings both by asset size and industry. The coefficients of variation of the intercepts for cash and securities are of similar size for the various groups of firms, while the coefficients of variation for the means of cash are generally much larger than the coefficients of variation for the intercepts for cash.

If for any of the groups of firms examined the intercepts clustered about some mean value it would suggest that only an intercept for the whole group of firms need be estimated, rather than an intercept for each firm. The results in Table A-1 are not very suggestive on this count. The possible exceptions are industry groups 3, 4, and 5, whose intercepts for both cash and securities display much less variation than other groups of firms.

APPENDIX 2: ANALYSIS OF RESIDUALS BY YEAR, ASSET SIZE AND INDUSTRY OF THE FIRMS, AND SIZE OF THE INDEPENDENT VARIABLES

On page 94 it was mentioned that the analysis of the residuals is based on a slightly different form of the regression equations than was presented in that section. The appendix will begin with a discussion of this point. With no loss of generality, and some saving of space, we will consider for illustrative purposes that the change in cash is related to one independent variable, X, and that separate intercepts are specified for each firm so we have

$$\Delta C_{it} = \alpha_{1i} + \alpha_2 \bar{X}_{it} + u_{it}, \tag{A-1}$$

where, as in the text, t runs over 9 years and i over 165 firms. When least squares estimating procedure is used,

$$\alpha_{1i} = \overline{\Delta C}_i - \alpha_2 \bar{X}_i. \tag{A-2}$$

Substituting equation A-2 for α_{1i} in equation A-1 we have

$$(\Delta C_{it} - \overline{\Delta C}_i) = \alpha_2 (X_{it} - \bar{X}_i) + u_{it}. \tag{A-3}$$

Thus equation A-3 is an alternative way of formulating an equation specifying separate intercepts.

The reason given for specifying separate intercepts was that it is frequently difficult to explain the differences in the average value of stock variables among firms. However, means of changes in stocks (or flows) like $\overline{\Delta C}$ are not apt to exhibit many inexplicable differences among firms, at least over a short period. Thus instead of equation A-3 one might write

$$\Delta C_{it} = \alpha_2(X_{it} - \bar{X}_i) + \alpha_3 + v_{it}, \tag{A-4}$$

where the v's are a new error term, and a common intercept, α_3, is specified. If we consider X to be a stock or flow variable whose average value among firms is not easily explained, then it will be useful to use this variable as a deviation from the mean of each firm, especially since it costs no degrees of freedom to do this.

Interestingly the least square estimates of α_2 are the same in equation A-4 as in equation A-3, and therefore as in equation A-1. In equations A-3 and A-4 the variance of $(X_{it} - \bar{X}_i)$ will be identical. Since

$$\sum\sum(\Delta C_{it} - \overline{\Delta C}_i)(X_{it} - \bar{X}_i) = \sum\sum \Delta C_{it}(X_{it} - \bar{X}_i),$$

the covariance is the same in equations A-3 and A-4, and so the two estimates of α_2 will be the same. For any number of X's the matrix of raw moments of equation A-4 will be identical with that of equation A-3 except for the row of sums.[52] Instead of the number of observations and zeros in the row of sums as in equation A-3, the row of sums for equation A-4 will consist of the number of observations, zeros for all the independent variables, and the last element will be the sum of ΔC_{it}. So the slope estimates on the independent variables will be the same in equation A-4 as in equation A-3, and the inverse of the matrix of raw moments will be the same. The estimate of the common intercepts, α_3, will be precisely $\overline{\Delta C}$. Finally the difference in residual variance between equations A-3 and A-4 will be $t\sum(\overline{\Delta C}_i - \overline{\Delta C})^2$. Since for changes in stocks or flows this magnitude is not apt to be large, it points to the advantage of equation A-4 over equation A-3. However, when a firm stock or flow is the dependent variable, the situation may be different.[53]

Another advantage of equation A-4 over equation A-3 is saving degrees of freedom. In the present study, going from equation A-4 to equation A-3 uses 164 additional degrees of freedom in estimating the mean of ΔC for each firm. The estimates of the cash and security equations of page

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[52] And except for the measure of the variance of the change in cash in the last row.

[53] See page 87, where two stocks, payables and net receivables, were used as dependent variables.

93, when written in the form of equation A-4 are

$$\Delta C_{it} = \underset{(0.0000)}{0.0020} + \underset{(0.0027)}{0.0333}(T_{it} - \bar{T}_i) - \underset{(0.1304)}{0.3848}(B_t - \bar{B}) - \underset{(0.0113)}{0.0391}(I_{it} - \bar{I}_i)$$
$$- \underset{(0.0144)}{0.0098}(R_{it} - \bar{R}_i - D_{it} + \bar{D}_i) + \underset{(0.0225)}{0.6312}[(\bar{C}_{t-1})_i - C_{it-1}]$$
$$+ \underset{(0.0194)}{0.1207}(\Delta N_{it} - \overline{\Delta N}_i) + w_{3it}, \tag{A-5}$$

$$\Delta S_{it} = \underset{(0.0000)}{0.0029} + \underset{(0.0040)}{0.0263}(T_{it} - \bar{T}_i) + \underset{(0.1886)}{0.0008}(B_t - \bar{B}) - \underset{(0.0169)}{0.1321}(I_{it} - \bar{I}_i)$$
$$- \underset{(0.0215)}{0.0260}(R_{it} - \bar{R}_i - D_{it} + \bar{D}_i) + \underset{(0.0218)}{0.4782}[(\bar{S}_{t-1})_i - S_{it-1}]$$
$$+ \underset{(0.0292)}{0.3237}(\Delta N_{it} - \overline{\Delta N}_i) + w_{4it} \tag{A-6}$$

As mentioned, the coefficients of the independent variables are identical with those of equations B of Table 4, but now there are common intercepts of $\overline{\Delta C}$ and $\overline{\Delta S}$ respectively. The coefficients above have lower standard errors because the sum of residuals squared when corrected for degrees of freedom is less in equations A-5 and A-6 than in equations B of Table 4. $R^2 = .371$ and $F = 145.82$ for cash in equation A-5 and $R^2 = .352$ and $F = 126.58$ for securities in equation A-6. As the same degrees of freedom are used in estimating equations A-5 and A-6 as are used in estimating equations A of Table 4, it is clear that equations A-5 and A-6 explain significantly more of the variance of the change in cash and the change in securities. The addition of intercepts for each firm to equations A-5 and A-6 does not add significantly to the explained variance of changes in cash and securities.

Having established why w_{3it} and w_{4it} of equations A-5 and A-6 are the residuals that are to be examined, some general comments about the character of these error terms are in order. From the form of equation A-4 it should be clear that the sum of residuals for each firm for cash is $t(\overline{\Delta C}_i - \overline{\Delta C})$, and for securities, $t(\overline{\Delta S}_i - \overline{\Delta S})$. As the sums of residuals for each firm are unrelated to the independent variables, which sum to zero for each firm, they are not of much interest. If the sums of residuals for each firm are of little interest, then the same is true for groups of firms by asset size and industry. However, the sum of residuals by year will be of interest and this is discussed below.

For this reason the analysis deals principally with the residual variance of subgroups of observations. Suppose for cash the first ten firms of the sample are a subgroup of interest. The initial variance of ΔC for this group

Table A-2 Analysis of Residual Variance by Asset Size and Industry

	Sum of Squared Residuals (1)	Cash Explained Variance (2)	F^a (3)	Sum of Squared Residuals (4)	Securities Explained Variance (5)	F^a (6)	Number of Firms (7)
A. Asset size groups							
1. $10 to 40 million	0.20615	0.07627	10.77	0.18288	0.19009	30.45	20
2. $40 to 65 million	0.16822	0.14530	23.73	0.28366	0.15121	14.73	19
3. $65 to 100 million	0.21210	0.17961	20.78	0.19245	0.06469	8.35	17
4. $100 to 150 million	0.10641	0.08139	19.94	0.24623	0.07598	8.06	18
5. $150 to 200 million	0.10245	0.07798	18.52	0.38345	0.21051	13.54	17
6. $200 to 400 million	0.11928	0.03307	10.20	0.36922	0.19304	19.14	25
7. $400 to 700 million	0.16023	0.04254	9.91	0.32298	0.13472	14.67	24
8. Over $700 million	0.06148	0.03612	21.49	0.48688	0.31354	29.18	25
B. Industry							
1. Food and tobacco	0.10721	0.05081	17.27	0.17590	0.05093	10.74	25
2. Petroleum and rubber	0.05867	0.01677	8.73	0.12151	0.07547	19.34	21
3. Chemicals	0.16168	0.12747	24.13	0.49781	0.24401	15.00	21
4. Steel and non-ferrous	0.12180	0.04922	11.71	0.27349	0.22391	23.91	20
5. Machinery	0.34118	0.25299	36.97	0.75302	0.35925	23.75	34
6. Transportation equipment	0.11570	0.08158	14.15	0.40303	0.29538	14.69	14
7. Retail trade	0.23008	0.09380	17.96	0.23632	0.08716	16.31	30

[a] Critical values of F range from 2.90 (2.14) for industry group 5 with 34 firms (306 observations) to 2.99 (2.19) for industry group 6 with 14 firms (126 observations), at the 1% (5%) level.

is $\sum_1^{10} \sum_{47}^{56} (\Delta C_{it} - \overline{\Delta C})^2$, and subtracting from this $\sum_1^{10} \sum_{47}^{56} w_{3it}^2$ we get a quantity which we shall call the "explained variance" for a subgroup. We then make the usual F test. The explained variance is divided by 6, for the 6 independent parameters estimated, to give the numerator of the F ratio. The denominator is the sum of residuals squared for the subgroup divided by the number of observations less 7, the number of parameters estimated. Thus, for the first ten firms of the sample,

$$F = \frac{\left[\sum_{1}^{10} \sum_{47}^{56} (\Delta C_{it} - \overline{\Delta C})^2 - \sum_{1}^{10} \sum_{47}^{56} w_{3it}^2\right] \div 6}{\left[\sum_{1}^{10} \sum_{47}^{56} w_{3it}^2\right] \div (90 - 7)}$$

The principal peculiarity of our concept of explained variance for a subgroup is that it could be negative. In this case, of course, no test is needed, and the hypothesis that the explained variance for the subgroup is zero (or less) is accepted. If we summed the numerator of the F ratios for an exhaustive set of subgroups, it would equal the numerator of the F ratio for the regression equation for all observations. However, the sum of the denominator over all subgroups must necessarily be larger than the denominator for the F ratio of the regression equation for all observations.[54] This means that the null hypothesis that the explained variance of a subgroup is zero is more likely to be accepted for a subgroup, regardless of the difference in the number of observations, than the same hypothesis for all observations. Since we want to be able to reject the null hypothesis this characteristic of the test is (rightly?) not in our favor.

In Table A-2 firms are classified into 8 asset size groups and 7 industry groups. The explained variance as defined above and the residual variance for these groups is presented in columns 1 and 2 for cash and 4 and 5 for securities. The above F statistics are given in column 3 for cash and 6 for securities. For all subgroups the explained variance is significantly different from zero at the 1% level. It should be made explicit that these tests do not tell us whether it would have been "better" to run a separate regression for each subgroup.

We turn now to analysis of residuals by year. In Table A-3 the sums of residuals for cash and securities and the sums of the dependent variables, ΔC and ΔS, are presented by year in columns 1 and 2. In columns 3 and 4 the residual variance and the explained variance are presented, and in

[54] This characteristic of the test makes it very difficult to reject the null hypothesis for small subgroups. Several of the industrial groupings of the present sample were four firms or less, and these have been put with other industrial groups for this reason. Thus, autos are included with transportation equipment, tobacco with food, rubber with petroleum, and non-ferrous metals with steel.

Table A-3 Analysis of Residual Variance by Year[a]

Year	Sum of Dependent Variable (1)	Sum of Residuals (2)	Sum of Residuals Squared (3)	Explained Variance (4)	F Ratio[b] (5)
1948					
Cash	−0.217669	−0.644198	0.12688	0.10213	22.30
Securities	0.973297	−1.700487	0.27179	0.02192	2.14[c]
1949					
Cash	0.532040	0.585148	0.10799	0.03699	9.06
Securities	2.073883	0.691080	0.22374	0.08990	10.62
1950					
Cash	0.564818	−0.055149	0.11589	0.03851	8.78
Securities	1.587197	−0.617922	0.18500	0.07036	10.11
1951					
Cash	0.785820	−0.237122	0.16306	0.13436	21.73
Securities	0.584626	−0.706728	0.35175	0.21132	15.93
1952					
Cash	0.108225	0.321343	0.11727	0.08989	20.23
Securities	−0.813031	0.884847	0.29845	0.38934	34.50
1953					
Cash	0.913694	−0.122216	0.16000	0.07639	12.60
Securities	0.715271	0.214770	0.26881	0.11043	10.89
1954					
Cash	0.197350	−0.356185	0.11160	0.09072	21.59
Securities	−0.323810	0.898786	0.22307	0.09014	10.73
1955					
Cash	−0.579722	−0.608756	0.10181	0.09117	26.50
Securities	1.689740	1.118945	0.31649	0.12693	10.63
1956					
Cash	0.676442	0.404765	0.13186	0.00741	1.48[c]
Securities	−2.233863	−0.783291	0.31605	0.22596	18.92

[a] Figures in columns 2 through 4 need to be divided by 165 to obtain average values for any year.
[b] Critical values of F for each year are 2.92 (2.16) at the 1% (5%) level.
[c] Null hypothesis is accepted at 5% or 1% level of significance.

column 5 the F ratios are given. It may be noted that the sums of the estimated residuals by year will be the same for either equation form A-3 or A-4.

Do the means of residuals differ by year? This question may be answered if it is assumed that the variances of residuals are the same in each year, an assumption of the present regression model. The critical value of F for this test for 8 degrees of freedom in the numerator (8 independent estimates of means) and (1485–7–9) degrees of freedom in the denominator is 2.53 (1.95) at the 1% (5%) level of significance. The F ratio for cash is 1.57, and the null hypothesis that the means of the residuals for cash are equal, and equal to zero, is accepted. The F ratio for securities is 3.58 and the null hypothesis is rejected for securities. The null hypothesis that the explained variance for each year is zero is rejected in all years except 1948 for securities and 1956 for cash.

The results that the means are different from zero for securities has something to do with time. The correlation of time with the residuals of each firm is not significant at the 1% level, and the correlation with the sums of residuals is not significant at either the 5% or 1% levels. However, the correlation is enough to substantially change the patterns of the sums of residuals. If we estimate

$$w_{4it} = a(t - \bar{t}) + w'_{4it},$$

the estimate of "a" is 0.0009, $R^2 = .003$, and the F ratio is 4.83. The critical value of F is 3.84 at the 5% level and 6.66 at the 1% level. If time is used to explain the residuals the sum in 1948 is -1.1, and in 1955 is 0.67, which is an improvement, but the sum in 1956 becomes -1.38, and in 1949, 1.14. For the test of the homogeneity of means the F value for securities with time as a variable is 2.97, and the hypothesis that the means are equal in each year would be rejected at the 5% or 1% level. However, whereas the null hypothesis that the explained variance for securities was zero at the 5% or 1% level in 1948 was accepted when time was not a variable, with time as a variable the F ratio would be 2.97, which is greater than the critical value at the 1% level, i.e., 2.72 with 7 and 158 degrees of freedom. These results suggest, we believe, that the explanatory value of time for securities has something to do with 1948.

In 1948 the equation predicted an increase in securities for 152 of the 165 firms. This preponderance of predicted increases may be partly due to the trend in the values of variables. However, inventory holdings for the firms in 1948 were not high relative to sales, so this factor led to more predicted increases in 1948 relative to other years of business expansion, and the fact that the sum of changes in securities is positive in 1948 also suggests that an equation describing security holdings might well have a large number of predicted increases in that year. However, actual increases in security holdings were made by only 70 firms. The problem with 1948, we suggest, is that a substantial number of the firms were still getting rid of their accumulation of securities from the war. This adjustment, though related to the lagged value of securities, would not necessarily be related

Table A-4 Analysis of Residual Variance of Firms Classified by Size of Sales, Inventories, Cash, and Securities (Range of Variable for Each Classification Given with Class Numbers)[a]

		Index of Residual Variance	
	Variable of Classification	Cash (1)	Securities (2)
A. Sales			
1.	0.54–0.77	89.8	70.5
2.	0.77–0.91	72.1	115.5
3.	0.91–1.02	65.4	186.9
4.	1.02–1.21	79.3	127.2
5.	1.21–1.36	95.0	79.5
6.	1.36–1.43	82.8	124.7
7.	1.43–1.69	114.7	123.7
8.	1.69–2.16	164.5	63.6
9.	2.16–2.77	133.9	83.1
10.	2.77–6.11	100.0	30.2
B. Inventories			
1.	0.046–0.124	56.8	82.9
2.	0.124–0.160	82.5	97.9
3.	0.160–0.194	127.8	119.9
4.	0.194–0.246	72.8	128.0
5.	0.246–0.276	103.2	143.8
6.	0.276–0.305	98.8	97.9
7.	0.305–0.341	84.1	92.3
8.	0.341–0.380	146.5	69.8
9.	0.380–0.456	157.8	57.4
10.	0.456–0.864	68.5	57.9
C. Lagged Cash			
1.	0.008–0.050	16.1	
2.	0.050–0.065	38.6	
3.	0.065–0.073	36.1	
4.	0.073–0.079	40.8	
5.	0.079–0.089	56.1	
6.	0.089–0.102	120.8	
7.	0.102–0.124	114.8	
8.	0.124–0.138	167.1	
9.	0.138–0.175	200.3	
10.	0.175–0.317	194.2	
D. Lagged Securities			
1.	0.000–0.001		13.0
2.	0.001–0.007		26.7
3.	0.007–0.022		30.2
4.	0.022–0.030		54.8
5.	0.030–0.045		87.4
6.	0.045–0.079		110.0
7.	0.079–0.099		118.1
8.	0.099–0.126		174.4
9.	0.126–0.158		182.5
10.	0.158–0.482		186.8

[a] Sixteen firms are included in each of the first five classes for each variable, and 17 firms in the last five classes. The average of the sum of squared residuals over all observations was used to form the index numbers. Thus the index numbers for cash for all variables have the same base and similarly for securities.

to the values of the other variables in the model, and may be the reason for the relatively poor performance of the securities equation in 1948.

The performance of the cash equation in 1956 is somewhat mystifying. An examination of signs revealed that the predicted change in cash holdings in 1956 was of the same sign as the actual change for 105 of the firms. Neither the sums of the changes in cash nor the sums of residuals are suggestive of any particular bias in that year. The values of the independent variables for that year are also not suggestive of why the explanatory value of the regression equation is low for 1956. One reason for the poor performance of the cash equation for 1956, which is not helpful in indicating the manner in which the estimates err, is that the initial variance of changes in cash is lowest in that year.

The error terms for cash and securities have also been related to the size of some of the independent variables, and in particular, sales, inventories, lagged cash, and lagged securities. As the size of these independent variables for each firm will tend to rise through time because they are divided by average total assets for the period, the average values of these variables for each firm have been used to rank firms. That is, firms have been ranked by the average size of the independent variables, and not observations. The firms have been divided into ten groups by the size of the variables, and the average residual variance has been converted into an index number for each group. These index numbers are presented in Table A-4.

It is quite obvious that there is substantial heteroskedasticity for cash with respect to lagged values of cash, and for securities with respect to lagged securities. For sales, it is not easy to tell whether the pattern of residual variance suggests a non-linear relationship between cash and sales, or that there is simply heteroskedasticity. For inventories the pattern of residual variance is quite mixed for cash. For securities the residual variance for both sales and inventories suggests that there may be some type of non-linear relationship which would describe the data better than the simple linear forms used here.

4

An Empirical Examination of a Commercial Bank Loan Offer Function*

DONALD D. HESTER

THEORY OF THE LOAN OFFER FUNCTION

On June 29, 1960, commercial banks in the United States had approximately 115 billion dollars of loans outstanding and were the largest source of short term funds for business. These credits were extended to a wide variety of borrowers and the terms of loans varied considerably among borrowers. Despite the obvious importance of bank lending, economists have not concerned themselves with a theory to explain this activity in detail. This chapter proposes a theory of bank lending and introduces supporting statistical evidence. Implications of the theory for monetary policy are considered in the final section.

This chapter considers only the terms at which loan applicants may obtain loans from commercial banks. It abstracts from bank choices among bonds, loans, and cash, except to the extent that these choices appear to influence the terms at which a bank will lend.[1] Services of banks as

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[1] Cf. Richard C. Porter, "A Model of Bank Portfolio Selection," *Yale Economic Essays*, I (Fall 1961), pp. 323–359, reprinted in Cowles Foundation Monograph 21, *Financial Markets and Economic Activity* (New York: John Wiley & Sons, 1967) Chap. 2; Roland I. Robinson, *The Management of Bank Funds* (New York: McGraw-Hill Book Company, Inc., 1951); and David Chambers and Abraham Charnes, *Inter-temporal Analysis and Optimization of Bank Portfolios* (O. N. R. Research Memorandum No. 27, The Technological Institute, Northwestern University, 1960).

consultants or sources of information are ignored.[2] The deposit structure, equity, management, etc., of any particular bank are assumed to be fixed. The loan market is assumed to be imperfect.

A loan offer function is a relation which specifies the terms at which a bank with particular characteristics is willing to lend to a borrower with a known profit, balance sheet, and credit history and with particular prospects for the future. It is a generalized supply function for loans in the sense that, instead of merely having the amount of loans determined by a set of exogenous variables, it has a set of loan terms including the amount of loans determined by the set of exogenous variables.

Any loan application may be characterized by a set of terms of lending, $t \in T$, where T is the set of all imaginable sets of terms of lending. Thus t might refer to a loan of one million dollars, possessing a maturity of one year, payable quarterly, having an interest rate of five per cent, etc. A potential borrower has balance sheets, income statements, and a credit rating which will be denoted by the set $v \in V$, where V is the set of all imaginable sets of information about borrowers. A lending bank has a set of characteristics, $u \in U$, where U is the set of all imaginable sets of characteristics of lending banks. Thus u might include a bank's deposit instability, its loan experience, the present state of its portfolio, rates of interest on competing assets available to it, etc. Abstractly, a loan offer function may be expressed:[3]

$$F(t; u, v) = 0. \tag{1}$$

The next section develops a theory of bank lending in terms of expression 1. Subsequent sections present empirical evidence on this theory, summarize the analysis and suggest its policy implications.

In pages 120 through 128, the discussion is considered to be suggestive rather than exhaustive. Other terms of lending, characteristics of borrowers, and characteristics of banks can be imagined. Similarly, quotations are intended to be illustrative rather than an exhaustive study of opinion in the banking literature.[4] Finally, the argument in these sections

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[2] Cf. George Katona, *Business Looks at Banks* (Ann Arbor: University of Michigan Press, 1957).

[3] Lawrence Ritter, in an interview, brought my attention to a manuscript by J. M. Guttentag. Mr. Guttentag's paper contained a description of bank lending behavior which was somewhat similar to the loan offer function. Although I had already developed the notion of a loan offer function when I first saw his manuscript, it is possible that my subsequent thinking was influenced by his draft. He presented no detailed statistical evidence. Cf. J. M. Guttentag, "Credit Availability, Interest Rates, and Monetary Policy," *The Southern Economic Journal*, XXVI (January 1960), pp. 219–228.

[4] Despite the prescriptive appearance of some of the quotations, it is believed that the authors intended their statements to be essentially descriptive.

frequently is derived from interviews which I held with numerous bank officers.

Analysis of Terms of Lending

It is assumed here that a loan applicant summarized by $\bar{v} \in V$ applies for a loan from a bank summarized by $\bar{u} \in U$. It is convenient to introduce the analysis of terms of lending by considering a relation implicit in the production function, the production possibility curve.

A production possibility curve may be defined to be the *efficient* set of outputs obtainable from a given set of inputs. The co-ordinates of this curve are measured in units of the goods which could possibly be produced. In the case of the loan offer function, the analogue of this curve is the *efficient* set of terms $t^* \in T'$ obtainable from given sets of characteristics, $\bar{u}$ and $\bar{v}$.[5] The coordinates are measured in units which are applicable to each term; thus maturity might be measured in months.

Efficiency in the sense of Pareto optimality implies that no more output of any good can be obtained from a particular set of inputs without reducing the output of some other good. Similarly, efficiency in the case of the analogous loan offer curve implies that a bank will not grant a more liberal loan from the point of view of one term or condition without worsening other terms. The notion of liberal terms of lending is considered below.

Terms of loans include the size; rate of interest; maturity; schedule of repayments; guarantees; other collateral; restrictions on dividends, working capital, salary increases, plant and equipment acquisitions, retained earnings, and personnel loans; and subordination of outstanding debts. Other terms include commitment fees charged by the bank, costs of audits, penalties for early repayments which come from other borrowing, verbal agreements on future balances, etc. Space considerations limit the discussion to four principal terms which are later analyzed empirically. These are the rate of interest, the size of the loan, the maturity of the loan, and whether or not the loan is secured.

The following statements are conjectures about a bank's view of each of the four terms of lending, assuming the remaining three terms are established. If a term is more liberal, it is less preferable from the point of view of the bank.

Obviously loans which are made at higher rates of interest are preferred by banks. It is assumed that a bank's marginal utility of income is always positive.[6]

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[5] $T' \in T$. T' is the obtainable set of terms of lending.

[6] Donald Hodgman has observed that higher loan rates of interest may not be preferable if they increase the probability of default or only partial repayment by a borrower. This

Banks also prefer relatively short maturity loans. This is partly attributable to the potential short term character of their demand deposit liabilities. Further, banks view default risk as a function of exposure time (maturity).[7]

Banks do not desire to make extremely short maturity loans (say one hour). The costs of investigating borrowers cannot ordinarily be covered by the interest on the loan. However, this is not an important qualification because few borrowers desire one hour loans.[8]

Banks prefer to lend moderate amounts rather than very large or small sums. Small loans have high handling charges relative to the interest on the loan. The analysis is restricted to loans where handling costs are relatively small.[9]

Large loans are more risky in two ways. First, a borrower who obtains a large loan will have a higher debt-asset ratio after the loan has been consummated and thus will have a larger default risk. Second, banks will not be able to diversify their loan portfolio optimally if equal-risk borrowers get loans of different amounts.[10]

If all other terms of lending are specified and if borrowers are charged the costs of providing collateral, banks prefer to make secured loans. Collateral reduces the default risk of the loan. Frequently borrowers do bear the costs of providing collateral.

In conclusion, bankers attempt to make loans which have high interest rates, short maturities, moderate amounts, and which are secured. Borrowers attempt to get more favorable terms by seeking low rates of

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[7] "For any given credit rating, a longer term loan should have a higher rate if for no other reason than that the liquidity differential in favor of short-term credits is bound to be worth something. The greater errors which are bound to creep into long-term credit judgments merit some differential." Robinson, *op. cit.*, p. 197.

[8] This paragraph ignores special arrangements like loans to brokers and security dealers.

[9] Roland I. Robinson places considerably more emphasis on the costs associated with bank lending. "A big borrower seeking a small accommodation can get a better rate than a small borrower, but he will have to pay more than he would have to pay for a larger sum, presumably still within the credit capacity of the borrower." *Ibid.*, p. 119.

[10] This statement assumes that the probability of an individual borrower defaulting on his loan is independent of the probabilities of default of other equal-risk borrowers. Cf. Harry M. Markowitz, *Portfolio Selection* (New York: John Wiley and Sons, Inc., 1959).

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result hinges on an assumption that interest payments on a loan are not collected continuously. No contradiction exists between Hodgman's argument and the statement in the text. It is quite possible that banks prefer not to lend to a poor risk when interest rates rise. It is only argued that if a loan is to be granted, banks will be made better off (or no worse off) by increasing the loan rate of interest. Cf. Donald Hodgman, "Credit Risk and Credit Rationing," *The Quarterly Journal of Economics*, LXXIV (May 1960), pp. 258–278.

interest, no security, and frequently larger amounts and longer maturities. If borrowers are effective bargainers, banks will end up on their offer frontiers.[11] An important aspect of this description of lending is that both bankers and borrowers may alter any of the terms of lending during negotiations.[12]

Despite the restrictive assumptions which have been imposed to develop these notions, evidence of the relationships among terms of lending can be found in the banking literature:

> We find it difficult to do more than generalize on rate. It is of course elementary to say that the rate should vary with the risk and is affected by general and sectional money market conditions. Correspondingly, it is elementary to say that the longer the period the higher the average rate should be.[13]

> The use of security in extending business credit is a common practice among banks in the United States. The main purpose of collateral or other security is to limit the bank's risk of loss and facilitate collection in the event the borrower is unable or unwilling to repay the loan at maturity. While banks generally insist on collateral where circumstances do not justify their making an unsecured loan, they still depend for repayment in large part on the good faith of the borrower. In some cases where the bank would be willing to extend unsecured credit, the borrower may find it advantageous to use security to obtain a larger loan, a longer maturity, or a lower rate of interest.[14]

Analysis of Borrower Characteristics

It is assumed here that a loan applicant requests a loan with terms $\bar{t} \in T$ from a bank summarized by $\bar{u} \in U$. It is again convenient to introduce the topic by first considering a derivative of the production function.

Isoquants of production functions show what minimum combinations of inputs to a production process are necessary to obtain a particular set of outputs. Borrower isoquants of a loan offer function show what minimum combinations of characteristics (if any) of a borrower, $v \in V$, are necessary in order that the bank be willing to lend at terms $\bar{t}$.

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[11] It is assumed that a bank's loan offer function is invariant with respect to the course of negotiations.

[12] Henry Wallich observes that banks may adjust the terms of lending for certain classes of borrowers: "Moreover, the premium which the less-than-gilt-edged borrower must pay may take forms other than interest, such as an inconveniently short maturity, or surrender of a share of control." "The Changing Significance of the Interest Rate," *The American Economic Review*, LVI (December 1946), p. 766.

[13] "Report of the Committee on Longer Term Loans," *Bulletin of the Robert Morris Associates*, Supplement, November 1937, p. 5.

[14] Caroline H. Cagle, "Security Pledged on Business Loans at Member Banks," *Federal Reserve Bulletin*, XLV (September 1959), pp. 1115.

It is elementary to observe that banks desire information about prospective borrowers in order to reduce the likelihood of making loans which will not be repaid.[15] But what information should banks collect?

Clearly the kind of information should not be independent of the terms of the loan request. Very small loans or very short maturity loans do not generate sufficient revenue to offset expensive data collection and analysis. Long term loans require emphasis on future earnings rather than the current position of the firm.[16] Security may well obviate the necessity for a detailed credit investigation.

Nevertheless, it is possible to list information to which bankers frequently refer when judging loan applications. If applications for loans with different terms are received, the signs of the relationships between the various terms of lending and the following variables remain unchanged; only the weights placed on the variables may be altered. Important information about loan applicants includes the present and past size of his current assets, liquid assets, working capital, current ratio, inventories, total assets, outstanding debt, net worth, profits, sales, and deposit balances; the age of his inventories, plant, and equipment; the stability of demand for his products; and certain qualitative information, the purpose of the loan, the business of the borrower, the integrity and competence of management, the labor relations of the borrower, etc.[17]

Some indication of the significance of each piece of information can be inferred from standard works on statement analysis by Wall, Foulke, and Guthmann.[18] Although comprehensive systems of statement analysis have been developed, none is infallible. Different credit men do not place the same emphasis on each of the above or other pieces of information.

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[15] Roland I. Robinson has emphasized the importance of avoiding default risks: "The arithmetic of lending and loan interest is impressive. The average rate of return on member bank loans in 1948 was 3.8 per cent. About two-thirds of this amount was absorbed in expenses leaving only slightly more than 1 per cent for losses on loans and profits for stock-holders. An average loss ratio of 1/2 of 1 per cent would have meant that the profit rate was halved; it disappeared if average losses went to 1 per cent of outstanding loans." Robinson, *op. cit.*, p. 102.

[16] ". . . obviously, in general, short term credit is repaid from seasonal movements, while term loans depend upon realization of projected earnings in the majority of cases . . . ." "Term Loans," *Bulletin of the Robert Morris Associates*, Supplement, July 1957, p. 11.

[17] Robinson, *op. cit.*, Ch. 8, and Benjamin H. Beckhart, ed., *Business Loans of American Commercial Banks* (New York: The Ronald Press Company, 1959), Ch. 4.

[18] Alexander Wall, *How to Evaluate Financial Statements*, 1st ed. (New York: Harper and Brothers Publishers, 1936); Roy A. Foulke, *Practical Financial Statement Analysis*, 1st ed. (New York: McGraw-Hill Book Company Inc., 1945); and Harry G. Guthmann, *The Analysis of Financial Statements*, rev. ed. (New York: Prentice-Hall, Inc., 1936).

The remainder of this part considers certain of the above variables which can easily be subjected to quantitative examination.

The expected after-tax profits of a loan applicant is a critical variable to banks for three reasons. First, a future stream of profits yields a cash flow which may be used to repay loans or meet future unforeseen emergencies. Second, the firm may grow as a result of the profitability of the business which implies that the bank may be able to obtain larger deposit balances and profitable loans in the future. Finally, banks may believe that profits are evidence of the competence of an applicant's management.

The current ratio, working capital, current assets, and liquid assets are all measures of a firm's ability to withstand immediate temporary adverse business fluctuations.[19] Different analysts place different emphasis on each of the measures. These variables are particularly important for loans of short maturity. Trends in these variables may reveal developing credit weaknesses.

Uncontrolled inventories are evidence of impending bankruptcy.[20] If an applicant's inventories are rapidly growing or are particularly high, banks are cautious when extending credit. The ratio of inventories to sales for a firm relative to its industry is a measure of whether inventories are controlled. Over time the firm's ratio may reveal a highly cyclical character of its demand. Fluctuations in demand may prevent a borrower from repaying his loan on schedule.

Net worth is a measure of the solvency of a firm. Obviously default risks rise as loan applicants become less solvent. High ratios of debt to net worth may portend a decline in the firm's solvency at some future date.[21]

Finally, a bank is less willing to reject loan applications from firms carrying large deposit balances with it. From interviews with bankers, I inferred that they believe good present balances imply good future balances. In effect, firms carrying large idle balances with commercial banks pay higher interest rates on a loan with terms $\bar{t}$. However, the privilege of borrowing more frequently and perhaps larger sums may compensate these firms for the effective rate differential.[22]

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[19] Robinson, *op. cit.*, pp. 138–140.

[20] *Ibid.*, pp. 140–142.

[21] Interpretation of the level of net worth as a measure of default risk is a bit treacherous. Net worth must be compared with the magnitude of misfortunes which a firm might have to face in order to be a realistic measure of default risk. The crude generalization in the text implicitly assumes that all firms may be expected to experience more or less similar unforeseen losses.

[22] An excellent discussion of the role of deposit balances of borrowers may be found in a recent article by George Garvy. One implication of Garvy's argument is that banks desire balances in order to reduce their deposit instability, a factor which will be considered later. George Garvy, "Structural Aspects of Money Velocity," *The Quarterly Journal of Economics*, LXXIII (August 1959), pp. 443–446.

Also, firms with large total assets frequently have many banking connections.[23] Individual banks may find their bargaining position slightly weakened by this greater competition, and consequently accept loans from larger firms, even though other features of their balance sheets are not as sound.

It was observed before that banks try to make loans of moderate amounts, of short maturity, with high rates, and with collateral. Loan applicants also attempt to extract terms favorable to themselves. If the loan market is relatively competitive, banks and borrowers move each other to efficient frontiers. It was implied that the position of the bank's offer frontier is a function of characteristics of an applicant, summarized by $\bar{v}$, and characteristics of the bank, summarized by $\bar{u}$. If the frontier is not *completely* determined by $\bar{u}$, then some minimum credit standards exist for some point on the frontier.

The standards may be interpreted to be some minimum restrictions on some or all of the above variables. But obviously two borrowers need not possess identical balance sheets, income statements, etc., in order to be regarded as similar credit risks. Some trade-off among the above variables exists in the minds of credit analysts (banks). This trade-off is considered empirically in the subsequent sections.

Analysis of Bank Characteristics

Characteristics of banks also influence their willingness to grant loans. A bank isoquant of a loan offer function shows the minimum combination of characteristics which a bank must have before it is willing to make loans with terms $\bar{t}$ to borrowers with characteristics $\bar{v}$. It is a completely analogous concept to the borrower isoquant considered before.

The following characteristics of banks and their environment are believed to influence their willingness to lend: a bank's deposit level and stability, equity, and growth in deposits; the proportion of a bank's portfolio in loans and the distribution of its loans among industries; the maturity structure of its security holdings; the aggressiveness and specialization of a bank's lending officers; the interest rates on competing assets; the legal restrictions on its actions; the demand for a bank's loans; and the structure of its competition.

Banks are less willing to lend when their deposits are unstable. This behavior derives from banks' aversion to discounting, criticism by bank examiners, and emergency reserve adjustments. The probability that a given excess reserve position will be insufficient to meet weekly fluctuations is an increasing function of deposit instability. Consequently, banks

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[23] Cf. Katona, *op. cit.*

suffering from very unstable deposits prefer a more liquid portfolio. Further, the average maturity of loans of these banks tends to be shorter.[24]

In the Appendix it is demonstrated with relatively weak assumptions that the ratio of variance of deposits to the level of deposits is an increasing function of bank size. Thus large banks are expected to be less willing to lend than small banks, if banks are averse to a high deposit variance.[25] Bank aversion to high deposit variance implies that this variable is an argument in a bank's utility function. It is assumed that a bank's expected utility is a function of the rate of return on its assets, the standard deviation of rates of return, and the variance of its deposits. A second conclusion from the Appendix is that growing or declining banks experience a smaller deposit variance than banks whose deposits are unchanging.

Because time deposits are more stable in the short run than demand deposits, banks which have larger proportions of time deposits are expected to have larger proportions of loans in their portfolios.

Bank examiners and regulations frequently specify that a bank must maintain a certain proportion of its portfolio in liquid assets. Also, a bank often is not permitted to lend sums in excess of 10% of its equity to any one borrower.[26]

Considerations of portfolio balance also influence the willingness of a bank to lend. It is not wise for banks to have 100% of their portfolios in loans nor would they be prudent to put all their loans in one industry. Diversification reduces default risks.[27] But the aggressiveness and specialization of a bank's lending officers modify the concept of portfolio balance. Unfortunately, none of these factors can be quantified.

If a bank is a monopoly, then it may be able to discriminate among loan applicants. In this case the loan offer function is not independent of

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[24] In response to the question, "If you feel it is proper to make term loans, are any limitations suggested in your mind as to the desirable percentage of this type of loan as compared with the aggregate of all commercial loans within the bank?," one lending officer responded: "There is no rule of thumb as to what the desirable percentage should be. Obviously for a bank with no time deposits and very volatile or seasonal demand deposits, the percentage should approach zero." "Term Loans," *Bulletin of the Robert Morris Associates*, Supplement, July 1957, p. 7.

[25] The argument is not relevant for very large banks who have access to the federal funds market. However, for other banks the analysis suggests that larger banks will have a smaller and more conservative loan component in their portfolios.

[26] Indeed, as the following quotation suggests, banks may prefer not to lend even this maximum amount: "A bank should not take term loans from any customer in an amount so great that its legal lending limit or its appraisal of the borrower's credit worthiness will make it unable or unwilling to handle its proper share of the customer's short term credit needs." George S. Moore, "Term Loans and Interim Financing," Beckhart, ed., *op. cit.*, p. 253.

[27] Cf. Markowitz, *op. cit.*, Chs. 2, 4.

the demand for loans. Because an analysis of the demand for loans is beyond the scope of this chapter, the present theory is relevant only for banks which have close competitors.

Banks are less willing to lend at terms *t* when interest rates on competing assets rise. One reason is simply that banks as profit maximizing institutions prefer to substitute higher yielding bonds for loans with unchanged yields. Other reasons have been suggested by writers concerned with the "availability" of credit.

Wallich[28] and Musgrave[29] have suggested that when bond interest rates rise, banks' expectations about the ability of borrowers to repay loans are altered: "First there is the familiar point that central bank action directed at a rate increase tends to be an indication that the boom has run its course."[30]

Roosa[31] and Scott[32] have suggested that changes in bond interest rates increase uncertainty in the minds of bankers about yields on assets. Because banks dislike uncertainty, they are less willing to lend in periods of changing rates.[33]

Roosa[34] and Musgrave[35] believe that banks prefer not to sell bonds which are selling below their acquisition price. This aversion[36] to recording capital losses means that banks attempt to rebuild their secondary reserves, if bonds become "frozen in." Consequently, banks' willingness to lend is reduced.

Finally, Samuelson[37] and Kareken[38] have observed that increases in bond interest rates temporarily reduce the market value of a bank's holdings of bonds. If banks had previously held a desired volume of secondary

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[28] Wallich, *op. cit.*, p. 765.

[29] Richard A. Musgrave, "Credit Controls, Interest Rates, and Management of the Public Debt," *Income, Employment, and Public Policy: Essays in Honor of Alvin H. Hansen* (New York: W. W. Norton and Company, 1948), pp. 221–254.

[30] *Ibid.*, pp. 227–228.

[31] R. V. Roosa, "Interest Rates and the Central Bank," *Money, Trade, and Economic Growth: In Honor of John Henry Williams* (New York: Macmillan, 1951), pp. 270–295.

[32] Ira O. Scott, Jr., "The Availability Doctrine: Theoretical Underpinnings," *The Review of Economic Studies*, XXV (October 1957), pp. 41–48.

[33] "But the potency of such changes comes from the impact of 'uncertainty' upon markets dominated by sensitive investors." Roosa, *op. cit.*, p. 284.

[34] Roosa, *op. cit.*, p. 290.

[35] Musgrave, *op. cit.*, p. 228.

[36] Cf. "Bank Reactions to Security Losses," *Monthly Review* of the Federal Reserve Bank of Kansas City, June 1960, pp. 9–16.

[37] Paul A. Samuelson, "Statement," U.S. Congress, Joint Committee on the Economic Report, *Monetary Policy and the Management of the Public Debt*, 82nd Congress, 2nd Session, 1952, Patman Hearings, pp. 691–698.

[38] J. Kareken, "Lenders' Preferences, Credit Rationing, and the Effectiveness of Monetary Policy," *The Review of Economics and Statistics*, XXXIX (August 1957), pp. 292–302.

reserves (perhaps relative to their deposit variance), they may attempt to increase their security holdings when rate increases occur. This action reduces their willingness to lend.

Banks with different characteristics lend to borrowers summarized by $\bar{v}$ on terms $\bar{t}$. Bank isoquants are considered empirically later.

Some Final Points

The endogenous and exogenous variables of the loan offer function have been introduced. It has been observed that banks substitute among endogenous variables and among each of the two classes of exogenous variables. Banks also substitute between these three groups of variables. For example, a bank is willing to alter one term of lending, say the amount of the loan, if a loan applicant can improve one of his balance sheet variables, perhaps his current ratio. Figure 1 suggests that banks grant larger loans to borrowers with higher current ratios, if all other relevant variables are held constant. This curve is a complete analogue of the transformation curve in the theory of production.

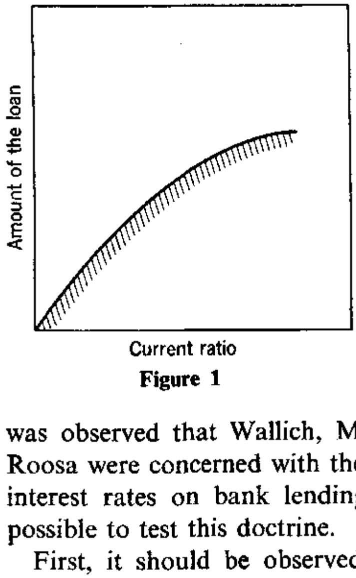

Figure 1

Similarly, substitution between sets U and V is easily imagined.

It is desirable to digress at this point and interpret the availability of credit doctrine with the loan offer function. It was observed that Wallich, Musgrave, Scott, Samuelson, Kareken, and Roosa were concerned with the impact of changes in government security interest rates on bank lending. By interpreting their arguments, it is possible to test this doctrine.

First, it should be observed that, with the exception of Samuelson, whose argument is dynamic, there is some doubt whether these authors are concerned with the rate of change in interest rates or simply the level of interest rates. I am not able to determine from their articles which is the variable that they believe causes changes in bank lending. If they are concerned with the rate of change of interest rates, then a dynamic argument must be made explicit in the loan offer function. Development of this argument is beyond the scope of this chapter. For this reason and because the subsequent empirical work is best directed towards analyzing the impact of different interest rate levels, arguments of these authors are interpreted in terms of the impact on bank lending of different levels of competing asset (bond) interest rates.

For various reasons, the above authors believe that the loan market is not cleared by loan interest rates alone, if interest rates on competing assets rise. Some believe that the supply schedule of loans is inelastic with respect to the loan rate of interest.[39] Others believe that loan interest rates are quite inflexible, and thus, although the interest elasticity of the supply schedule may not be negligible, it is not given a chance to work.[40] Usury ceilings may prevent interest rates from clearing markets. Finally, Professor Wallich has observed:

> At any time there is a more or less conventional range of rates on loans, negotiable and otherwise, which limits the maximum risk premiums that can be arranged for. Banks and investors usually prefer not to become involved in dubious situations, even if they believe their actuarial risk to be adequately compensated for.[41]

If banks associate dubious situations with high loan interest rates, regardless of rates on competing assets, again non-rate terms are clearing the market.

With the exception of the inelastic supply case, the above reasons are exhibited in an extreme form by the solid line in Figure 2. The dotted line shows that the loan rate is indeterminant from the supply side if supply is interest inelastic.

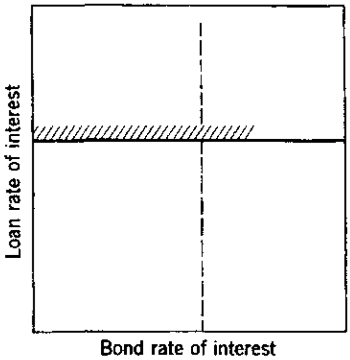

Figure 2

Somehow the loan market must be cleared. Advocates of the availability doctrine have suggested that "credit rationing" takes place. Apparently credit rationing implies (1) that a higher percentage of loan applications are rejected and (2) that of those loans which are granted to borrowers characterized by $\bar{v}$, the amounts are smaller, the maturities are shorter, and the security requirements are greater. The notion of credit rationing can be seen in the following quotations:

> . . . the allocation of funds is guided by the banker's desire to allocate quotas to different uses of funds so as to obtain the right combination of risk and liquidity in his asset portfolio. . . . When a bank's lending capacity is curtailed, the quota available for each group of borrowers will be cut somewhat,

[39] Ira O. Scott, Jr., "The Availability Doctrine," *The Canadian Journal of Economics and Political Science*, XXIII (November 1957), p. 536.
[40] Kareken, *op. cit.*, p. 295.
[41] Wallich, *op. cit.*, p. 768.

but the quota for risk loans will tend to fall more sharply than that for credit to prime borrowers.[42]

> A change in interest rates may make itself felt less by affecting profit calculations, and through them the demand for funds than by affecting the behavior of financial institutions which lend the funds or act as intermediaries between the borrowers and the ultimate lenders. ... As far as commercial banks are concerned a substantial drop in the official discount rate (accompanied by an increase in the liquidity of banks and a fall in the rates which they charge customers) may induce them to "comb the market" more thoroughly than before.... Thus they may be more ready than before to lend to entrepreneurs who wish temporarily to finance the installation of new equipment by short-term credits with the intention of funding the credits later through security issues, or of repaying them out of working profits.... They may lower their requirements with respect to the "current ratio" which is so frequently used as an index of the credit-worthiness of customers, and resort to other devices for creating an outlet for their funds.... The reverse applies more forcefully ... commercial banks will not only tighten the conditions under which they themselves grant credit to business, but they will also often resort to credit rationing.[43]

Figure 3 attempts to represent credit rationing graphically. Let there be a borrower characterized by $\bar{v}$ who applies to banks which are identical, except that some have opportunities to invest in higher yielding securities (which are assumed to be riskless). Assume that all terms of lending but the rate of interest and the loan maturity are settled. There are two cases: (1) loan interest rates are flexible and the supply is elastic and (2) loan interest rates are inflexible and/or the supply is inelastic. In case 1,

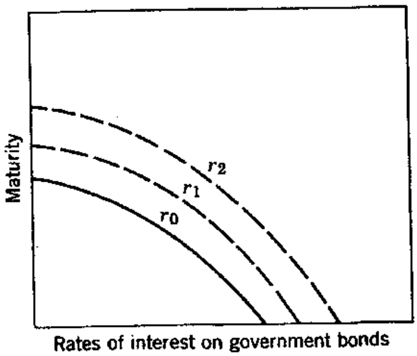

Figure 3

[42] Musgrave, *op. cit.*, p. 230.

[43] F. A. Lutz, "The Interest Rate and Investment in a Dynamic Economy," *The American Economic Review*, XXXV (December 1945), pp. 828–829.

nothing can be said about the ability of the borrower to get long term credits from the banks which can invest in higher yielding bonds. This is because, at a sufficiently high level of loan interest rates, applicants will be able to compensate these banks for the inconvenience of long term loans. The curve in Figure 3 will shift out to the dotted lines when loan interest rates rise.

In case 2, however, changes in loan interest rates can be ignored. The solid curve in Figure 3 then implies that, when competing rates are high, loan applicants are unable to get certain long maturity loans.[44] Formulating lending behavior in terms of a loan offer function permits an empirical test of whether terms of lending do exhibit this hypothesized response to high rates of interest on government securities.

The form of the loan offer function must be made explicit if the theory is to be subjected to empirical test, so we return to the main argument.

Let: R = the loan rate of interest (in per cent).

M = the maturity of the loan (in months).

A = the amount of the loan (in dollars).

S = 1 if the loan is secured, 0 otherwise.

W_i = the ith relevant characteristic of loan applicants, $i = 1, 2, \ldots, I$.

Z_j = the jth relevant characteristic of lending banks, $j = 1, 2, \ldots, J$.

If no other terms of lending are relevant to a bank, equation 1 may be written as:

$$F(R, M, A, S) = G(W_1, W_2, \ldots, W_I;\ Z_1, Z_2, \ldots, Z_J). \qquad (2)$$

Can F and G be expressed simply? It is not likely that they are linear in the variables. In the case of G, a firm could achieve an infinite current ratio by paying off its current liabilities, but banks do not lend large sums of money for extended periods simply because of this transaction. Similarly, firms with very large net earnings are not able to obtain loans at arbitrarily low rates of interest. The fact that a firm regularly earns one million dollars greatly influences a bank's appraisal of its credit worthiness, but the bank will not be as greatly impressed by the difference between regular earnings of ten and eleven million dollars. Similar arguments can be constructed for F.

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[44] To place Musgrave properly in this interpretation, one must assume that longer maturity loans are more risky.

For these reasons non-linear (polynomial or logarithmic) formulations of F and G are more appealing.[45] If F and G are polynomial, the theory should specify the order of the polynomial and the character of the interactions between the various arguments of the function. Some broad conjectures about the relationships can be made.

Equations expressing each of the four terms of lending as functions of Z's and W's, ignoring other terms of lending, were estimated for a subsample of loans with multiple regression techniques. Various functional forms were attempted. Inspection of the resulting residuals suggested that they were distributed lognormally. Throughout the remainder of this chapter, it is therefore assumed that F and G are logarithmic in their arguments.[46] The theory of the loan offer function does not preclude F and G having logarithmic forms.

In order to determine whether equation 1 or the regressions mentioned in the preceding paragraph (hereafter called partial loan offer functions) are identifiable, it is necessary to consider the demand for terms of lending. By an argument quite analogous to the theory of bank lending, loan applicants are believed to have desires for certain rates of interest, maturities, amounts, security requirements, etc. Each borrower possesses some function, a loan asking function, which characterizes his desires in terms of his needs. The functions differ substantially among applicants. By an argument presented by E. J. Working,[47] identification is possible if the variance of the stochastic terms in the supply function (loan offer function) is substantially smaller than the corresponding variance in the demand function (loan asking function). Identification is easier if different borrowers have different asking functions.

What basis can there be for assuming that the stochastic terms in the asking function (or partial asking functions) are much larger than those in the offer function (or partial offer functions)? First, a borrower desires loans for reasons which are related to seasonal or cyclical fluctuations in his industry. Second, treasurers of different firms are requesting loans and there is no compelling reason for these individuals to behave similarly.

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[45] These non-linear forms are not totally satisfactory in the case of the loan rate of interest. Because of the existence of a prime rate, a *kink* in the offer frontier will occur when borrowers are sufficiently powerful to begin to borrow at prime. Empirically, this problem may be avoided by using probit regression techniques of estimation. If this elaboration is ignored, the misspecification is probably not very serious. Cf. James Tobin, "Estimation of Relationships for Limited Dependent Variables," *Econometrica*, XXVI (January 1958), pp. 24–36.

[46] It is necessary to redefine S if logarithms of that variable are to be taken. If $S = 1$, it was set equal to 10; if $S = 0$, it was set equal to 1.

[47] E. J. Working, "What Do Statistical 'Demand Curves' Show?" *Readings in Price Theory* (Chicago: Richard D. Irwin, Inc., 1952), pp. 97–118.

Finally, many of the factors with which banks are concerned (an applicant's credit position or a bank's deposit instability) are unrelated to a firm's desire for terms of lending.

A given bank, however, forces its lending officers to follow certain common techniques of credit analysis. Greater experience with processing loan applications on the part of these officers results in precision (smaller stochastic variance) in lending. Finally all commercial banks are subjected to more similar external forces than are a sample of borrowers drawn from a wide range of industries. It is therefore possible to ignore demand or the loan asking function.

A loan offer function may be estimated directly by the method of canonical correlation. This technique involves defining two canonical variates:

$$q_1 = (\text{Log } R)' + k_1(\text{Log } M)' + k_2(\text{Log } A)' + k_3(\text{Log } S)' + u.^{48}$$

$$q_2 = \sum_{i=1}^{I} a_i(\text{Log } W_i)' + \sum_{j=1}^{J} a_{I+j}(\text{Log } Z_j)' + v.$$

The stochastic variable u is assumed to be independent of the terms of lending, but not independent of characteristics of the borrower and lending bank. Similarly, v is assumed to be independent of those characteristics, but not independent of the terms of lending.

The computational procedure yields those a's and k's which maximize the correlation between q_1 and q_2 when q_1 and q_2 are normalized to have unit variance.[49] The results of applying this technique to five samples of loans are reported later in this chapter.

Unfortunately, it is not possible to obtain standard errors for the a's and k's. But some basis is necessary for testing which characteristics of banks and applicants are relevant in lending decisions. A test, which is by no means ideal, is whether characteristics of banks and borrowers are significantly related to *each* of the terms of lending. In the following two sections partial loan offer functions are estimated from five samples of loans in order to make this test.

Finally, if there is no substitution between terms of lending, then the partial loan offer functions completely characterize bank lending behavior. The only difference between the partial loan offer function and the loan offer function is that the latter permits substitution among terms of lending.

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[48] Primes (′) on variables indicate that they are defined as deviations from their means.

[49] Harold Hotelling, "Relations Between Two Sets of Variates," *Biometrica*, XXVIII (December 1936), pp. 321–377.

ANALYSIS OF TERM LENDING

This section presents statistical results of an analysis of commercial bank term lending. Data were collected from a small number of large banks on individual term loans granted during the period January 1955 through October 1957.[50] The data include information about terms of lending, the credit position of the loan applicant, and previous relationships between the bank and the applicant.

Properties of Term Loans

> A term loan is a loan transaction which has a final maturity exceeding one year, which may or may not be secured and which usually specifies repayment in monthly, quarterly, semi-annual, or annual payments. Moreover, it is evidenced by a note or notes embodying the terms and conditions of the loan, or is subject to a separate formal agreement between the borrower and the lender.[51]

Term lending became popular among bankers in the United States during the depression when demand for loans was low. Because of the sharp break with traditional "seasonal" financing, an extensive discussion of this method of lending evolved in the contemporary banking literature and has continued to the present day. Bankers have been cautious in granting term loans and have kept detailed statistical records of their experience with them.

Current interest in term lending and superior statistics about past term lending are compelling reasons for studying this class of loans.[52] Term loans have additional desirable properties. They are frequently large, which permits an investigator to ignore costs of lending. Term of individual term loans vary substantially. Borrowers with considerably different credit positions are accorded term loan financing. Large commercial banks grant a sufficiently large number of term loans to permit within-bank analyses.

The quantitative significance of term lending at large banks in New York City may be seen in Table 1.

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[50] I am most indebted to the co-operating banks for their very considerable advice and labor while making these data available. Their over-worked credit departments made substantial contributions to this research effort. Although it is inappropriate to reveal the names of the co-operating institutions, their interest in academic research is a tribute to themselves and the banking industry.

[51] American Bankers Association, *Term Lending by Commercial Banks*, Credit Policy Commission (New York: American Bankers Association, 1957), p. 5.

[52] A. Hayes, "A Breathing Spell for Monetary Policy," *Monthly Review* of The Federal Reserve Bank of New York, XLII (June 1960), pp. 100–104.

Table 1 Business Loans at Large New York City Banks on Selected Dates[a] (in Billions of Dollars)

	10/5/55	10/16/57	10/14/59	10/12/60
All business loans	7.4	10.4	10.0	10.2
Term loans	3.5	5.2	5.7	5.6

[a] *Monthly Review* of The Federal Reserve Bank of New York, XLIII (February 1961), p. 31.

Differences in term lending behavior among large commercial banks may be attributable to differences in bank preferences for term loans, differences in their portfolio positions at the time of lending, differences in bank deposit structure, etc. The relevance of results in this section to other banks depends upon the sensitivity of the estimated parameters to these omitted variables. Because the banks which are considered were not drawn in a random fashion, generalization of what follows to the population of banks is hazardous.

Hypotheses

Costs of data collection limited the volume of information about a borrower which could be obtained. In particular, no information was obtained about a borrower's net worth, inventories, liquid assets, or debt. Among the variables which were recorded are the following:

P_m = average losses of the applicant over the 3 to 5 years immediately preceding the loan (5 if available) if the applicant experienced net losses over that period, $P_m = 1$ otherwise (in dollars per year).

P_p = average net profits of the applicant over the 3 to 5 years immediately preceding the loan (5 if available) if the applicant experienced net profits over that period, $P_p = 1$ otherwise (in dollars per year).

C = current ratio (ratio of current assets to current liabilities) of the applicant at the close of the applicant's fiscal year immediately preceding the loan.

E = average demand deposit balances of the applicant at the lending bank during the year before the loan, $E = 1$ if no balances existed (in dollars).

Y = number of years which the applicant had continuously maintained a demand deposit relationship with the bank at the time of the loan, $Y = 1$ if there was no continuous relationship (in years).

$\bar{R}$ = prime rate of interest at the time of the loan (in per cent).

W_m = negative of the average working capital of the applicant over the 3 to 5 years immediately preceding the loan (5 if available) if the applicant reported negative average working capital over that period, $W_m = 1$ otherwise (in dollars).

W_p = average working capital of the applicant over the 3 to 5 years immediately preceding the loan (5 if available) if the applicant reported positive average working capital over that period, $W_p = 1$ otherwise (in dollars).

$\left(\frac{dP}{dt}\right)_m$ = negative of the average annual change in the applicant's profits over the past 3 to 5 years (5 if available) if the change was negative, $(dP/dt)_m = 1$ otherwise (in dollars per year per year).

$\left(\frac{dP}{dt}\right)_p$ = average annual change in the applicant's profits over the past 3 to 5 years (5 if available) if change was positive, $(dP/dt)_p = 1$ otherwise (in dollars per year per year).

$\left(\frac{dW}{dt}\right)_m$ = negative of the average annual change in the applicant's working capital over the past 3 to 5 years (5 if available) if change was negative, $(dW/dt)_m = 1$ otherwise (in dollars per year).

$\left(\frac{dW}{dt}\right)_p$ = average annual change in the applicant's working capital over the past 3 to 5 years (5 if available) if change was positive, $(dW/dt)_p = 1$ otherwise (in dollars per year).

H = total assets of the applicant at the close of the fiscal year immediately preceding the loan (in dollars).

V_p = variance of the applicant's annual profits over the 5 years immediately preceding the loan (in dollars squared per year squared).

A_0 = the amount of loans obtained from other banks (their participation) in the term loan transaction, if more than one bank is involved. The variable is not defined for loans involving only one bank (in dollars).

E_a = amount of deposit balances carried by some affiliates of the applicant with the lending bank (in dollars).

It is necessary to define two variables to represent mean profits, mean working capital, and trends in profits and working capital because of the decision to use logarithms reported previously. Similarly, null values of balances, years of relationship, etc., must be redefined. This is because logarithms of non-positive numbers are undefined.[53]

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[53] The procedure is definitely not ideal. There is no reason to believe that bankers regard zero as a particularly significant number. It may be that loans to firms with

The following hypotheses may be inferred from the previous discussion. Subsequently the hypotheses are defended in terms of the rate of interest. It is hypothesized that each of the following cause the rate of interest on the loan to increase, and/or the maturity of the loan to decrease, and/or the amount of the loan to decrease, and/or likelihood of security to increase.[54]

1. *Ceteris paribus*, an increase in an applicant's average losses P_m or a decrease in his average profits P_p.
2. *Ceteris paribus*, a decrease in an applicant's current ratio C.
3. *Ceteris paribus*, a decrease in an applicant's average deposit balance E.
4. *Ceteris paribus*, a decrease in the length of time Y over which the applicant has continuously maintained deposits with the bank.
5. *Ceteris paribus*, an increase in the prime rate $\bar{R}$.
6. *Ceteris paribus*, an increase in an applicant's average negative working capital W_m or a decrease in his average positive working capital W_p.
7. *Ceteris paribus*, an increase in an applicant's average annual decline in profits $(dP/dt)_m$ or a decrease in his average annual growth in profits $(dP/dt)_p$.
8. *Ceteris paribus*, an increase in an applicant's average annual decline in working capital $(dW/dt)_m$ or a decrease in his average annual growth in working capital $(dW/dt)_p$.
9. *Ceteris paribus*, a decrease in an applicant's total assets H.
10. *Ceteris paribus*, an increase in the ratio of losses to assets P_m/H or a decrease in the ratio of profits to assets P_p/H.
11. *Ceteris paribus*, an increase in an applicant's borrowings from other banks (participations) A_0.
12. *Ceteris paribus*, an increase in the variance of an applicant's profits V_p.
13. *Ceteris paribus*, a decrease in balances of affiliates of the applicant E_a.

[54] Because S is a dummy variable, statements involving S require some interpretation. If regression equations predict a value of S close to unity, it is believed that banks are more likely to insist upon security. Interpretations of the variance of residuals of regressions involving S are also ambiguous. Throughout this chapter it is assumed that regressions involving S can be analyzed as if S is a continuous variable.

profits less than ten thousand dollars have a different profit elasticity than loans to firms with profits above ten thousand dollars. Then logs should be taken of profits minus ten thousand. Although this problem is generally intractable, C. I. Bliss verbally suggested an iterative scheme for those cases where "log zero values" are below the minimum profit figure contained in the sample. His method was developed for estimating α and β in the following equation: $\log y = \alpha \log (x - \beta) + u$. Unfortunately, the multivariate extension of this technique did not converge and it became necessary to adopt the above convention.

Hypothesis 1 states that if there are two firms, identical in every essential respect except that one earned larger after tax profits in recent years, applying to a bank for a loan, then the firm with larger profits will be charged a lower rate of interest. The rationale for hypothesis 1 was previously presented. Average profit figures of the applicant were employed rather than profits in the most recent year in order to avoid undue noise in the equations and because the credit literature[55] advocates the use of average profit figures.[56]

Hypothesis 2 states that if two firms, identical in every essential respect except that the current ratio differs between the firms, apply to a bank for a loan, then the firm with the larger current ratio will be charged a lower rate of interest. The current ratio is particularly significant because current liabilities may be viewed as a measure of expected short term future outpayments which a firm will have to make. The ratio of current assets to current liabilities is therefore a measure of the extent to which these outpayments can be covered without recourse to outside borrowings.

The current ratio and other variables to be considered in this section should be adjusted for the character of an applicant's business. Thus firms with a large current ratio may be more prone to bankruptcy than firms with a smaller current ratio, simply because the current liabilities of the former are more volatile. Some adjustment for interindustry differences is made by banks which use techniques advocated by the Robert Morris Associates.[57] These techniques involve comparing a firm's current ratio with the average current ratio of similar firms in the same industry. No attempt was made to utilize such techniques here because industrial classifications are ambiguous and the typical term loan borrower had few comparable firms within his "industry."

A second inadequacy of the current ratio (and also working capital) is that current assets include inventories. If a firm's inventories are large, his current ratio may be large, but he may be close to bankruptcy. If the hypothesis is to have the indicated sign, it is necessary to assume that inventories are controlled. A more detailed analysis would include inventories as a separate variable.

Hypothesis 3 states that if two firms, possessing identical income statements and balance sheets and differing only in that one firm maintains a larger demand deposit balance with the lending bank than the other, apply to a bank for a loan, then the bank will charge a lower rate to the

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[55] American Bankers Association, *op. cit.*, pp. 9–10.

[56] The fact that continuous profit figures were reported for only three years in some cases may bias the estimated profit elasticities. The bias is believed to be negligible.

[57] Cf. Robert Morris Associates, *1958 Statement Studies* (Philadelphia: Robert Morris Associates, 1959).

holder of the larger balance. One reason for this behavior is that firms carrying larger deposit balances are expected to do so in the future and thus in order to charge both applicants the same *effective* rate a bank must act in accordance with the hypothesis. A more interesting argument is associated with the fact that applicants who keep idle balances with a bank perform a favor for the bank by reducing its deposit instability. Banks may prefer to charge such firms a slightly lower rate rather than risk the loss of their accounts.

Measurement difficulties obscure the significance of *E*, the applicant's average balance during the previous year. Information about activity of balances could not be obtained. If a great number of checks were drawn on the account, bookkeeping expenses and excessive deposit instability may negate the desirability of a large balance. This qualification is not likely to be too serious because bankers impose service charges after a certain level of activity.

A second problem arises because it was not possible to obtain statistics about an applicant's current or previous short term borrowings. The argument for hypothesis 3 is concerned with an applicant's deposit balance net of other borrowings. Use of *E* therefore unavoidably involves a misspecification of the loan offer function. Despite these objections, it is important to note that banks keep records of gross deposit balances rather than net deposit balances and from comments by bankers I infer that *E* is a reasonable proxy for net balances.

A final problem relates to the complexity of organization of contemporary borrowers. A corporation may have five or six affiliated concerns, each of which carry deposit balances with the bank. Hypothesis 13 represents a crude attempt to take this factor into account. In the case of certain loans, the banks voluntarily reported "conspicuous" affiliated balances which were factors in the bank's decision to lend. Needless to say, reporting of such affiliated balances represented an arbitrary judgment. It is quite difficult to associate balances of a huge complex with any particular firm. Empirical examination of affiliated balances is at best hazardous.

Hypothesis 4 states that if two firms, possessing identical income statements, balance sheets, and being similar in every other essential respect except that one had maintained a deposit account with the bank for a longer period, apply to a bank for a loan, then the bank will charge a lower rate of interest to the applicant with the longer account relationship. The reasoning is that banks have more knowledge of old customers and their businesses. Greater knowledge reduces uncertainty associated with a loan. Banks ordinarily compensate for uncertainty by charging higher interest rates.

It is of course true that merely carrying a deposit with a bank for an extended period need not increase a bank's knowledge of an applicant. Previous loans to the applicant, however, would have conveyed information to the bank. It is assumed that old depositors are more likely to have borrowed in the past.[58]

Hypothesis 5 states that if two identical firms apply to a bank for a loan at two different points in time at which the bank is in the same

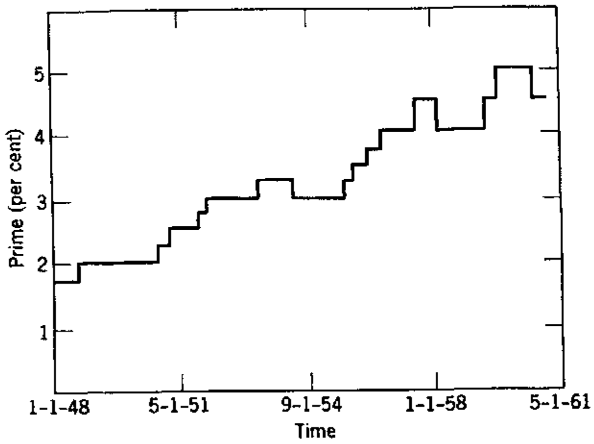

Figure 4 Data necessary to construct Figure 4 were secured from a confidential inter-office memorandum in a large commercial bank. A similar chart appeared in *The Wall Street Journal*, August 29, 1960.

position except that the prime rate of interest has risen, then the bank will charge a higher rate when prime is higher. This is because banks regard prime as a floor for loan interest rates and tend to set rates at prime plus some differential for more risky borrowers. Because prime is essentially a convention among large banks, the hypothesis does not apply to smaller banks.

The reader may object that movements in the prime rate have little relevance to the amount or maturity of a loan. Large banks move prime relatively frequently as can be seen in Figure 4. In interviews, however, lending officers in commercial banks concede that interest rates above

[58] An alternative hypothesis implies an opposite relationship between the years of deposit relationship and terms of lending. This would follow if banks compete for new accounts by offering low rates of interest. Old depositors, due either to inertia or unwillingness to change banks because of other bank services, are charged slightly higher rates. *A priori*, this explanation does not seem likely and the conjecture is not tested.

prime are somewhat less flexible. If banks are initially in equilibrium and higher loan rates are less flexible when prime rises, banks may be expected to ration credit[59] with respect to other terms of lending in order to clear the loan market.

A second argument which does not require inflexibility of certain rates is that banks prefer to substitute less risky loans at higher levels of market interest rates. Empirically, it is not possible to discriminate between these explanations.

Hypothesis 6 states that if two firms, with identical income statements, etc., and with balance sheets which are identical in every essential respect except that one has larger working capital (current assets minus current liabilities), apply to a bank for a loan, then the bank will charge a lower rate of interest to the firm with larger working capital. This hypothesis is quite similar to hypothesis 2 and is an alternative way of formulating the current position of a firm. Net working capital differs from the current ratio in that it does not show the relative magnitudes of current assets and current liabilities.

Hypothesis 7 states that if two firms, identical in every essential respect except that one has been experiencing a larger average annual growth in net profits or a smaller average annual shrinkage in net profits, apply to a bank for a loan, then the bank will charge a lower rate of interest to the firm whose profits have been growing most or declining least. Firms with growing profits are excellent prospects for future balances and loan business. Banks may interpret growth in profits as evidence of superior management. A growing stream of profits, which is expected to continue growing, provides an increasing safety margin against unanticipated setbacks in a firm's business.

The variables $(dP/dt)_m$ and $(dP/dt)_v$ were obtained by regressing each borrower's profits on time.[60] The resulting slopes are the variables.

Hypothesis 8 is perfectly analogous to hypothesis 7 except that it refers to annual changes in working capital rather than annual changes in profits. The variables $(dW/dt)_m$ and $(dW/dt)_v$ were again obtained as slopes of regressions. Growth in working capital may result from growth in inventories, payment of accounts payable, collection of accounts receivable or from growth in cash assets attributable to profit flows, depreciation flows and reductions in investment, dividends, etc. If working capital is improving over time and is expected to continue to grow, again an increasing safety margin against unanticipated setbacks in the firm's business exists.

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[59] This argument is consistent with the availability of credit doctrine.

[60] The equation of the regression is $P = a + bt + \epsilon$.

Hypothesis 9 states that if two firms, identical in every essential respect except that one possesses larger total assets, apply to a bank for a loan, then the bank will charge a lower rate to the firm with larger total assets. The reason for this behavior is that large firms have more banking connections and thus are in a superior bargaining position.[61]

Hypothesis 10 argues that if two firms, identical in every essential respect except that one possesses a higher ratio of average profits to assets or a lower ratio of average losses to assets, apply to a bank for a loan, then the bank will charge a lower rate to the applicant possessing the greater profit rate. This hypothesis differs from hypothesis 1 in that it asserts that banks are concerned with the "efficiency" with which firms utilize their assets rather than with dollar flows. In future research, a more meaningful profit rate might be expressed as the ratio of profits to net worth.

Hypothesis 11 states that if two firms, identical in every essential respect except that one is simultaneously obtaining loans from other banks, apply to a bank for a loan, then the bank will charge a lower rate to the firm which is not simultaneously borrowing from other banks. The reason is that simultaneous borrowings increase the ratio of debt to equity of the applicant thereby increasing the probability of default.

Hypothesis 12 states that if two firms, identical in every essential respect except that one experiences greater variance of profits over time, apply to a bank for a loan, then the bank will charge a lower rate of interest to the firm with the lower profit variance. The reason is that future instability of earnings may imply increased probability of bankruptcy and it may cause a delay in loan repayment (not necessarily associated with bankruptcy). This variable is the residual variance about the regression line from which $(dP/dt)_m$ and $(dP/dt)_p$ were obtained. It was only computed for those observations containing five consecutive annual profit figures. In interviews, bankers reported that variability of profits was an undesirable feature of loan applicants, but were unable to specify what measure of variability they employed. Variance of yearly profits is assumed to be an appropriate measure.

Hypothesis 13 states that if two firms, identical in every essential respect, both having affiliates or subsidiaries which carry balances with a bank, apply to that bank for a loan, then the firm with larger affiliated balances will be charged a lower rate of interest. The reason for this hypothesis was presented while discussing hypothesis 3.

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[61] Total assets is correlated with many other balance sheet variables which have been omitted from this analysis. Assets might be viewed as a proxy for net worth, debt, current assets, etc. Unfortunately, these variables do not affect a bank's willingness to lend in the same way and thus the sign of the relationship becomes ambiguous.

Empirical Results

Partial loan offer functions were estimated from data on term loans for each of three large commercial banks. Term loan information collected from smaller commercial banks was either incomplete or of insufficient quantity to permit analysis. Hypotheses 1 through 10 were tested by examining coefficients of estimated partial loan offer functions. Hypotheses 11 through 13 were tested by examining residuals of the estimated partial offer functions.[62]

Use of partial loan offer functions for tests of the above hypotheses is not without objection. A variable may be insignificant in each of the partial offer functions and yet be significantly related to some linear combinations of terms of lending. It is arbitrarily assumed that, if any hypothesis is significant in more than one of the estimated partial offer functions, the hypothesis is accepted.[63] Tests of coefficients are one tailed tests and a coefficient is judged significantly greater or less than zero if the probability of the event occurring when the null hypothesis is true is less than 0.025.

Table 2 reports regressions of the loan rate of interest on profit and profit rate variables, the current ratio, applicant's balances, years as a depositor, and the prime rate for each of the three banks. Tables 3 through 5 contain the corresponding regressions of maturity, amount, and the security dummy variable.

All regressions in these tables are significant at the 0.05 level. The number of observations ranges from 60 to 130.[64]

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[62] A_0, E_a, and V_p were reported for a smaller number of loans than were the other variables. It was assumed that coefficients associated with these other variables in each of the four partial offer functions were independent of the reporting and magnitude of A_0, E_a, and V_p. The assumption permits estimation of these other coefficients with all observations.

[63] A decision rule is necessary because the banks were not selected randomly. With twelve partial offer functions, the probability of a random variable being significant at the 0.025 level at least once is approximately 0.26. The probability of a random variable being significant in two or more regressions is approximately 0.035.

The reader might question why a simple pooling of "t" ratios would not be a more elegant test than the procedure reported in the text. The difficulty with pooling is that a variable may only (1) be strongly related to one term of lending or (2) be significant in the case of one bank. It is quite possible that such variables would not prove significant when pooled. It is my view that these two cases should not be ignored. The alternative is to consider each of the three banks separately, a procedure which would unduly extend this chapter.

[64] The reader is cautioned that the sample of loans used to determine the functional form is included in regressions of bank 1. Approximately fifty per cent of the observations from bank 1 were used to determine the appropriate functional form. A purist would insist that these observations not be included in subsequent tests. In fact, regressions estimated from the fifty per cent which were previously used and from the other half of the sample were not very different.

Table 2 Regressions of Logarithm of Loan Rate of Interest[a]

	Bank 1	Bank 2	Bank 3
R^2	0.768	0.801	0.740
Constant	0.29799	0.22819	0.50641
	(0.03879)	(0.07617)	(0.05441)
$\text{Log } P_m$	−0.021376	0.0077583	−0.048994
	(0.010546)	(0.0126343)	(0.02144)
$\text{Log } P_p$	−0.028141[b]	−0.026016[b]	−0.051199[b]
	(0.003764)	(0.007273)	(0.005624)
$\text{Log } (P_m/H)$	0.013766	0.17353[b]	0.044202
	(0.035608)	(0.06243)	(0.039758)
$\text{Log } (P_p/H)$	−0.0040334	0.0000387	0.019266
	(0.0120053)	(0.0192769)	(0.012640)
$\text{Log } C$	−0.0035993	0.0050930	0.027917
	(0.0094913)	(0.0152388)	(0.011215)
$\text{Log } E$	−0.0022438	−0.0012317	0.0057964
	(0.0022897)	(0.0035640)	(0.0038054)
$\text{Log } Y$	0.0013883	0.011829	−0.041044[b]
	(0.0081666)	(0.012885)	(0.013261)
$\text{Log } \bar{R}$	0.88445[b]	0.94109[b]	0.82513[b]
	(0.04975)	(0.07117)	(0.07837)

[a] Numbers in parentheses are the standard errors of the coefficients in this and subsequent tables.
[b] Indicates significance at 0.025 level.

Hypothesis 1 is accepted because the profit variable P_p is significant in eight of twelve regressions and the loss variable P_m is significant in one. Unfortunately, had the hypothesis about the loss variable been of the opposite sign, that variable would have been significant in five of the regressions. In other words, the results suggest that firms which experience large losses or profits are lent money on easier terms than firms with small net profits. The loss paradox apparently derives from misspecification.

One explanation is that profits is highly correlated with scale variables, total assets, and net worth. Doubt is cast on this explanation by the credit literature[65] on term loans which emphasizes earnings rather than net worth. When total assets is added to the above regressions, the fit is not improved. Nevertheless, the P_m coefficients might change sign if the right scale variable were employed.

[65] American Bankers Association, *loc. cit.*

Table 3 Regressions of Logarithm of Loan Maturity

	Bank 1	Bank 2	Bank 3
R^2	0.300	0.507	0.252
Constant	2.7423	2.4538	1.9245
	(0.2805)	(0.4948)	(0.3262)
Log P_m	0.022349	0.077759	0.089841
	(0.076251)	(0.082036)	(0.128551)
Log P_p	−0.01642	0.097984[a]	0.061644
	(0.2722)	(0.047225)	(0.033717)
Log (P_m/H)	0.087133	−0.39020	0.033918
	(0.257463)	(0.40538)	(0.238343)
Log (P_p/H)	0.13893	−0.0091561	−0.069556
	(0.08780)	(0.1251702)	(0.075777)
Log C	0.25379[a]	0.23589[a]	0.21279[a]
	(0.06863)	(0.09895)	(0.06724)
Log E	0.0099599	−0.027579	−0.014139
	(0.0165557)	(0.023142)	(0.022814)
Log Y	−0.001404	0.10170	0.019700
	(0.0590489)	(0.08367)	(0.079500)
Log $\bar{R}$	−1.6371[a]	−2.4696[a]	−1.1492[a]
	(0.3597)	(0.46213)	(0.4698)

[a] Indicates significance at 0.025 level.

A second explanation which seems more plausible derives from the observation that firms which lose substantial sums of money for periods of three to five years are exceptional firms. They are even more exceptional when commercial banks will lend them money for a period of years. Their exceptional characteristics may include development of new products, particularly capable management, etc. Had these characteristics been included in the regressions, perhaps P_m would have coefficients of a different sign.

Concentrating on the P_p coefficients, the estimated profit elasticity of the loan rate of interest varies between 0.026 and 0.051 and differs significantly between the banks. Thus a tenfold increase in a firm's profits will permit it to borrow term money at a rate of interest which is lower by approximately one fourth to one half of a point.

In the case of bank 2, increases in a firm's profits induce that bank to lend at longer maturities. A similar statement does not characterize the other banks.

All three banks grant larger loans when an applicant's profits rise. Profit elasticities with respect to amount vary from 0.30 to 0.44 and the coefficients differ significantly between the banks.

Table 4 Regressions of Logarithm of Amount of Loan

	Bank 1	Bank 2	Bank 3
R^2	0.436	0.536	0.479
Constant	3.8782	3.4590	2.7861
	(0.3947)	(0.6300)	(0.6623)
Log P_m	0.34318	0.44928	0.62381
	(0.10730)	(0.10451)	(0.26101)
Log P_p	0.30118[a]	0.34179[a]	0.44388[a]
	(0.03830)	(0.06016)	(0.06846)
Log (P_m/H)	−0.23291	0.31845	−0.060286
	(0.36231)	(0.51641)	(0.483947)
Log (P_p/H)	−0.22484	−0.0209343	−0.29203
	(0.12216)	(0.159452)	(0.15386)
Log C	−0.11031	−0.074821	−0.17331
	(0.09658)	(0.1260521)	(0.13652)
Log E	0.071128[a]	0.064824[a]	0.052576
	(0.023298)	(0.029481)	(0.046322)
Log Y	−0.082879	0.0024384	−0.059843
	(0.083096)	(0.1065818)	(0.161421)
Log $\bar{R}$	−0.24783	0.40405	−0.22943
	(0.50619)	(0.58871)	(0.95400)

[a] Indicates significance at 0.025 level.

In the case of bank 1, increases in a firm's profits and decreases in a firm's losses are associated with increased likelihood of security. Similar statements do not apply to the other banks.

Hypothesis 2 is accepted because coefficients of C are significant in each bank's maturity regression. Banks lend further into the future as an applicant's current ratio improves. The current ratio elasticity of maturity varies from 0.21 to 0.25, a difference well within the standard errors of each of the estimates. The coefficient of C has the wrong sign in the rate regression of bank 3. There is no obvious reason for this and it is assumed to be spurious.

Hypothesis 3 is accepted because coefficients of E are significant in the amount regressions for banks 1 and 2. Firms holding larger balances at these banks tend to be granted larger loans. Balance elasticities in both cases are approximately 0.07.

Hypothesis 4 is accepted although significant coefficients of Y appear only in regressions involving bank 3. Old depositors are able to secure loans at lower rates of interest and more frequently without security.

Hypothesis 5 is accepted. Coefficients of $\bar{R}$ are significant in the interest rate and maturity regressions for all three banks. The prime rate elasticities of the loan rate of interest are 0.88, 0.94, and 0.83 for banks

Table 5 Regressions of Logarithm of Security "Dummy" Variable

	Bank 1	Bank 2	Bank 3
R^2	0.238	0.264	0.222
Constant	0.64815	−0.14593	0.64072
	(0.42578)	(0.82473)	(0.61148)
Log P_m	0.31561[a]	0.20416	0.23161
	(0.11575)	(0.13680)	(0.24098)
Log P_p	−0.097139[a]	0.0032402	−0.071817
	(0.041314)	(0.0787505)	(0.063206)
Log (P_m/H)	1.0529[a]	−0.15262	0.43284
	(0.3908)	(0.67600)	(0.44680)
Log (P_p/H)	−0.24308	−0.55109[a]	−0.23919
	(0.13177)	(0.20873)	(0.14205)
Log C	−0.10298	0.10804	−0.20391
	(0.10418)	(0.16500)	(0.12604)
Log E	0.0050158	0.0076621	.076944
	(0.0251320)	(0.0385914)	(0.042767)
Log Y	−0.12322	−0.10592	−0.31464[a]
	(0.08964)	(0.13952)	(0.14903)
Log $\bar{R}$	−0.055012	−0.79358	−0.51984
	(0.54604)	(0.77063)	(0.88077)

[a] Indicates significance at 0.025 level.

1, 2, and 3, respectively. The lower two elasticities are significantly different from unity. This should not necessarily be interpreted as evidence of credit rationing. Bankers frequently express loan rates to borrowers as prime, prime plus a quarter, prime plus a point, etc. The logarithmic formulation assumes that differentials from prime increase proportionately with the level of prime. Consequently, if many loans are made at rates above prime and the differentials are independent of prime, the coefficient of $\bar{R}$ would be expected to be less than unity.

Coefficients of $\bar{R}$ in the case of the maturity regressions are revealing. Increases in the prime rate tend to shorten the maturity of new loans.[66] The result suggests that loan interest rates did not or could not rise sufficiently above prime to induce banks to grant very long maturity term loans. Because movements in the prime rate are correlated with movements in bill rates, discount rates, bond rates, etc.; one implication of restrictive credit policies by monetary authorities may be a reduction in the willingness of banks to grant longer term loans. This result might

[66] The coefficient of $\bar{R}$ in the case of the maturity regression for bank 2 is misleading. A sampling difficulty caused the coefficient to be negatively biased. The conclusion in the text would probably still hold if this bias could be eliminated.

also derive from the Wallich-Musgrave interpretation of the availability doctrine if it is believed business expectations are inversely related to the level of interest rates. Other coefficients of $\bar{R}$ are not significantly different from zero.[67]

When working capital, W_m and W_p, change in working capital $(dW/dt)_m$ and $(dW/dt)_p$, change in profits $(dP/dt)_m$ and $(dP/dt)_p$, and total assets H were individually added to the above regressions, the fits of the regressions were not significantly improved.[68] Therefore, hypotheses 6, 7, 8, and 9 are rejected.

Hypothesis 10 is accepted. The coefficient of the negative profit rate P_m/H in the interest rate regression of bank 2 is significant. Firms which have negative profit rates are forced to pay higher interest rates. In the case of bank 1, the coefficient of P_m/H in the security equation is significantly positive implying that more negative profit rates increase the likelihood of security. For the same equation of bank 2, the coefficient of P_p/H is significantly negative implying that higher profit rates decrease the likelihood of security. Other coefficients of P_m/H and P_p/H are not significantly different from zero.

Hypotheses 11, 12, and 13 are rejected. Residuals of the above regressions were regressed on A_0, V_p, and E_a individually. Only those observations containing nonzero values of the independent variable (A_0, V_p, or E_a) were included in each of the calculations. Infrequent reporting of affiliated balances limited empirical examination of hypothesis 13 to one bank. None of the four slopes was significantly different from zero.[69]

Two banks reported the volume of participations A_0. In both cases no coefficients were significant. Interestingly, had the hypothesis implied opposite signs and the rejection regions been 0.05, both coefficients in the amount (residuals) equations would have been significant. In other words, simultaneous outside borrowing seems to increase the amount of term money a bank will lend to a borrower. One possible explanation is that confidence in a borrower grows in the mind of a banker if other bankers concur in his decision to lend. A second explanation, verbally supported

[67] One banker suggested that this result reflected a diminution of demand for these funds. His argument is equivalent to saying that the partial loan offer function was not identified. Such arguments are not convincing unless reasons for lack of identification can be suggested.

[68] The test of H was not precisely that described in the text. A covariance matrix containing log P_p/H, log P_p, and log H is singular. When P_p/H and P_m/H were omitted from regressions, additions of H to the regressions did not significantly improve the fit. This was the basis for rejecting hypothesis 9.

[69] It should be recalled that reporting of E_a was voluntary. More systematic data collection might conceivably alter the conclusion.

by an officer in a bank, is that active participation in loan syndicates is a matter of prestige and a show of competitive strength. Further empirical work is necessary before these explanations can be accepted.

Variance of an applicant's profits was analyzed for each of the three banks and none of the coefficients was significant.

Two additional tests were performed on the term loan samples. The first examined the hypothesis that all three banks could be characterized by the same partial loan offer functions rather than separate functions for each bank. Employing the F test, the hypothesis is rejected at the 0.05 level in the cases of the rate of interest and maturity regressions. The ability of an applicant to obtain certain rates of interest and certain maturities clearly depends upon the bank to which he applies. The hypothesis is accepted in the cases of the amount and dummy security variables.

The second test examined the hypothesis that if the sample for each bank were split in two sections, loans granted from January 1955 through May 1956 and loans granted from June 1956 through October 1957, the estimated partial loan offer functions would not be significantly different from the equations reported in Tables 2 through 5. Again employing the F test, the hypothesis is accepted in all four regressions of each of two banks. However, for a third bank, the hypothesis is rejected in the maturity and dummy security regressions at the 0.05 level.

In a comparison of the first and second half of the period, the following statements apply to that bank. Firms were required to have a higher current ratio in order to be granted a loan of a particular maturity. The bank became even less willing to grant long maturity loans as prime rose. A higher current ratio was necessary in order to achieve a particular probability of a security requirement. Further, the bank made fewer loans to firms which experienced mean losses over the preceding three to five years. A subsequent conversation with an officer of this bank confirmed that there was a sharp change in lending policy early in 1956. This change included a greater unwillingness to make term loans. It is of interest to observe that this tightening did not involve a change in the interest rate regression.

ANALYSIS OF COMMERCIAL AND INDUSTRIAL LENDING

This section reports results of statistical tests performed on samples from the 1955 and 1957 surveys of business loans collected by the Board of Governors of the Federal Reserve System.[70] The surveys contain

[70] I am most grateful to the Board for making available summaries of these surveys. Valuable comments and assistance were obtained from Mr. Edward P. Snyder of the Banking Section of the Board's Division of Research and Statistics.

information on loans of various amounts and maturities, in contrast to the large, long maturity term loans considered before.

Data gathered in the surveys permit examination of the relevance of a few borrower characteristics to the loan offer function. More importantly, tests of hypotheses about the effects of some bank characteristics on bank lending can be made, because the data were collected from a large number of banks. Finally, tests of the impact of increased bond interest rates on bank lending can be performed. The last set of tests is possible because samples collected in 1955 and 1957 were drawn at points of time when interest rates were respectively low and high.

Hypotheses

A description of the surveys and their sampling techniques may be found in the April 1956[71] and the April 1958[72] *Federal Reserve Bulletins.* For reasons of cost, only data relating to one district of the Federal Reserve System could be processed. Apparent balance in terms of industry, size of banks, and demand for loans suggested the Cleveland district and it was selected.

The surveys collected information on individual loans granted by a sample of member banks. Four conditions had to be met by the loans in the surveys if they were to be included in the present study:

1. They must have been granted to firms in the United States (1955 only).
2. They must have had maturities (when granted) of not more than ten years.
3. They must have been granted or approved in the month immediately preceding the date of the survey.
4. All variables considered in this section had to have been reported.

The following new variables were reported in the 1955 survey:

D = the level of deposits of the lending bank in June of the year of the survey. (in dollars)

L = ratio of lending bank's commercial and industrial loans to its total assets, as of the survey date. (in per cent)

B = 10 if borrower was located in the same metropolitan area as the lending bank, B = 1 otherwise.

Both surveys reported H, the total assets of the borrower; R, effective loan rate of interest; M, the maturity of the loan when granted; A, the

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[71] James B. Eckert, "Business Loans to Member Banks," *The Federal Reserve Bulletin,* XLII (April 1956), pp. 337–340.

[72] James B. Eckert, "Member Bank Lending to Small Business, 1955–7," *The Federal Reserve Bulletin,* XLIV (April 1958), pp. 393–394 and pp. 410–411.

amount of the loan; and *S*, the dummy security variable. Unfortunately, the 1957 survey did not collect information on *L* and *B*.

Variables *D*, *L*, *H*, and *M* were recorded in class intervals. Thus the level of deposits of a lending bank might be reported in the interval of ten to twenty million dollars. If an observation fell into an interval, it was arbitrarily assigned the midpoint. If the class interval had an open end, an estimate of its mean was obtained from other sources. This procedure may bias the results, but in most cases a sufficient number of classes existed to reduce this bias to negligible proportions. An exception was the loan ratio *L* where only four classes were available.

The theory developed previously assumed that loans were sufficiently large or of sufficiently long maturity that costs of lending could be ignored. In view of the fact that nearly forty per cent of the loans in the Federal Reserve samples were to borrowers with total assets under $50,000 and ninety per cent for periods of less than one year, this assumption may not be valid. Small loans and loans with short maturities are relatively less desirable than would be true if lending were costless. With this qualification,[73] the following hypotheses may be inferred from the theory:

1. *Ceteris paribus*, as the total assets of a borrower increase, the rate of interest on the loan decreases and/or the maturity of the loan increases and/or the amount of the loan increases and/or the likelihood of security decreases.
2. *Ceteris paribus*, as the level of deposits of a lending bank increases, the rate of interest on the loan increases and/or the maturity of the loan decreases and/or the likelihood of security increases.
3. *Ceteris paribus*, as the loan ratio of the bank increases, the rate of interest on the loan increases and/or the maturity of the loan decreases and/or the amount of the loan decreases and/or the likelihood of security increases.
4. *Ceteris paribus*, if the borrower resides in the same city as the lending bank, the rate of interest on the loan is lower and/or the maturity of the loan is longer and/or the amount of the loan is larger and/or the likelihood of security is smaller.

Supporting arguments for these hypotheses are developed in terms of *R*. The remaining relationships in the hypotheses may be inferred, *mutatis mutandis*, because *R* is believed to be a complement of *M* and *A* and a substitute for *S*.

Hypothesis 1 states that if two firms apply for a loan, then the firm with larger total assets will be charged a lower rate of interest. It may be

[73] This qualification is probably not serious. Small loans earn small sums, but their credit analysis is also simple and cheap.

defended on the grounds that bankers believe the probability of default is smaller when a borrower's assets are larger.

The fact that coefficients of borrower's assets were insignificant before should not discourage use of the variable in this section. Profits and assets are highly correlated and the coefficients of profits were significant. Information on a borrower's income was not obtained in the Federal Reserve surveys; total assets is viewed as a proxy for an applicant's profits.

Hypothesis 2 states that if identical firms apply to banks, differing only in size, then larger banks will charge higher rates of interest. This hypothesis is derived from three assumptions: (1) banks are averse to deposit instability, (2) a bank's utility function is quadratic with respect to changes in the level of its deposits, and (3) the analysis in the appendix characterizes banks in the real world.

The hypothesis makes no statement about the relationship between the amount of the loan and the level of deposits of the lending bank. However, the relationship is probably positive because commercial banks are not permitted to lend sums in excess of ten per cent of their net worth. Traditional bank examination standards require the level of a bank's deposits and its equity to be positively correlated.

Hypothesis 3 states that if identical commercial firms apply to banks differing only in their business loan ratios, then banks with higher ratios of commercial and industrial loans to deposits will charge higher rates of interest.[74] This hypothesis utilizes the notion of portfolio balance. These banks have some common optimum portfolio; if the proportion of business loans is low, they lower rates to encourage more business lending. Rates will be raised if the banks have too many business loans.[75]

Specialization of lending may operate to offset this hypothesis. If some banks specialize in agricultural loans, they may feel quite inexperienced when lending to manufacturers or shopping centers. This lack of experience induces such banks to be conservative commercial and industrial lenders. Following the same line of reasoning, some banks may view themselves essentially as lending institutions while others prefer to be regarded as depositories. The former institutions are systematically

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[74] The reader may object that lending by banks during the month prior to the survey date may influence the loan ratio at the time of the survey. The ideal loan ratio for the purposes of this hypothesis is that existing a month prior to the survey date. However, this ideal statistic is not available and it is reasonable to assume that the ratio existing at the time of the survey had not been appreciably altered during the preceding month.

[75] Cf. James Tobin, "Liquidity Preference as Behavior Towards Risk," *The Review of Economic Studies*, No. 67 (February 1958), pp. 65–86; reprinted in Cowles Foundation Monograph 19, *Risk Aversion and Portfolio Choice* (New York: John Wiley & Sons, Inc., 1967) Chap. 1.

more aggressive lenders. Their loans to borrowers of given means are at lower interest rates, of longer maturities, of larger amounts, and with lower probability of security. The latter banks are more conservative lenders.

The question of whether a common portfolio balance or specialization best describes the real world is important for appraising the ease of obtaining credit in certain communities where banks have high business loan ratios. There is no theoretical basis for selecting which of the two hypotheses is right. Empirical tests will doubtless reflect both patterns of behavior.

Hypothesis 4 states that if a bank receives two loan requests from borrowers identical in every respect except that one of them is located in a different city than that in which the bank and the other borrower reside, then the bank will charge a higher rate of interest to the first borrower. Among the reasons which support this hypothesis are: (1) higher costs of processing and checking distant borrowers, (2) a belief that the elasticity of demand for loans is greater in the bank's own city, and (3) greater ease of surveillance of the borrower.

Empirical Results

Partial loan offer functions were estimated from a sample of approximately 3000 loans. Hypotheses 1, 2, and 4 are one tailed tests of parameters and again the 0.025 level of significance was selected. Hypothesis 3 is a two tailed test and coefficients of L are tested at the 0.05 level.

As before, statistical tests of parameters in partial loan offer functions are not ideal tests of the theory. Hypotheses are again judged to be accepted if at least two coefficients are significant.[76] Table 6 reports the estimated partial loan offer functions.

All multiple regressions in Table 6 are significant at the 0.01 level. Hypothesis 1 is accepted. Coefficients of total assets H are significantly different from zero in all four regressions. The asset elasticity of the rate of interest is 0.066. Thus if a firm had previously borrowed at eight per cent and suddenly expanded its assets tenfold, it could expect to borrow at about seven per cent.[77] Banks apparently do view a borrower's total assets as a measure of expected default risk. The reader should recall that total assets is a proxy for other income and balance sheet variables which were not recorded.

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[76] The probability of a random variable being significant at the 0.025 level in at most one regression is 0.997.

[77] The statement obviously makes the usual static cross-section assumption that differences between borrowers at a point in time are analytically identical to differences in a given borrower at different points in time.

Table 6 Partial Loan Offer Functions Estimated from the 1955 Federal Reserve Survey of Business Loans

Dependent Variable	R^2	Constant	Log D	Log L	Log H	Log B
Log R	0.287	1.04771	0.0054857[a]	−0.012094	−0.066186[a]	−0.010048[a]
			(0.0023484)	(0.0064626)	(0.0020187)	(0.0047189)
Log M	0.009	0.19964	−0.021283	0.11413[b]	0.022868[a]	−0.074805
			(0.013009)	(0.035799)	(0.011182)	(0.026140)
Log A	0.513	−0.056965	0.060246[a]	0.088687[b]	0.63398[a]	−0.012915
			(0.014878)	(0.040943)	(0.012789)	(0.029896)
Log S	0.018	0.55192	0.042968[a]	0.010879	−0.081928[a]	−0.099366[a]
			(0.013516)	(0.037194)	(0.011618)	(0.027158)

[a] Indicates significance at 0.025.
[b] Indicates significance at 0.05.

Hypothesis 2 is accepted; larger banks charge higher rates of interest to, and are more likely to insist upon security from, borrowers of a particular size. The failure of the hypothesis in the case of the maturity regression is a bit puzzling. One explanation is that small banks do not in practice make loans with long maturities. There is probably a tendency to issue short maturity notes with the implicit understanding that these notes will be renewed if conditions of the borrower do not change drastically. Larger banks, on the other hand, may prefer to make term loans because of the lower average legal and administrative costs associated with the larger loans which they grant. The failure of the coefficient to be significant may result from a failure of the survey to measure the *effective* maturity of loans of small banks.

Unfortunately, if *L* and *B* are omitted from the regressions, the coefficient of *D* is not significant in the interest rate equation. As is usually true when multicollinearity appears, the meaning of this second result is unclear. The hypothesis is still accepted on the basis of the significant coefficients, but further research is necessary before doubt is extinguished.

Hypothesis 3 is rejected in favor of the specialization hypothesis discussed above. The coefficient of the business loan ratio is significantly positive in the maturity and amount regressions and narrowly misses being significant in the interest rate regression. Banks with high business loan ratios make new business loans which have longer maturities and larger amounts to borrowers of any particular size. This result contradicts a view that banks have some common optimum portfolio toward which they constantly adjust.

An explanation for the failure of the hypothesis in the interest rate and dummy security variable regressions is that aggressive banks prefer to compete only with certain terms of loans, i.e., maturity and amount. This explanation is consistent with statements sometimes encountered in the banking literature concerning the undesirability of interest rate competition.[78]

Hypothesis 4 is tentatively accepted because of significant coefficients of *B* in the interest rate and dummy security variable regressions. The coefficient of *B* possesses the wrong sign in the case of the maturity and amount regressions. Indeed, if the hypothesis had predicted that the coefficient in the maturity regression be negative, the coefficient would have been significantly different from zero. No single explanation for the failure of the hypothesis in these regressions is obvious. Further research on the relationship of location to bank lending is needed.

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[78] Beckhart, *op. cit.*, pp. 305–307.

The Impact of High Interest Rates

Higher interest rates on competing assets influence the terms at which firms may obtain loans. Analysis of the impact of different levels of interest rates on the willingness of commercial banks to lend can only be accomplished by examining bank lending at different points in time. If the effect of competing interest rate changes is to be identified, other variables which influence the willingness of a bank to lend must be considered at the various points in time. A brief discussion of factors influencing the loan offer function in October 1955 and October 1957 follows. It may be seen that, if anything, the net effect of these other factors would tend to discourage bank lending in 1957.

Both Federal Reserve surveys were conducted in early October, thus permitting seasonal determinants of lending to be ignored. Although a modest increase in unemployment was occurring in the fall of 1957, business expectations were by no means bleak. They were probably more pessimistic than in October 1955 when the economy was prospering. This change in the economic picture probably induced bankers to be more cautious when granting loans. In both periods, discount rates had risen one half point in the two months preceding the survey dates. Very similar patterns were exhibited by the prime rate and bill rates in the same two month periods.

The most important difference in the loan market on the two survey dates was higher interest rates in 1957. Between October 1955 and October 1957 new issue bill rates jumped from 2.23 to 3.58, prime rose from 3.50 to 4.50, rates on bankers' acceptances rose from 2.23 to 3.75, and rates on United States Government long term bonds rose from 2.89 to 3.73.[79]

Another difference was that the ratio of loans to deposits of most commercial banks was higher in the second period. This change in bank portfolios would be expected to make banks more cautious when granting loans.

The following hypotheses may be inferred from the theory presented on pages 125 to 133.

5. *Ceteris paribus*, when rates of interest on competing assets are higher, borrowers of any particular size—

(*a*) pay a higher rate of interest on their loans.
(*b*) receive loans with shorter maturities.
(*c*) receive smaller loans.
(*d*) are more frequently required to provide security.

[79] *Federal Reserve Bulletin*, XLII (April 1956), p. 365, and *Federal Reserve Bulletin*, XLIV (April 1958), p. 457.

6. *Ceteris paribus*, when rates of interest on competing assets are higher, the deposit coefficient (elasticity) of—

(*a*) the loan rate of interest is more positive.
(*b*) the maturity of the loan is more negative.
(*c*) the amount of the loan is more negative.
(*d*) the likelihood of security is more positive.

Part (*a*) of hypothesis 5 is consistent with the conventional theory that loan rates of interest clear loan markets. It may also be consistent with the "levels" version of the availability of credit doctrine which does not always prohibit movements in loan interest rates. But as observed earlier, supporters of that doctrine believe that these movements are insufficient to clear loan markets. Parts (*b*), (*c*), and (*d*) of the hypothesis reflect their view that credit rationing is necessary to clear loan markets when interest rates reach higher *levels*.

Credit rationing may also be achieved by increasing the number of loan rejections instead of altering terms of lending. No direct test of this form of credit rationing is possible in the present study because information on rejections is not available. However, it seems strange that bankers would not ration credit *both* by increasing rejections and modifying terms of lending. If only the former technique is employed, then banks must behave in the following fashion. If a firm seeks a two year loan of $10,000 the banker says "yes" or "no." He does not attempt to scale down the firm's request or to extract a faster repayment schedule. In fact, he behaves contrary to answers by bankers in a recent survey by the American Bankers Association.[80]

Hypothesis 6 implies that an increase in competing interest rates causes large banks to be even less willing to lend than small banks. Part (*a*) of this hypothesis reflects the conventional view that increased aversion to lending results in higher interest rates. Parts (*b*), (*c*), and (*d*) reflect the corresponding credit rationing arguments.

Table 7 reports multiple regressions of each of the terms of lending on the level of deposits of the lending bank, total assets of the borrower, and a shift constant. For purposes of testing the hypothesis, separate slopes were estimated for the variables in each of the two surveys. The total number of observations is on the order of 5000 and all regressions are significant at the 0.01 level.

Part (*a*) of hypothesis 5 is accepted. Inspection of the loan rate of interest regression reveals that in 1957 borrowers had to pay higher rates of interest. This conclusion is true because the coefficient of the shift

[80] E. S. Adams, "Monetary Restraint and Bank Credit," *Banking*, L (September 1957), pp. 68–142.

Table 7 Partial Loan Offer Functions Estimated from the 1955 and 1957 Federal Reserve Surveys of Business Loans[a]

Dependent Variable	R^2	Constant	C_{57}	Log D_{55}	Log D_{57}	Log H_{55}	Log H_{57}
Log R	0.255	0.97374	0.089367[b]	0.0033392	−0.0013864	−0.065526[b]	−0.037387[b]
			(0.0054164)	(0.0021005)	(0.0023366)	(0.0019706)	(0.0018213)
Log M	0.007	0.066015	0.052545	−0.0031113	−0.0006963	0.033151[b]	0.029188[b]
			(0.031816)	(0.012339)	(0.013726)	(0.011565)	(0.010698)
Log A	0.591	−0.24335	0.22165	0.074922[b]	0.070752[b]	0.63757[b]	0.68951[b]
			(0.034309)	(0.013306)	(0.014801)	(0.012483)	(0.011537)
Log S	0.018	0.50698	0.0006333	0.043566[b]	0.023140	−0.071970[b]	−0.076586[b]
			(0.030988)	(0.012018)	(0.013368)	(0.011274)	(0.010420)

[a] Definitions of the independent variables in Table 7 are as follows. A loan made in 1955 would have $D_{55} = D$, $D_{57} = 1$, $H_{55} = H$, $H_{57} = 1$, and $C_{57} = 0$. Similarly, a loan made in 1957 would have $D_{55} = 1$, $D_{57} = D$, $H_{55} = 1$, $H_{57} = \mathrm{H}$, and $C_{57} = 1$.

[b] Indicates significance at the 0.025 level.

constant is significantly positive and the asset elasticity of the loan rate of interest is significantly less negative. The change in asset elasticity implies in addition that the interest rate differentials between small and large borrowers were smaller in 1957. Acceptance of part (*a*) of hypothesis 5 is consistent with the conventional theory of the loan market and the availability of credit doctrine.

Parts (*b*), (*c*), and (*d*) of hypothesis 5 are rejected. First coefficients of C_{57} are not significantly different from zero in the case of the maturity and dummy security variable regressions. In the amount regression, the coefficient of C_{57} is significantly positive implying that at least some borrowers could obtain larger loans in 1957, contrary to the availability argument.

Second, none of the three asset elasticities changed in such a way as to bear out the hypothesis. The 1957 asset elasticity of maturity is not significantly different from the corresponding 1955 elasticity. The asset elasticity of amount is significantly higher in 1957 than in 1955, contrary to the availability doctrine. A borrower of a given size could obtain larger loans in 1957 than in 1955. The asset elasticity of the dummy security variable is not significantly different in the two periods.

As observed previously, business conditions were deteriorating in October 1957. This deterioration should have changed the coefficients of C_{57} and H in precisely the direction suggested by the doctrine. The failure of the levels version of the availability doctrine is thus even more conspicuous.[81,82]

Between 1955 and 1957 bankers believed that credit rationing had not appreciably reduced the growth in their loans.[83] Their view is consistent with the outcome of tests of hypothesis 5.

Hypothesis 6 is also rejected. No deposit elasticity changed significantly in the two year period. In other words, there is no evidence that borrowers from large or small banks bear the burden of higher competing (bond) interest rates more heavily.

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[81] The regressions in Table 7 suggest that the trade-offs between the loan interest rate and other terms of lending changed between the two surveys. Table 10 in the subsequent section reports that nonrate terms were relatively more important in 1957. But if all borrowers obtained credit at the same or better terms (with the exception of the loan rate of interest), this observation is of little value as an explanation of the effectiveness of monetary policy.

[82] Professor Henry Wallich has verbally suggested an explanation of the above results consistent with the availability of credit doctrine. He argues that bankers normally tend to become more liberal lenders as the economy moves further away from a previous recession. If banks were unusually conservative lenders in 1955 because of the 1953–1954 recession, then the arguments in the text must be qualified. I do not share this view.

[83] E. S. Adams, *loc. cit.*

ESTIMATION OF THE LOAN OFFER FUNCTION WITH CANONICAL CORRELATION

This section reports attempts to estimate a commercial bank loan offer function with canonical correlation.[84] Substitution between terms of lending is explicitly considered when this technique is employed. One measure of the degree to which substitutability exists among terms of lending is the amount by which the canonical correlation exceeds the largest multiple correlation of the previous partial offer functions. Unfortunately, no probability statement can be made about whether the difference between these two correlations is significantly greater than zero.[85]

The theory first presented suggests that for similar borrowers the loan rate of interest should increase as the amount or maturity of a loan increases and should be lower if security is supplied. Also, for similar borrowers the maturity of a loan should be shorter if the amount of the loan is larger and should be longer if security is offered. Finally, the amount of money a bank will be willing to lend to a particular borrower should increase if security is proffered.[86]

Table 8 reports canonical correlations for each of the three banks considered in pages 134 to 149.[87]

The hypotheses about terms of lending are supported by the reported coefficients (canonical weights) with the exception of the dummy security variable. That variable has limited economic meaning and it is not surprising that its canonical weight did not always possess the predicted sign.

The coefficients suggest that if a borrower with given characteristics requests a longer maturity loan, a more than proportionate reduction in

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[84] See p. 133.

[85] The reader may object that this rather elaborate statistical procedure is just a ruse; examination of the partial correlation coefficients of the residuals of the partial offer functions would be equally satisfactory. The error in this objection is that partial correlation coefficients are not *jointly* determined with other parameters, as the theory requires. The signs of estimated partial correlation coefficients will depend critically on whether the function has been properly specified. Variables such as net worth and debt of a borrower have been omitted, thereby misspecifying the function. In fact, partial correlation coefficients were estimated for regressions reported in Tables 2 through 6. The signs of the coefficients were not in accordance with *a priori* expectations.

[86] The theory is informally tested in this section by the degree of conformity of signs of canonical weights to these *a priori* expectations.

[87] Numbers in Tables 8 through 10 differ from those in true canonical equations by a constant of proportionality. As the analysis only concerns ratios of coefficients, comparisons will be more easily made if the equations are normalized. The value of the canonical correlation is invariant to such transformations.

amount will be necessary to compensate the bank, given other terms of lending. On the other hand, requests for either longer maturity loans or larger loans may be compensated for with a relatively small increase in the loan rate of interest. The rankings of the three coefficients are identical in the case of each of the three banks.

Among the borrower characteristics, only profit variables have the same sign for all three banks. Coefficients of bank 1 and bank 2 have

Table 8 Canonical Correlations from Samples of Term Loans

Variable[a]	Bank 1	Bank 2	Bank 3
$(\text{Log } R)'$	1.0000	1.0000	1.0000
$(\text{Log } M)'$	−0.053203	−0.086959	−0.070112
$(\text{Log } A)'$	−0.012387	−0.052804	−0.032025
$(\text{Log } S)'$	−0.015547	0.000069	−0.0013735
Canonical correlation (squared)	0.799	0.852	0.796
$(\text{Log } P_m)'$	−0.031719	−0.022617	−0.075585
$(\text{Log } P_p)'$	−0.029489	−0.052602	−0.069635
$(\text{Log } C)'$	−0.014137	−0.011387	0.018826
$(\text{Log } E)'$	−0.0037316	−0.0022580	0.0049976
$(\text{Log } Y)'$	0.0044043	0.0027871	−0.040074
$(\text{Log } \bar{R})'$	0.97548	1.12284	0.91374
$(\text{Log } P_m/H)'$	−0.0043322	0.060639	0.043162
$(\text{Log } P_p/H)'$	−0.0049697	0.0015566	0.033827

[a] Primes (′) on variables indicate that they are defined as deviations from their means.

identical signs with the exception of the profit rate variables. Table 5 reports that the latter are significantly related to S. The coefficients of S have different signs for the two banks.

In the cases of banks 1 and 2, coefficients of negative profits P_m and years as a depositor Y have signs which are not consistent with the previous hypotheses. Difficulties with P_m are again believed to be associated with misspecification. Coefficients of Y are not significant in the regression analysis for banks 1 and 2 and are interpreted to be spurious.

For bank 3, the coefficient of Y possesses the hypothesized sign, confirming the significance of this variable in the regression analysis. Because profit rates and balances are not significant in regressions for this bank, wrong signs are not surprising. The sign of the coefficient of the current ratio apparently derives from the fact that the coefficient of C is positive in Table 2. Because rate equations tend to dominate the coefficients in Table 8, the positive coefficient in Table 2 outweighs the corresponding coefficient of *C* in Table 3. No plausible explanation of the sign of this coefficient is obvious.

The squared canonical correlations exceed the largest previous R^2 by 0.031, 0.051, and 0.056 for banks 1, 2, and 3 respectively.

Table 9 reports canonical correlation results for the 1955 sample of loans collected by the Board of Governors of the Federal Reserve System.

Table 9 Canonical Correlations from Cleveland 1955 Sample

Variable	Weight
(Log *R*)′	1.0000
(Log *M*)′	−0.036209
(Log *A*)′	−0.38171
(Log *S*)′	0.066075
Squared canonical correlation	0.547
(Log *D*)′	−0.013906
(Log *L*)′	−0.049349
(Log *H*)′	−0.31442
(Log *B*)′	−0.0089774

The table demonstrates that all *a priori* predictions about trade-offs between terms of lending are verified. Again the coefficient of *S* should be regarded with some skepticism.

In the case of the Federal Reserve sample, increases in requested loan maturity by borrowers of a particular size are associated with less than proportionate decreases in loan amount, given other terms of lending. Apparently the reason for the difference between this result and the preceding term loan coefficients exists because the average business loan has a very short maturity. Doubling of average commercial and industrial loan maturities might involve extending maturities six months. In the case of term loans, however, a doubling of loan maturities might extend loans one to five years.

A substantial rise in the loan rate of interest is associated with requests for larger loans by borrowers of a particular size. This contrasts with the previous term loan result. Apparently interest rate differentials are more frequently used to compensate bankers for large risks in the commercial and industrial loan market than in the more restricted market for term loans. One reason for this behavior may be that term borrowers are relatively large firms having access to other sources of financing if bank rates rise too high. Consequently, banks obtain safety by reducing the maturity of loans to individual term borrowers. Other conditions of borrowing also compensate banks which do not charge large interest rate risk differentials. Term loan agreements usually require borrowers to keep some minimum level of working capital.

As in the case of term lending, only modest increases in interest rates are needed to compensate banks for increases in loan maturity, given borrower size and other terms of lending.

Table 10 A Comparison of Canonical Correlations Computed from Cleveland 1955 and Cleveland 1957 Samples

Variable	Weights 1955	1957
(Log R)′	1.00000	1.00000
(Log M)′	−0.033975	0.011718
(Log A)′	−0.38626	−1.67200
(Log S)′	0.065991	0.46584
Squared canonical correlations	0.546	0.664
(Log D)′	−0.041459	−0.170110
(Log H)′	−0.58216	−1.90516

The coefficients of bank and borrower characteristics possess the hypothesized signs with the exception of deposits of the lending bank, D. As explained previously, D is necessarily correlated with A because of maximum legal lending limits established by bank inspectors. Because the amount regression tends to dominate the canonical equation, the coefficient of D has the negative sign.

The increase in the squared canonical correlation over the R^2 of the amount regression was 0.034.

Table 10 presents comparable canonical equations estimated from Cleveland district member banks in the 1955 and 1957 Federal Reserve surveys. There appear to have been three interesting changes between the two surveys. First, the weight placed on the loan interest rate relative to other terms of lending declined, consistent with the change in the asset elasticity reported in Table 7. I suspect that some advocates of the availability of credit doctrine perceived this relative change and inferred that this was the mechanism by which monetary policy became effective. However, as reported before, this inference is incorrect because there is no evidence that any size of borrower was forced to accept either a smaller loan, a shorter loan,[88] or a higher frequency of security in 1957 than in 1955. Possible explanations of this change include proximity of rates to maximums specified by usury laws, growing criticism of high loan rates, etc.

Second, the canonical correlation was substantially higher in 1957 than in 1955. Lending behavior of banks could be more precisely predicted in 1957 from a knowledge of an applicant's total assets and a bank's level of demand deposits. One possible explanation of this greater precision is that, as interest rates rose and loan portfolios grew, banks made fewer loans for noncredit reasons, e.g., loans motivated by competition for a new customer or loans to old "friends of the bank."

Finally, the weight on loan maturity changed signs. As the weight on this variable in both equations is very small, this result probably should not be regarded too seriously. If the change actually occurred, it implies that banks viewed maturity as a desirable property. One explanation is that, if banks expected loan interest rates to drop in the near future, they could improve their future earnings by lending at longer maturities. Further evidence is necessary before this conjecture can be accepted.

The squared canonical correlations exceeded the corresponding R^2 of the amount regressions by 0.034 and 0.018 in 1955 and 1957 respectively.

SUMMARY AND POLICY IMPLICATIONS OF THE ANALYSIS

Summary of the Analysis

In the first section a theory was proposed to explain the terms at which a bank with particular characteristics would lend to a loan applicant.

Certain simplifying assumptions were made in order to develop the theory. First, it was assumed that broad asset choices between bonds, loans, and cash could be generally ignored. Second, it was assumed that the services of banks as consultants or sources of information could be ignored. Third, deposit structure, equity, management, etc. of any bank were assumed to be fixed. Finally, the loan market was assumed to be imperfect.

A loan offer function was defined to be a relation which specifies the terms at which a bank with particular characteristics will be willing to lend to a borrower with a known profit, balance sheet, and credit history and particular prospects for the future.

It was then possible to speak of characteristics of an applicant and characteristics of a bank defining some efficient set of terms of lending.

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[88] The coefficient of $\bar{R}$ in maturity regressions (Table 3) is an exception. This point is considered again on page 167.

Four principal terms of lending were considered: (1) the loan rate of interest, (2) the loan maturity, (3) the amount of the loan, and (4) the likelihood of security. Effective bargaining by borrowers was assumed to force bankers to this efficient frontier. Banks were hypothesized to be willing to substitute among terms of lending. Thus longer maturity loans might be obtained by paying higher interest rates and/or accepting smaller amounts of money and/or by offering security. Relationships between various borrower and bank characteristics and terms of lending were hypothesized.

The various hypotheses were tested with multiple regression and canonical correlation analysis. Five samples of data were analyzed. Three of the samples were drawn from term loans granted by three large commercial banks during the period from January 1955 through October 1957. Two other samples were extracted from the massive commercial and industrial loan surveys conducted by the Board of Governors of the Federal Reserve System in October 1955 and again in October 1957.

An applicant's profits, the ratio of his current assets to current liabilities, his deposit balances, the number of years which he was a depositor at the bank, his profit rate, his location, and perhaps his total assets appear to influence significantly the terms at which banks lend. The size of banks (a proxy for deposit variance), the bank's ratio of commercial and industrial loans to deposits, and the level of the prime rate of interest also affect the terms at which banks lend.

The previous section reported that, with canonical correlation analysis, it appears that banks do trade off terms of lending in the manner specified by the theory. When a borrower with particular characteristics seeks a longer maturity loan, he must expect either to pay a higher rate of interest and/or receive a smaller amount. The trade-off between these terms of lending and the dummy security variable was not consistently in the direction specified by the theory. In part this failure is associated with the crudeness of the security measure.

Implications of the Analysis for Monetary Policy

Policy implications of the analysis are considered from two points of view: (1) economic efficiency at a point in time and (2) the impact of monetary policy.

It is assumed economic efficiency implies that banks employ their funds so as to obtain a high rate of return and a low probability of bank failure. It is trite to observe that uncertainty of future deposit levels and uncertainty of loan repayment complicates this maximization problem.

There is no *a priori* reason for doubting that statistics such as a borrower's level of profits, his current ratio, and his profit rate successfully discriminate between safe and risky loans. Further, if the future rate of return of investments can be predicted by past profit and profit rate variables, banks which use these criteria cause capital to flow into high-yielding investments.

Recent proposals have been made to permit commercial banks to pay interest on demand deposits.[89] It has been argued that balances have the dual properties of increasing effective interest rates and reducing deposit variance. The amount regressions presented before support this argument. The size of term loans granted by banks 1 and 2 to a borrower are an increasing function of his past demand deposit balances. If banks prefer to hold smaller deposit balances as a result of being forced to pay interest on demand deposits, they will not care to make as many large term loans. The proposal must be considered from this perspective also.

It is not obvious that the number of years which a borrower has carried deposits with a bank is a socially desirable criterion for lending. Why is this variable considered? Information about borrowers is not costless. If borrowers supply more information to banks by maintaining a relationship, they have reduced a bank's cost. Criticism of this inertia by bankers is more a criticism of imperfect information flows than a comment on bank efficiency. Eliminating personal relationships between banks and borrowers is not desirable unless some other method of conveying information can be demonstrated to be cheaper.

Although no appraisal of the effectiveness of monetary policy on the level of economic activity can be attempted, the analysis does permit some discussion of the impact of monetary policy on bank lending.

Results in pages 145 to 148 suggest that increases in the prime rate of interest are associated with a shortening maturity of new term loans. Because prime tends to move with other interest rates in the economy, this implies that when monetary authorities permit rates to rise, they are in fact sanctioning a reduction in long term loans. If capital markets are imperfect, these long term borrowers may delay or may not be willing or able to carry out their projects. There arises a definite question as to whether such changes in the capital market are consistent with the objectives of monetary policy.

Analysis of the commercial and industrial loan samples indicated that, although interest rates on these loans rose with other interest rates over the period 1955 to 1957, no other terms of lending were made more restrictive. It was observed that the asset elasticity of the loan rate of interest became significantly less negative over the period. Again a change in capital markets resulted when other interest rates were permitted to rise.

[89] Cf. James Tobin, "Towards Improving the Efficiency of the Monetary Mechanism," *The Review of Economics and Statistics*, XLII (August 1960), pp. 276–278.

The point, then, is that monetary policy does alter the composition of flows through the capital market. Until recently, very little attention has been directed to the character of these changes. The distinction between monetary policy and discretionary governmental controls is not very sharp. Decisions to employ monetary weapons rather than discretionary controls must be evaluated in terms of both the changes in the allocation of resources and the resulting reduction or expansion in aggregate demand.

Implications of the Analysis for the Availability of Credit Doctrine

The availability literature[90] suggests that either rising or high levels of interest rates result in credit rationing. No test of short term changes in interest rates could be made in this study. Because the level of interest rates was substantially higher in 1957 than in 1955, the comments of this paper pertain to the "levels" rather than "change" versions of the availability doctrine.

There is some evidence that banks are less willing to grant long maturity term loans when interest rates are higher. Because long maturity loans are inherently more risky, this result might be interpreted as credit rationing. Whether this behavior derives from changes in competing interest rates, higher levels of competing interest rates, or simply a growing proportion of loans in a bank's portfolio cannot be discerned.

Analysis of commercial and industrial loans revealed that borrowers of any particular size could obtain loans of at least the same maturity, the same amount, and with the same likelihood of security in 1957 as in 1955. If risk is associated with longer maturity, greater amount, or no security, we have the result that identically risky loans could be obtained by borrowers of given means, as measured by their total assets, regardless of the level of competing interest rates. There was no credit rationing![91]

This behavior is not consistent with the "levels" version of the availability of credit doctrine unless bankers behave in the following peculiar fashion. When a man comes to a bank with a loan request, the banker says "yes" or "no"; there is no substitution among terms of lending. Bankers do not scale down loans or obtain shorter maturities.

In order to test the availability doctrine ultimately, detailed information on loan rejections must also be studied. Unfortunately, this is difficult because a loan rejection is not well defined.

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[90] See pages 128–131.

[91] As reported in the previous section, there is evidence that bankers were less willing to substitute between the loan rate and other terms of lending. But this change in the relative roles of terms of lending is not an explanation of the effectiveness of monetary policy.

It has been observed earlier,[92] with respect to an American Bankers Association survey, that most bankers felt increased selectivity of lending had not appreciably restricted growth of their lending. This conclusion is supported by a study of large samples of commercial and industrial loans. Although some evidence in support of availability arguments was exhibited in the rather specialized case of term lending, it is doubtful that great reliance can or should be placed on credit rationing.

APPENDIX

An important factor in predicting bank lending is the instability of bank demand deposits. An empirical conclusion of this appendix is that the ratio of the variance of demand deposits to the level of deposits is an increasing function of bank size. Further, growing banks or declining banks will have a smaller ratio than banks which are of unchanging size. Three assumptions are necessary to demonstrate these conclusions.

First, assume that the rate at which transactions (deposits and withdrawals) occur can be represented as a non-linear function of the level of a bank's demand deposits.

$$\frac{dn}{dt} = \alpha D^{\gamma} \qquad \alpha, \gamma > 0.^{93} \tag{A-1}$$

where:

$\frac{dn}{dt}$ = number of transactions per unit time.

D = a bank's demand deposits net of interbank and government deposits.

Second, assume that the size of the average transaction is independent of whether it is a deposit or withdrawal and that it is also a non-linear function of the level of demand deposits.

$$s = \beta D^{\delta} \qquad \beta, \delta > 0. \tag{A-2}$$

where: s = the size of the average transaction.

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[92] See p. 159.

[93] Very recently, some evidence has been published suggesting that $\gamma = 1$. Cf. "Interpretation of Size-Cost Relationships in Banking," *Monthly Review* of the Federal Reserve Bank of Kansas City, March 1961, pp. 8–9.

Finally, assume that transactions are distributed according to the binomial distribution with p equal to the probability that the next transaction will be a deposit, $1 - p$ equal to the probability that it will be a withdrawal. Growing banks have $p > 0.5$ and declining banks have $p < 0.5$.

The expected value of the level of deposits at the close of a period T units long is:

$$D_{t+T} = D_t + (2p - 1)\alpha\beta D^{\delta+\gamma} \cdot T. \quad \text{(A-3)}$$

The variance of the distribution of changes in deposits is given by:

$$\sigma^2 = 4T \cdot (p - p^2)\alpha\beta^2 D^{\gamma+2\delta}. \quad \text{(A-4)}$$

A number relevant to this discussion is the turnover rate of demand deposits. In terms of the above, we must express the expected turnover as:

$$R = (1 - p)\alpha\beta D^{\gamma+\delta-1} \cdot T. \quad \text{(A-5)}$$

$$\frac{\partial R}{\partial D} = (1 - p)\alpha\beta(\gamma + \delta - 1)D^{(\gamma+\delta-2)} \cdot T. \quad \text{(A-6)}$$

Because T, $(1 - p)$, α, and β are positive, a necessary and sufficient condition for this derivative to be positive is:

$$\gamma + \delta > 1. \quad \text{(A-7)}$$

Multiplying equation A-4 by $1/D$ and differentiating with respect to deposits yields

$$\frac{\partial(\sigma^2/D)}{\partial D} = 4(p - p^2)\alpha\beta^2(\gamma + 2\delta - 1)D^{\gamma+2\delta-2} \cdot T. \quad \text{(A-8)}$$

Because $(p - p^2)$, α, and T are positive, a necessary and sufficient condition for equation A-8 to be positive is that $\gamma + 2\delta > 1$. Because $\delta > 0$, if equation A-7 holds the result is proven.

Table A-1 Average Demand Deposit Turnover Rate, 1956[a]

Banks in	R
(*a*) New York City	45.8
(*b*) 6 other centers[b]	28.8
(*c*) 337 other reporting centers	21.8

[a] *The Federal Reserve Bulletin*, XLIV (April 1958), p. 446.
[b] Boston, Philadelphia, Chicago, Detroit, Los Angeles, San Francisco.

It is well known that the average bank size in New York City, in terms of volume of deposits, is the largest in the United States. It is also quite clear that the average bank size in the six other large centers exceeds that in 337 other reporting centers. Assuming all other things are equal,[94] this implies that equation A-7 holds.

Consequently, the first result is demonstrated. The second result follows directly from equation A-8 because $(p - p^2)$ will be a maximum when $p = 0.5$.

Introducing stochastic terms in equations A-1 and A-2 does not seem to qualify seriously the conclusion of this appendix. The result will depend upon the sign and magnitude of the covariance of these terms. There does not appear to be an obvious *a priori* reason for rejecting the assumption that their covariance is zero.

Finally, no cognizance of the important retention rate of transactions by a bank has been made in this appendix. If the bank being considered is a monopoly bank, then all the withdrawals will appear as deposits and the instability of deposits reduces to fluctuations in the bank's float. On the other hand, if the bank expects that all checks drawn on it will never again appear as deposits, then variance of deposits is critical. It is assumed that size of bank is not correlated with the retention rate of transactions.

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[94] In particular, it is assumed that there are no aggregation effects in the consolidated turnover statistics. This means that a bank of a particular size in New York will have the same turnover experience as a similar sized bank in another city. There is no obvious way to test this assumption without additional evidence.

5

An Empirical Model of Commercial Bank Portfolio Management*

JAMES L. PIERCE

I

Commercial banking constitutes an extremely important form of financial intermediation. Very little is known, however, about commercial bank behavior. The purpose of this chapter is to provide some empirical information about the determinants of the allocation of depositors' funds among the major asset types which banks hold. Variations in bank deposits are a primary vehicle of monetary policy. Knowledge of the speed and extent of adjustment of bank portfolios to deposit changes is essential for determining which of the real sectors of the economy are directly influenced by monetary policy. A verifiable model of bank portfolio selection is set forth and estimated using time series data.

The framework of the study is designed to aggregate a typical commercial bank's asset portfolio sufficiently to facilitate the analysis while retaining enough detail to allow a meaningful treatment of portfolio selection. The bank is assumed to have a certain supply of funds at its disposal. These funds are its deposit liabilities, less required reserves, and its capital account. It distributes these given funds among available assets.

* I should like to thank Dale Jorgenson for his advice and encouragement in the early stages of the research for this chapter. I am indebted to James Tobin, James Friedman, Donald Hester, and William Brainard for their many constructive comments on earlier versions of this chapter. Finally, I wish to thank the Board of Governors of the Federal Reserve System for providing me access to needed data. Part of the research for this chapter was supported by the National Science Foundation.

The total asset portfolio is separated into three components: a portfolio of highly liquid reserve assets; a portfolio of investment assets composed of relatively long-term, high yielding securities; and a portfolio of non-financial loans. A brief description of the components is given here, and a more detailed analysis follows. Reserve assets provide the bank with a pool of highly liquid assets to be used for transactions purposes. The components of the portfolio are holdings of cash (excess reserves and balances due from other banks), short-term Treasury liabilities (bills, certificates, and notes and bonds maturing within 1 year), and other highly liquid assets. The investment asset portfolio is held for income and diversification purposes, and it provides a potential source of speculation. This portfolio contains such securities as intermediate (1 to 5 year) and long-term Treasury bonds, municipal bonds, and special long-term issues. The nonfinancial loan portfolio is held for income purposes and is composed of all loans other than the extremely short-term loans made to brokers, dealers, and finance companies; these are included in the reserve asset group. The following notation is used:

A: Total assets (less required reserves)
R: Reserve assets
I: Investment assets
L: Loan assets
F: Total available funds
D: Demand deposits (less required reserves)
T: Time and saving deposits (less required reserves)
C: Capital accounts

These terms are arranged in the following balance sheet identities:

$$A = R + I + L$$
$$F = D + T + C$$
$$F = A$$

The bank's portfolio decision concerns the determination of the desired shares of R, I, and L in the total asset portfolio.

The validity of this three asset approach rests on the assumption that the bank makes two essentially independent decisions concerning the characteristics of its total asset portfolio. First, it decides upon the desired distribution of funds among reserve, investment, and loan assets. Second, it determines the desired composition of each of the three asset groups. The bank is assumed to set general policy goals in terms of the relative sizes of R, I, and L. Given these goals, it then attempts to allocate funds optimally within each of these asset groups.

It goes without saying that in reality the total size and the composition of the three asset groups are not wholly unrelated. If, for example, the bank decides to reduce R, it can offset some of the possible costs by making the reserve asset portfolio more liquid, i.e., it can substitute cash for bills. A complete treatment of the management of a bank's portfolio would involve a simultaneous determination of the size and internal composition of the three asset groups. Such an approach is beyond the scope of this study.

Due to the complexity of the behavioral relationships involved, a rigorous analysis of bank portfolio management in a world of uncertainty and change is beyond the scope of this study. The development of a theoretically respectable model of bank behavior is difficult to achieve. Some fairly rigorous models of bank behavior have been developed, but they have a long way to go before they can be tested.[1] Hopefully, empirical experimentation of the type presented in this chapter will provide information for the construction of more realistic models.

II

Like any other business, a commercial bank must have a fund of assets at its disposal which enables it to carry out its transactions in an orderly manner. The reserve asset portfolio represents such a group of assets. It permits the bank to compensate for the lack of synchronization between the inflow and outflow of funds.[2] The reserve asset portfolio not only provides a means of economically adjusting the total portfolio for estimated variations in deposits, but it also serves as a buffer stock of liquid assets which insulates the other asset groups from unexpected deposit variations.[3] If the bank should experience an unexpected net loss of funds during any period of time, it is able to meet at least part of the loss from this buffer. The use of the reserve asset portfolio in this capacity reduces the probability that the bank will have to sell other assets at unfavorable terms.[4] Likewise, if the bank should experience an unexpected net inflow of funds

[1] Cf. Richard C. Porter, "A Model of Bank Portfolio Selection," *Yale Economic Essays*, Vol. 1, No. 2 (Fall, 1961), pp. 323–359, reprinted in Cowles Foundation Monograph 21, *Financial Markets and Economic Activity* (New York: John Wiley & Sons, Inc., 1967) Chap. 2. David Chambers and Abraham Charnes, "Inter-Temporal Analysis and Optimization of Bank Portfolios," *Management Science*, Vol. VII (July 1961), pp. 393, 410.

[2] The discussion which follows is restricted to stochastic deposit movements. Random variations in loan demand are not explicitly treated.

[3] Assets in the buffer stock need not and typically are not in cash form. Interest-bearing liquid assets provide the bank with some current income and they can be sold quickly at low cost if the need should arise.

[4] It is assumed that competition among banks prevents any individual bank from having effective control over its deposit liabilities. Borrowing is treated as a deduction in reckoning the size of R.

during any period, it will tend to view the funds as transitory and hold them in liquid form. It is generally not profitable to invest the funds in other assets if the inflow will soon be reversed.

It is assumed that the bank's experiences have prompted it to treat its deposit forecast as the midpoint (mean) of a range of possible deposit levels. The bank is assumed to treat future deposits as a random variable (the nature of its probability distribution is discussed below). The deposit forecast is the mean of the probability distribution of this variable. The risk, as the bank sees it, that deposits will fall below any given level is given by the probability distribution. The greater the dispersion of the distribution, the less confidence the bank places in the forecast. The desired size of the reserve asset portfolio is assumed to vary positively both with mean expected deposits and with the risk of experiencing unexpected losses of funds. The standard deviation may be taken as a measure of this risk.

The assumed probability distribution of deposits should possess certain desirable characteristics. The distribution must disallow negative deposit levels, and this rules out, for example, the normal distribution. The standard deviation should be positively related to the mean. A given absolute deviation from the mean, in dollars, is more likely when the mean level of deposits is large than when it is small. These two criteria suggest the lognormal distribution.

Suppose that the bank has N depositors, each with a given size deposit at the beginning of any period. Let total deposits at the end of the same period be a random, lognormally distributed variable, with expected value α and variance β^2. The basic properties of the distribution are easily presented.[5] Consider a random variable, x, defined over the range $0 < x < \infty$. If $y = \log(x)$ is normally distributed with mean μ and variance σ^2, then x is lognormally distributed. The mean of x, α, is given by $\alpha = e^{\mu+\frac{1}{2}\sigma^2}$, and the variance, β^2, by $\beta^2 = e^{2\mu+\sigma^2}(e^{\sigma^2} - 1) = \alpha^2\eta^2$, where $\eta^2 = (e^{\sigma^2} - 1)$; η is the coefficient of variation of the distribution. The distribution of x is completely specified by the parameters μ and σ^2.

Abstracting from seasonal and other systematic influences, it is assumed that the bank uses the current level of deposits as a measure of the deposit level which it expects to prevail at the end of the period, i.e., $E(x_{t+1}) = \alpha_{t+1} = x_t$ and therefore $E(y_{t+1}) = \mu_{t+1} = \log x_t$, where x now denotes the total level of deposits. It is further assumed that with N fixed the bank considers the parameter σ^2 to be a constant for all t. This assumption implies that given *percentage* deviations of x from its expected value are viewed by the bank as having the same likelihood of occurrence no matter

[5] J. Aitchison and J. A. C. Brown, *The Lognormal Distribution* (Cambridge: The University Press, 1957), pp. 7–19.

what the current level of x. Since η depends only on σ^2, it is a constant under this assumption. As the standard deviation of x is given by $\beta = \alpha\eta$, $\beta_{t+1} = a_{t+1}\eta = x_t\eta$. The bank considers the standard deviation of x in period $t + 1$ to be proportional to the current level of deposits, x_t.

When the assumption of a fixed number of depositors is relaxed, the strict proportionality between mean deposit level and the standard deviation of this level disappears. In general, an increase in deposits represents in part an increase in the number of accounts. If random variations in these accounts are not perfectly and positively correlated with those of the old, the standard deviation of total deposits will rise less than proportionately to mean expected deposits; σ^2 will decline. The contribution which these new accounts make to α and β depends upon the average size and the standard deviation of each and upon their correlation, either with each other or with the original deposits.

Thus, the bank's estimate of the risk of unexpected movements in deposits will vary positively with the size of deposits, but less than proportionately, because increased deposits bring some economies of risk. It follows that the demand for assets to hold as a safety allowance will vary positively but less than proportionately with deposit size. It is not obvious what form the relationship between total R and deposits takes. Nevertheless, it greatly simplifies the empirical work if it is assumed that R varies in proportion to deposits.

It has been assumed so far that demand deposits comprise the only source of available funds. Given that savings and time deposits, T, represents more than 40 per cent of total bank liabilities, this assumption must be relaxed.[6] Their greater predictability and their lower rate of turnover suggest that a dollar of T requires a smaller proportion of reserve assets than a dollar of demand deposits. It is assumed that R varies positively and proportionately with T.

The investment asset portfolio, I, is intermediate with respect to the other two portfolio groups in expected return,[7] liquidity, and risk. The expected return on I is higher than for R, but such return can be gained only at the cost of decreased portfolio liquidity and increased asset risk.

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[6] The capital account, the remaining element in F, is omitted from the analysis on the empirical observation that it is not sufficiently variable to have a significant influence on R.

[7] An indication of the relative magnitudes of expected rates of return on I and L is provided by a recent study by D. Hester and J. Zoellner: "The Relation Between Bank Portfolios and Earnings: An Econometric Study," a paper presented before the 1964 Winter meetings of the Econometric Society. For banks in the Kansas City Federal Reserve District the contribution to after tax profits of government securities was 2.74 per cent for the years 1956 to 1959 and of commercial and industrial loans was 2.86 per cent for the same years.

While investment assets are marketable, they do not provide the high liquidity of short-term assets. Relatively high brokerage fees, random variations in price, and possible market "thinness" make them ill-suited for the short-run manipulations required of reserve assets. Rapid and frequent purchases and sales of these assets in response to unexpected deposit movements would tend to reduce their net return below the yield on R. Brokerage fees and short-term price fluctuations make the net yield on I in part a function of the length of time these assets are held. The holding period for investment assets is too long to make them suitable as components of a buffer stock. Banks can sell investment assets to meet a deposit loss; this gives them an important advantage over many types of loans.

It is assumed that the actual rate of return on an investment asset purchased in period t and sold in period $t + n$ is a random variable. It is further assumed that the bank considers only the expected rate of return, $E(r_I)$, and the standard deviation of return, σ_I, in determining the relative attractiveness of investment assets. The capital gain and loss factor in the rate of return leads to a far greater amplitude of fluctuation of rates of return than of market yields.[8] This greater amplitude implies that securities can at times be a much closer substitute for loans in terms of both expected rates of return and variance of return than market yields would suggest.

Of the three asset groups, loans have highest expected return, greatest risk, and least liquidity. Only loans possess significant risk of default. Unlike the other two asset groups the return and risk on loans are assumed to be subject to a certain degree of bank control.

Loans are a matter of negotiation between borrower and lender in which both the expected return and the risk are determined. In evaluating the credit worthiness of loan applicants the bank examines such characteristics as the size and composition of their assets and liabilities, their sales, and their profits.[9] The borrowers' value as deposit customers—average deposit levels and tenure as depositors—influences the bank's conception of the long-run expected return from the loans.[10] Given borrower

[8] An indication of the range of movement in rates of return is provided in Section III.

[9] Cf. Donald D. Hester, "An Empirical Examination of a Commercial Bank Loan Offer Function," *Yale Economic Essays*, Vol. 2, No. 1 (Spring, 1962), 3–57, reprinted in this volume, Chap. 4, and Jack Guttentag, "Credit Availability, Interest Rates, and Monetary Policy," *The Southern Economic Journal*, Vol. XXVI, No. 3 (January 1960), 219–228.

[10] Bank latitude in establishing and enforcing compensating balance requirements along with other elements in the "customer relationship" are important examples of additional factors which influence the expected return on loans. See Donald Hodgman, *Commercial Bank Loan and Investment Policy*, Champaign: University of Illinois, 1963.

characteristics, the interest rate set and the dollar value of loans granted at this rate depend upon both the bank's and its customers' views concerning loan size, maturity, and guarantees.

Other things being equal, borrowers prefer relatively large average loan size, long maturities, and no guarantees. Banks, on the other hand, prefer relatively small loan size (per loan), short maturities, and strong guarantees. The work of Hester and Guttentag indicates that it is useful to combine these return and risk factors to form what Hester calls a set of loan terms.[11] It should be stressed that the set of loan terms, S, is a vector. The lack of common dimension prevents the elements in the set from being represented by a single number. Hester's empirical work indicates that to a certain degree both the bank and its borrowers are willing to trade one element in the vector for another. The combined effect of the elements in S is to determine the expected rate of return and risk on loans, $E(r_L)$ and σ_L. Let stringent loan terms be associated with relatively high interest rates, short maturities, small average loan size, and strong guarantees.

In order to formulate testable relationships, it is necessary to make some simplifying assumptions concerning the determinants of the demand for bank loans. In particular, it is assumed that the current level of economic activity determines the profit and sales expectations of borrowers. The higher the level of aggregate income, the greater actual and expected sales and profits, and the greater the demand for bank loans. The second assumption deals with the influence of alternative costs of funds. It is assumed that the relative costs of borrowing do not change. When the stringency of bank loan terms rises, the terms of borrowing from other sources rise in proportion. This assumption permits the exclusion of alternative costs of funds from the analysis.

It is further assumed that the stringency of loan terms can be represented by a single number. The actual number selected is arbitrary. It is convenient to use the rate of interest on bank loans as representative of the stringency of loan terms, but this is solely for expository convenience. No explicit use is made of the interest charge, or of any other loan term, in the model to be developed. The interest charge is a poor proxy for either S or $E(r_L)$ and σ_L. Indeed, this interest rate is considered to be unobservable, and it is eliminated from the expressions below.

The specification of the simplified model which follows uses the following variables:

L_s: The dollar value of loans supplied per unit of time
L_d: The dollar value of loans demanded per unit of time
L: The observed dollar value of the bank's loan portfolio

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[11] Hester, *op. cit.*, pp. 3–7.

F: The total supply of funds
Y: An aggregate income or sales variable
r: The interest charge on new loans
i: The market yield on investment assets
u and v: Stochastic terms

These variables appear in two structural behavioral equations and two market equilibrium equations.

$$L_d = a_1 - a_2 r + a_3 Y + u,$$
$$L_s = b_1 + b_2 r + b_3 F - b_4 i + v,$$
$$L_s = L_d = L.$$

It is possible to eliminate r, L_s, and L_d from the system of equations and to obtain a "reduced form" equation which relates the size of the loan portfolio to the observed predetermined variables F, Y, and i. An expression for r is derived from the demand equation. Substituting this expression into the supply equation yields an expression for the observed size of the loan portfolio of the general form:

$$L = A_1 + A_2 Y + A_3 F - A_4 i + Z,$$

namely,

$$L = \frac{a_2 b_1 + a_1 b_2}{a_2 + b_2} + \left[\frac{a_3 b_2}{a_2 + b_2}\right] Y + \left[\frac{a_2 b_3}{a_2 + b_2}\right] F - \left[\frac{a_2 b_4}{a_2 + b_2}\right] i + \frac{b_2 u + a_2 v}{a_2 + b_2}.$$

The observed size of the loan portfolio varies positively with the level of aggregate income, positively with the size of the bank's total resources, and negatively with the yield on investment assets. The size of the portfolio is determined by both the supply and the demand for bank loans. The separate influences of these two functions on observed L could be determined only if it were possible to observe r, or more precisely $E(r_L)$ and σ_L. The system is in principle over-identified; there are 8 reduced form coefficients to estimate 7 structural parameters. But since r is not observable, the reduced form for r is lost and we are left with 4 coefficients in the L equation to estimate 7 parameters.[12]

The loan supply function asserts that $\partial L_s/\partial r$ is a constant. Perhaps a more plausible assumption would be that $\partial L_s/\partial r \geq 0$, $\partial^2 L_s/\partial r^2 \leq 0$. Given the size of total resources, F, a rise in the volume of loans represents an increase in the share of loans in total assets. Such a rise increases risks of illiquidity and of capital loss. If the bank is averse to such risk, the

[12] The Hester-Zoellner paper, *op. cit.*, provides cross-sectional estimates of marginal net rates of return on loans. Their methods provide a potential source of time series estimates of $E(r_L)$ and σ_L.

assumption of $\partial^2 L_s/\partial r^2 < 0$ would be preferred.[13] This in turn would imply that $\partial^2 L_s/\partial Y^2 < 0$ in the reduced form. This assumption is tested in Section III.

The time necessary for R, I, and L to adjust fully to variations in the predetermined variables in the system depends upon the speed of adjustment of both the bank and its loan customers to changes in these variables. If, for example, the bank should receive an unexpected deposit inflow at the beginning of a period, by earlier assumption all of the funds would be held in reserve assets at the end of the period. If these funds should remain with the bank, it would have incentive to purchase investment assets and to increase the volume of loans it is willing to supply at existing terms of lending. Time is required, however, to achieve a new portfolio balance. The inertia in the system is conditioned by the speed with which the bank makes its portfolio decisions and by the minimum time necessary to find borrowers and to process new loans. The most important form of inertia arises from the speed of reaction of borrowers to the increased availability of bank loans. When the bank decides it wishes to increase L, it will find it necessary, given Y, to reduce the stringency of loan terms to attract new borrowers. The reaction of borrowers to the more favorable terms of lending takes time.

The paths of reaction of the three asset groups to variations in the set of exogenous variable are of considerable interest. Consider a situation in which all exogenous variables have been constant for a sufficiently long period of time to allow all reactions to have completely worked themselves out, i.e., R, I, and L are constant. Assume that, in period $t = 0$, the level of demand deposits rises and permanently remains at its higher level. A likely composite response of the bank and of its borrowers to this increase in the level of deposits is illustrated in Figure 1. Time is represented on the horizontal axes.

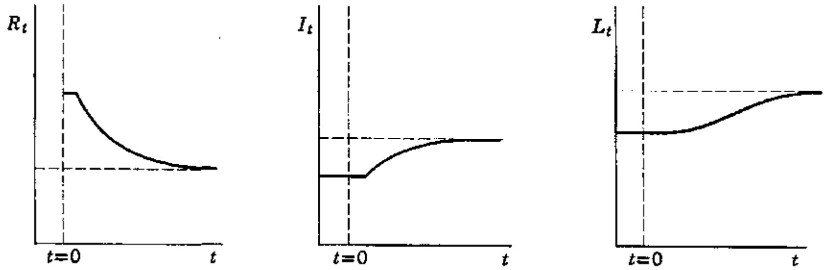

Figure 1

[13] Even if the bank itself is not concerned with such risk, bank examiners and corporate treasurers are. They may provide the bank with the necessary risk aversion.

In the initial period, all of the increase in D is mirrored in a rise in R. As time passes the bank moves relatively quickly into securities and rather more slowly into loans.

The full model appears as follows:

$$A_t = \alpha D_t + \beta T_t + \gamma[E(r_I)_t] + \delta(\sigma_I)_t + \eta C_t + \theta Y_t + t(\lambda) + E_t$$

where

A	is a 3×1 vector of the asset groups R, I, and L
D	is an $n \times 1$ vector of total demand deposits in periods $t - i$ $(i = 0, \ldots, n - 1)$
T	is an $n \times 1$ vector of total saving and time deposits in periods $t - i$
$E(r_I)$	is a $m(n) \times 1$ vector of the m forecasts of the rate of return on an investment asset purchased in periods $t - i$ and sold in periods $t - i + j$ $(j = 1, \ldots, m)$
σ_I	is an $m(n) \times 1$ vector of standard errors of the rate of return forecasts
C	is an $n \times 1$ vector of the capital account in periods $t - i$
Y	is an $n \times 1$ vector of the level of income in periods $t - i$
t	is a scalar representing time
E	is a 3×1 vector of error terms with expected value zero
$\alpha, \beta, \eta, \theta$	are $3 \times n$ matrices of coefficients
γ, δ	are $3 \times m(n)$ matrices of coefficients
λ	is a 3×1 vector of coefficients

The coefficients in λ measure shifts in portfolio preferences with respect to time.

III

This section proceeds in two steps. First, a bond price forecasting model is used to produce expected rates of return series for investment assets. Second, these series are used in conjunction with the other variables in the system to test the portfolio model.

The Rate of Return Forecast

The purpose here is to produce expected rates of return series for investment assets using information which would be available to a bank at the time of forecast. The forecasting model is a simple one. First estimate the following autoregression coefficients:

$$P_t = a_0 + \sum_{i=1}^{n} a_i P_{t-i} + \varepsilon_t.$$

Let P_t^m be the bond price m periods in the future as forecasted in period t. Use the estimated autoregression coefficients recursively to produce forecasts running 1 through m periods into the future:

$$P_t^i = a_0 + a_1 P_t^{i-1} + a_2 P_t^{i-2} + \cdots + a_{i-1} P_t^1 + a_i P_t + a_{i+1} P_{t-1} + \cdots + a_n P_{t+i-n}; \text{ for each } i \ (i = 1, \ldots, m).$$

These price forecasts are combined with the market yield in period t and with an average bid-asked differential to produce m forecasts of rates of return, $E(r_I)_t^1, \ldots, E(r_I)_t^m$.

The data used in the forecasts were generated from the Federal Reserve Board's published average yield on 3 to 5 year Government securities. The yield was converted to a price series for a 4 year, $100.00 par bond issued at a 4 per cent coupon.[14] In order to be consistent with the portfolio data, the forecasts must span the period January 1960 through September 1964.

For rather obvious reasons, the autoregression technique works best when the coefficient estimates are frequently revised by dropping older data from the sample and adding new information as it becomes available. New autoregression coefficients were estimated each quarter over the 1960 to 1964 period. The first set of coefficients were estimated over the period January 1956 through December 1959. On the basis of these coefficients and existing prices as of January 1960, forecasts were made 1 through 12 months into the future. The process was repeated in turn for the prices in February and March 1960. In the second quarter of 1960, the autoregression coefficients were revised by dropping the first quarter of 1956 from the sample and adding the first quarter of 1960. The process of making 12 forecasts each month and of revising the coefficients each quarter was repeated over the entire 1960 to 1964 period. This technique provides a continuous series of price forecasts from which the expected rates of return are generated. Over the 1956 to 1961 period, a fourth order model was necessary to capture the significant coefficients. For the 1962 to 1964 period only a third order model was needed. The autoregression coefficients appear in Table 1.

These coefficients were applied to current and past price data to form the bond price forecasts. The forecasts of future prices were combined with current market yields and an assumed constant bid-asked differential of $1.875 per $1000 bond to form expected rates of return. An example of such a series is presented in Table 2 and Figure 2. The series shows the return expected on the security if it were purchased in period t and sold in period $t + 12$, as well as realized rates of return over the same period.

[14] The yield data are monthly averages of weekly observations.

Table 1 Autoregression Coefficients: Four Year Government Bond

Period	10/55–9/59	1/56–12/59	4/56–3/60	7/56–6/60	10/56–9/60	1/57–12/60	4/57–3/61
a	7.226	7.300	9.561	9.663	9.025	8.620	8.603
P_{t-1}	1.837[a]	1.721[a]	1.720[a]	1.663[a]	1.627	1.656[a]	1.657[a]
	(0.136)	(0.137)	(0.137)	(0.144)	(0.141)	(0.146)	(0.147)
P_{t-2}	−1.583[a]	−1.324[a]	−1.293[a]	−1.237[a]	−1.094[a]	−1.109[a]	−1.072[a]
	(0.258)	(0.255)	(0.254)	(0.273)	(0.258)	(0.272)	(0.277)
P_{t-3}	1.229[a]	1.016[a]	0.939[a]	0.954[a]	0.747[a]	0.683[a]	0.612[a]
	(0.258)	(0.254)	(0.256)	(0.271)	(0.256)	(0.268)	(0.277)
P_{t-4}	−0.554[a]	−0.485[a]	−0.460[a]	−0.475[a]	−0.370[a]	−0.315[a]	−0.282
	(0.139)	(0.142)	(0.142)	(0.142)	(0.140)	(0.142)	(0.146)

Period	7/57–6/61	10/57–9/61	1/58–12/61	4/58–3/62	7/58–6/62	10/58–9/62	1/59–12/62
a	7.329	7.774	7.444	8.971	14.239	7.415	7.485
P_{t-1}	1.558[a]	1.468[a]	1.395[a]	1.380[a]	1.258[a]	1.163[a]	1.185[a]
	(0.160)	(0.151)	(0.139)	(0.148)	(0.148)	(0.144)	(0.151)
P_{t-2}	−0.758[a]	−0.590[a]	−0.476[a]	−0.533[a]	−0.469[a]	−0.292	−0.275
	(0.275)	(0.253)	(0.232)	(0.241)	(0.228)	(0.218)	(0.203)
P_{t-3}	0.128	0.045	0.007	0.064	0.069	0.056	0.015
	(0.160)	(0.151)	(0.136)	(0.144)	(0.136)	(0.127)	(0.152)

Period	4/59–3/63	7/59–6/63	10/59–9/63	1/60–12/63	4/60–3/64	7/60–6/64	10/60–9/64
a	6.925	7.751	11.474	18.246	16.348	18.692	9.119
P_{t-1}	1.187[a]	1.146[a]	1.105[a]	1.057[a]	1.008[a]	1.110[a]	0.964[a]
	(0.151)	(0.149)	(0.138)	(0.139)	(0.153)	(0.143)	(0.151)
P_{t-2}	−0.277	−0.257	−0.275	−0.312	−0.226	−0.229	−0.045
	(0.203)	(0.225)	(0.205)	(0.202)	(0.210)	(0.196)	(0.203)
P_{t-3}	0.021	0.034	0.057	0.075	0.056	−0.066	−0.010
	(0.152)	(0.148)	(0.135)	(0.130)	(0.133)	(0.144)	(0.144)

[a] Regression coefficient is significantly different from zero at the 0.05 level in a two-tailed test.

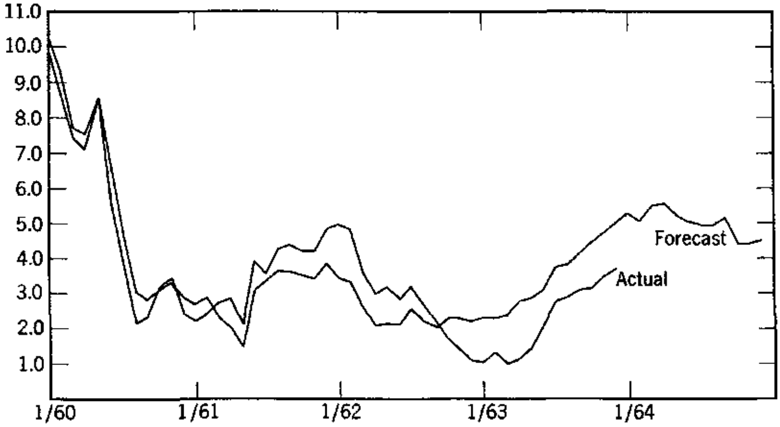

Figure 2 Rates of return: twelve month horizon.

Table 2 Rates of Return: Twelve Month Horizon (Annual Rates)

Forecast Made on	For	Forecast	Actual	Forecast Made on	For	Forecast	Actual
1–60	1–61	10.15	9.82	7–62	7–63	2.63	3.24
2–60	2–61	9.16	8.61	8–62	8–63	2.22	2.69
3–60	3–61	7.72	7.21	9–62	9–63	1.98	2.17
4–60	4–61	7.51	7.05	10–62	10–63	2.31	1.66
5–60	5–61	8.43	8.58	11–62	11–63	2.28	1.44
6–60	6–61	6.71	5.46	12–62	12–63	2.24	1.13
7–60	7–61	4.43	3.84	1–63	1–64	2.30	1.08
8–60	8–61	3.04	2.23	2–63	2–64	2.34	1.31
9–60	9–61	2.81	2.36	3–63	3–64	2.45	0.99
10–60	10–61	3.15	3.18	4–63	4–64	2.84	1.14
11–60	11–61	3.44	3.47	5–63	5–64	2.86	1.50
12–60	12–61	2.94	2.39	6–63	6–64	3.18	2.14
1–61	1–62	2.73	2.19	7–63	7–64	3.80	2.81
2–61	2–62	2.85	2.40	8–63	8–64	3.91	2.94
3–61	3–62	2.37	2.78	9–63	9–64	4.17	3.14
4–61	4–62	2.03	2.93	10–63	10–64	4.49	3.22
5–61	5–62	1.42	2.10	11–63	11–64	4.74	3.52
6–61	6–62	3.10	4.02	12–63	12–64	5.01	3.70
7–61	7–62	3.42	3.47	1–64	1–65	5.32	
8–61	8–62	3.75	4.34	2–64	2–65	5.10	
9–61	9–62	3.72	4.38	3–64	3–65	5.64	
10–61	10–62	3.47	4.17	4–64	4–65	5.66	
11–61	11–62	3.43	4.21	5–64	5–65	5.22	
12–61	12–62	3.96	4.92	6–64	6–65	5.02	
1–62	1–63	3.42	5.03	7–64	7–65	4.92	
2–62	2–63	3.34	4.84	8–64	8–65	4.90	
3–62	3–63	2.50	3.59	9–64	9–65	5.11	
4–62	4–63	1.97	2.96	10–64	10–65	4.44	
5–62	5–63	2.15	3.23	11–64	11–65	4.44	
6–62	6–63	2.14	2.80	12–64	12–65	4.55	

While the autoregression technique provides surprisingly accurate forecasts,[15] it is by no means clear that the expected rates of return generated in this manner are the proper ones to use in testing the portfolio model. A bank has its own forecasts which may differ drastically from those provided here. It is asserted that a large commercial bank is at least as good a forecaster as the author, and probably much better. It is true, however, that the use of the expected rates of return series in estimating coefficients for the portfolio model does introduce an error in variables

[15] The relatively poor showing of the forecasts in the later periods appears to stem from a misspecification of the autoregression model for these periods. Table 1 indicates that P_{t-3} ceases to be significant in the later regressions. These should have been re-estimated assuming a second order structure. Unfortunately, time constraints prevented the re-estimation.

problem. If the bank does in fact make forecasts, it is difficult to see how this problem can be solved. The use of current yields or actual rates of return will lead to similar errors in variables as these are not the variables the bank looks at in adjusting its portfolio.

The Portfolio Model

The asset and liability data used in the statistical analysis are derived from the weekly balance sheets of some 85 large commercial banks.[16] The weekly data cover the period from January, 1960 through September, 1964. The specific banks included in the sample are those which are particularly active in the money market. Such activity is represented by frequent and relatively large purchases and sales of Federal funds and by other behavior which suggests that the banks are willing and able to manage their portfolios closely. The banks in the sample are large and they have access to all the short-term assets which comprise the money market. All Federal Reserve Districts are represented in the sample.

Unfortunately it was not possible to use individual bank data in the empirical work which follows. While the theoretical analysis refers to the behavior of an individual commercial bank, it is necessary to estimate the model using time series data aggregated over all banks in the sample.[17] The use of such data obviously introduces aggregation problems. The fact that banks were included in the sample on the basis of their roughly similar sizes and motives reduces but certainly does not eliminate these problems. A further undesirable feature of the sample is the extremely short period of time which it covers.

The variables used in the empirical analysis appear as follows:

D: Total demand deposits net of required reserves
T: Total time and savings deposits net of required reserves
Y: The Federal Reserve Board's Monthly Index of Industrial Production
$E(r_I)$: The expected rate of return series generated above
R: Reserve assets
I: Investment assets
L: Loans

The data represent monthly observations on all variables. Due to its relatively small size and purely residual character, the level of the capital

[16] The banks comprise a subset of the "Weekly Reporting Member Bank" series which is regularly published in the *Federal Reserve Bulletin*.

[17] All necessary adjustments such as deduction of required reserves from the deposit items were made to the individual bank data.

account is excluded from the model. The shortness of the time span covered by the data prevents any computation of changes in σ_I.

The three equations of the portfolio model are estimated in first difference form. While the values of a variable at two adjacent points in time may be highly correlated, it is not obvious that two adjacent changes are likewise correlated.

Given the nature of the data, the evidence which follows should be interpreted with caution. There is an insufficient number of observations to allow one to draw any convincing conclusions from the results. Part of the data were used in earlier studies where some experimentation with functional forms was attempted.[18] Further experiments are mentioned below.

Due to the lack of any *a priori* knowledge of the length of the planning horizon for investment assets, five sets of regressions were estimated employing the following combinations of the value of j, the forecast horizon:

1. $j = 3, j = 6, j = 9, j = 12$
2. $j = 6, j = 9, j = 12$
3. $j = 6, j = 12$
4. $j = 9, j = 12$
5. $j = 12$

Estimates for (4) and (5) appear in Tables 3 and 4. The standard errors appear in parentheses below the coefficient estimates and d is the value of the Durbin-Watson statistic.

The reduced form character of the equations and the poor quality of the data make interpretation of the results difficult. While the existence of serially correlated residuals precludes tests of significance, some general comments can be ventured. In the interests of brevity, the discussion is confined primarily to the equations in Table 4.

The coefficient estimates for the current changes in the level of demand deposits conform to prior expectations. The bulk of any current change in D is mirrored in R. Given previous deposit changes, a \$1.00 change in D produces approximately a \$0.69 change in R, a \$0.13 change in L and a \$0.09 change in I. These coefficients appear to be reasonable approximations of the short-run response of banks to variations in the levels of their demand deposits.

[18] James L. Pierce, "The Monetary Mechanism: Some Partial Relationships," *American Economic Review: Papers and Proceedings*, May 1964, pp. 523–531 and a revised and extended version of the same paper in Cowles Foundation Discussion Paper No. 168, April, 1964.

Table 3

	ΔR	ΔI	ΔL
Intercept	−0.349	0.101	0.371
ΔD_t	0.713	0.072	0.120
	(0.115)	(0.078)	(0.066)
ΔT_t	0.576	0.072	0.407
	(0.293)	(0.200)	(0.168)
ΔY_t	−0.0004	0.001	0.013
	(0.0318)	(0.022)	(0.183)
$\Delta E(r_I)_t^9$	−0.575	0.511	0.111
	(0.157)	(0.107)	(0.090)
$\Delta E(r_I)_t^{12}$	1.237	−1.110	−0.244
	(0.381)	(0.260)	(0.219)
ΔD_{t-1}	0.073	0.026	−0.139
	(0.133)	(0.091)	(0.076)
ΔT_{t-1}	0.391	−0.303	−0.261
	(0.314)	(0.214)	(0.180)
ΔY_{t-1}	−0.050	0.006	0.034
	(0.032)	(0.022)	(0.019)
$\Delta E(r_I)_{t-1}^9$	−0.553	0.543	0.113
	(0.165)	(0.112)	(0.095)
$\Delta E(r_I)_{t-1}^{12}$	1.833	−1.968	−0.229
	(0.526)	(0.358)	(0.302)
ΔD_{t-2}	−0.047	0.103	−0.021
	(0.136)	(0.093)	(0.078)
ΔT_{t-2}	0.200	−0.051	−0.113
	(0.312)	(0.213)	(0.179)
ΔY_{t-2}	−0.050	0.039	0.024
	(0.034)	(0.023)	(0.020)
$\Delta E(r_I)_{t-2}^9$	−0.244	0.226	0.048
	(0.134)	(0.092)	(0.077)
$\Delta E(r_I)_{t-2}^{12}$	0.817	−0.667	−0.196
	(0.393)	(0.268)	(0.226)
ΔD_{t-3}	−0.166	0.158	−0.012
	(0.124)	(0.085)	(0.071)
ΔT_{t-3}	−0.149	0.273	0.207
	(0.301)	(0.206)	(0.173)
ΔY_{t-3}	−0.204	0.016	0.010
	(0.032)	(0.022)	(0.019)
$\Delta E(r_I)_{t-3}^9$	0.018	−0.038	0.019
	(0.097)	(0.067)	(0.060)
$\Delta E(r_I)_{t-3}^{12}$	0.311	−0.357	−0.057
	(0.338)	(0.230)	(0.194)
R^2	0.712	0.581	0.570
F	3.853	2.152	2.055
d	1.650[a]	1.317[a]	0.808[a]

[a] Evidence of significant serial correlation of residuals at the 95 per cent level.

Table 4

	ΔR	ΔI	ΔL
Intercept	−0.272	0.043	0.347
ΔD_t	0.687	0.093	0.128
	(0.131)	(0.101)	(0.063)
ΔT_t	0.441	0.178	0.432
	(0.332)	(0.256)	(0.161)
ΔY_t	−0.003	0.002	0.015
	(0.036)	(0.028)	(0.017)
$\Delta E(r_I)_t^{12}$	−0.083	0.084	0.007
	(0.172)	(0.133)	(0.083)
ΔD_{t-1}	0.120	−0.022	−0.145
	(0.153)	(0.118)	(0.074)
ΔT_{t-1}	0.410	−0.294	−0.250
	(0.350)	(0.270)	(0.169)
ΔY_{t-1}	−0.034	−0.009	0.032
	(0.037)	(0.028)	(0.018)
$\Delta E(r_I)_{t-1}^{12}$	−0.115	−0.133	0.164
	(0.171)	(0.132)	(0.083)
ΔD_{t-2}	0.017	0.033	−0.031
	(0.153)	(0.118)	(0.074)
ΔT_{t-2}	0.088	0.022	−0.101
	(0.347)	(0.267)	(0.168)
ΔY_{t-2}	−0.041	0.029	0.023
	(0.039)	(0.030)	(0.019)
$\Delta E(r_I)_{t-2}^{12}$	0.061	0.087	−0.039
	(0.164)	(0.127)	(0.079)
ΔD_{t-3}	−0.082	0.080	−0.030
	(0.134)	(0.104)	(0.065)
ΔT_{t-3}	−0.069	0.200	−0.213
	(0.324)	(0.250)	(0.157)
ΔY_{t-3}	−0.001	−0.001	0.007
	(0.031)	(0.029)	(0.018)
$\Delta E(r_I)_{t-3}^{12}$	−0.043	−0.104	0.058
	(0.156)	(0.120)	(0.075)
R^2	0.562	0.184	0.522
F	2.848	0.511	2.548
d	1.402[a]	1.422[a]	1.018[a]

[a] Evidence of significant serial correlation of residuals at the 95 per cent level.

The time and savings deposit coefficients again indicate that the reserve asset portfolio is strongly influenced by current changes in the level of deposits. In this case, however, the coefficient in the loan equation is surprisingly large. The coefficients indicate that a $1.00 change in T produces a $0.44 change in R, a $0.43 change in L, and a $0.18 change in I. These results imply that banks react faster to short-run changes in T than they do to variations in D. It is possible that banks treat changes in T as permanent and immediately begin to adjust their portfolios whereas they apply a "wait and see" attitude with the more erratic short-run variations in D.

There are at least two other interpretations for this result. First, sales of certificates of deposits (CD's) during the period make T partially endogenous. Banks need not sell these liabilities until they are to be lent. To the extent to which CD sales are endogenous to the aggregate, the coefficients of ΔT_t are biased upward in the expression for ΔL_t and downward for ΔR_t.

The second possibility lies in the interpretation of the model itself. The model asserts that banks first receive funds and then gradually place them in the desired assets. During the period studied, the month-to-month variations in T_t were small relative to its mean and the series was subject to a definite upward trend. Under these conditions, the future level of T was highly predictable. The banks should have been able to forecast future levels of T with sufficient accuracy to allow them to make their portfolio decisions on the basis of expected future values of T. The ability to make such adjustments is particularly important for the loan account. The banks may have carried out their loan negotiations before they actually obtained the funds they were to lend. On the basis of this argument, the lags in adjustment exist, but they are associated with expected rather than actual T.

The coefficients for current changes in the level of Y have the expected sign in both sets of regressions. The coefficients in Table 4 indicate that a 1 point rise in current income, e.g., from 100 to 101, leads to a change in R of $-$\$3 million, a change in I of \$2 million, and a change in L of \$15 million. Clearly these coefficients do not approximately sum to zero.[19]

The estimates for changes in rates of return are disappointing. In Table 4 the coefficient for $E(r_I)_t^{12}$ has the expected sign in the expressions for ΔR and ΔI, but it has the wrong sign in the loan equation. The coefficients indicate that a rise of $E(r_I)_t^{12}$ of 1 percentage point leads to a change in R of $-$\$830 million, to a change in I of \$800 million, and to a change in L of \$7 million. The coefficients for both $E(r_I)_t^9$ and $E(r_I)_t^{12}$ in Table 3 are peculiar. The loan equation has the wrong sign for $\Delta E(r_I)_t^9$ and the investment asset equation has the wrong sign for $\Delta E(r_I)_t^{12}$.

The hypothesis concerning the influence of $E(r_I)^j$ on the composition of the total asset portfolio can be adequately tested only if the impact of variations in the rate of return on loans is taken into account. It is likely

[19] Experiments were made with nonlinear forms of the income variable for the five sets of regressions. Neither the use of a quadratic in Y nor a transformation of Y of the form $Y^* = a - a/Y$, where $a = 100$, produced any qualitative change in the results.

that the highly simplified and unrealistic demand for loans function does not capture the impact of loan demand on the composition of the portfolio. It is likely that $E(r_I)^j$ tends to vary positively with the return expected on loans, which suggests that the former may serve as a proxy for the latter in the regressions. Support for this argument is found in the behavior of the residuals (actual less predicted) from the loan equation. Figure 3 indicates the regression equation in Table 4 tends to over-predict changes

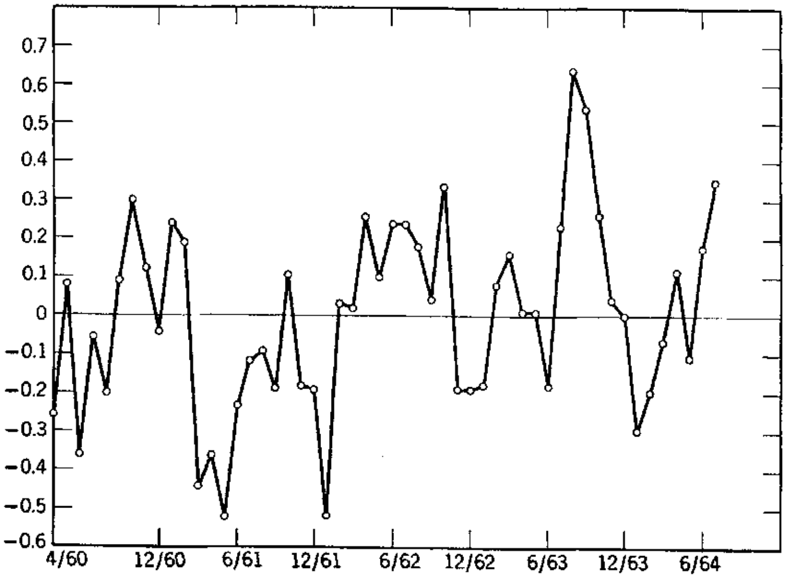

Figure 3 Residuals from the loan equation of Table 4.

in the loan portfolio during recession, 1960 and 1961, and to under-predict during the expansion of 1963 to 1964. This particular lack of serial independence of residuals is consistent with the contention that the expected rate of return on loans is not adequately accounted for in the regression equation. Table 2 indicates that $E(r_I)^{12}$ experienced consistently large month to month changes during the 1960 to 1961 recession. The improper specification of the return on loans should tend to lead to a positive relation between $E(r_I)_t^{12}$ and L_t during this period and to an over-prediction of ΔL_t as the spread of the two relevant rates of return is not fully accounted for. Table 2 also indicates that $E(r_I)^{12}$ rose slowly during the 1963–1964 period. The demand for loans was also rising during the period, but the expected return on loans was doubtless experiencing greater changes than $E(r_I)^{12}$. This should produce the under-prediction of ΔL_t indicated by the residuals during the 1963 to 1964 period.

There is very little that can be said about the coefficients of the lagged values of the exogenous variables. There is no discernible pattern of lagged response evidenced by the coefficients. The regressions do not produce the results expected. There are at least two possible explanations for the failure. The first and most obvious interpretation is that once the influence of current changes in the variables is accounted for, the high correlations between lag values of the variables makes it impossible to say anything about individual coefficients. The second interpretation is that the simplistic distributed lag model does not capture the salient features of bank response through time. The primary assumption of such a model is that the bank does not respond to variations in any relevant variable until a change in that variable actually materializes. The estimated coefficients for current changes in T suggest that banks may attempt to anticipate future movements in the exogenous variables. While the budget constraint requires that current values of the banks' liabilities must influence the current composition of their asset portfolios, no simple relationship is required between past values of the variables and the current portfolio composition. The extent of the relationship is limited to the degree to which the past values enter into the banks' forecasts of current values of the variables. If this argument is valid, it is not surprising that the lagged changes in the exogenous variables produce no predictable results.

IV

The poor quality of the data and the ambiguity of the empirical results make it difficult to draw strong conclusions from the study. A few empirical statements can be made, however. The coefficients for the current changes in D and T are sensible. While the coefficient estimates for changes in Y and $E(r_I)^j$ are unsatisfactory, the analysis of residuals does suggest that the expected behavior was at work during the period.

The results of this study strongly suggest that further work in this area will pay high returns. The use of individual bank data for both cross-sectional and time series analyses should greatly increase the chances of making useful, quantitative statements concerning bank portfolio management.

6

*Life Insurance Investment: The Experience of Four Companies**

LEROY S. WEHRLE

The increasing proportion of individual savings invested in financial intermediaries makes the demand for securities of these institutions a subject of vital interest. However, current economic theory, which is designed to explain an individual's selection of portfolio securities, is not adequate to explain a financial intermediary's demand for portfolio securities. The liability contract between depositor and financial institution exerts an independent influence on the institution's demand for securities. Even though a savings bank depositor may desire maximum return on his deposit, the bank will not accommodate this desire so long as it supplies the joint product, demand liquidity and interest return. For each financial institution, the nature of the liability contract by which the funds are received is different; hence each institution has a somewhat different demand function for securities.

The following study utilizes a variant of a theory of portfolio choice, as developed by Markowitz and Tobin,[1] to examine the actual portfolios of a

* SOURCE: This chapter is a condensation and revision of "Life Insurance Investment—the Experience of Four Companies," *Yale Economic Essays*, Vol. 1, No. 1 (Spring 1961), pp. 70–136, which is a portion of the doctoral dissertation, *Life Insurance Portfolio Selection*, submitted to Yale University in June 1959. I wish to thank Professor James Tobin and Professor Arthur Okun for their valuable criticism and advice on earlier drafts. The Cowles Foundation for Research in Economics generously financed the many computation and research expenses.

[1] Cf. Harry Markowitz, "Portfolio Selection," *The Journal of Finance*, Vol. VIII (March 1952). Also, more recently, *Portfolio Selection*, Monograph 16 of the Cowles Foundation, New York: John Wiley and Sons, 1959. See also James Tobin, "Liquidity Preference as Behavior Towards Risk," *Review of Economic Studies*, Vol. XXV (2), February 1958, reprinted in Cowles Foundation Monograph 19, *Risk Aversion and Portfolio Choice* (New York: John Wiley & Sons, 1967), Chap. 1.

particular financial intermediary, life insurance companies. The theory is modified appropriately to account for the particular investment risks associated with the liabilities of life insurance companies. The purposes of the investigation are to determine the important variables which control life insurance investment and to investigate the similarity of investment policies of different companies. The empirical study consists of an intensive examination of the portfolios of four life insurance companies during the postwar years.

Before presenting the results of the empirical study, it is necessary to describe the relevant aspects of the life insurance contract, list the various attributes of market securities, and briefly survey three different views concerning the principles of investment for life insurance companies.

NEEDS OF LIFE INSURANCE COMPANIES

"Life insurance provides cover against risk of death or survivance and it provides an investment service involving guarantees of future capital security and long-term yield."[2] Life insurance policies are essentially contracts for the future delivery of specific amounts of dollars at specified dates in the future in return for agreed inflows of dollars in a prescribed manner through time. That the benefit payments and premium receipts are predictable stems from the single fact that mortality experience for large groups is predictable. The unique risk of such a contract derives from the circumstance that the interest rate to be earned in the future, on both current and future premium receipts, is guaranteed today. This income risk is one of the paramount aspects of the investment situation of life insurance companies. Experience has proven the other two factors affecting the cost situation, mortality experience and cost of operations, to be generally predictable.

MARKET POSSIBILITIES

The traditional theory of portfolio choice describes the individual as choosing those securities that maximize the value of one variable, expected return. The introduction of uncertainty of future events increases the number of relevant attributes related to any security; the individual must choose securities which yield the optimum *combination* of attributes. The security attributes considered are: (1) return—interest or dividend, (2) default risk—the probability that interest or principal will be defaulted, (3) marketability or salability—the speed with which a security can be

[2] R. J. Kirton and A. T. Haynes, "The Structure of a Life Office," *Transactions of the Faculty of Actuaries*, Edinburgh, Scotland, Vol. 21 (1953).

liquidated at its market price (e.g., mortgages are less marketable than bonds), and (4) income risk—the degree to which future interest return is unpredictable, which is smaller as maturity is longer. The income of a forty year bond purchased today is more predictable than is the income of 160 consecutive Treasury Bills. The market relationship between yield and maturity is referred to frequently and is called the maturity yield function. Yield is placed on the ordinate and maturity on the abscissa. An increasing yield function describes a market situation in which the longer the maturity, the higher the yield.

THREE VIEWS OF LIFE INSURANCE INVESTMENT

Though all investment officers choose their portfolios from approximately the same selection of market securities, there are several reasons why different officers pick different collections of securities.[3] First, various officers visualize the needs of life insurance companies differently; some think yield is most important while others concentrate on minimizing default risk, etc. Second, preferences toward risks and return vary among investment officers independent of their judgment concerning the needs of the companies. Some officers are more willing to take "compensated" risks than others. Third, even if all preferences and needs are the same, there are alternative ways of meeting needs in the market. For example, a portfolio composed of one-half Governments and one-half Baa Industrials may have the same default risk as a portfolio containing all Aa Industrials.

The following summary of three different investment views is heavily indebted to the interesting and stimulating discussion in the Scotch and British actuarial journals.[4] The sketches of the three portfolios are necessarily very brief; only the most salient points are noted. Furthermore, the views are presented in narrow, idealized form in order to sharpen the contrast, rather than to depict faithfully the views of the authors.

The Capital Security Portfolio, the Trustee Viewpoint

> While life insurance is not legally a trust but a contract, it is accurate to say that the relationship between the management and the policy holder partakes of the nature of trustee and beneficiary. . . . The traditional objectives of trustee investment are first, safety; second, yield; and third, liquidity.[5]

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[3] This study is oriented toward explaining the collection of *attributes* of securities or the investment strategy, and not explaining the tactics (particular securities) chosen to implement the strategy.

[4] The most important journals are *The Journal of the Institute of Actuaries*, Cambridge, England (hereafter called *The Journal*), and the *Transactions of the Faculty of Actuaries*, Edinburgh, Scotland (hereafter called *Transactions*).

[5] W. Penman, "A Review of Investment Principles and Practices," *The Journal*, Vol. 64 (1933), pp. 121–152.

Default risk is the paramount risk. The risk of unexpected cash drains (deriving from policy conversions and unanticipated mortality experience) is also important, but subsidiary to default risk.

This capital security viewpoint is colored throughout by its *defensive* investment attitude. Increased coupon yield does not "compensate" for increased default risk. The risk of cash drains is deemed minimal because of the large and predictable cash inflow, yet it is thought prudent to insure against such embarrassment by maintaining a liquidity balance. Income risk is not explicitly discussed by these writers.

In summary, this investment view treats the "guarantee of future capital security" as the essential guarantee of the life insurance contract and hence as the essential objective of life insurance investment. Yield is an important, but secondary, consideration.

The Income Security Portfolio, Hedging the Future Interest Uncertainty

The emphasis of life insurance investment should be on the "guarantee of long-term yield." Stress should be placed on the long-term solvency position of the company with investment policy oriented toward insulating the portfolio from any unfavorable effects of future movements of the interest rate.

Income risk should be minimized by purchasing long maturities which, in some sense, *match* the maturities of the liabilities of the policy contracts.

> When one considers that the assumptions as to interest earning ability have been made in the light of conditions at the point of issue but that actual investment will occur at successive later dates, it seems clear that in theory the most stable position can be obtained by investing the increasing fund in its earlier years in very long securities with a gradual shortening of term of investment of successive increments. Normal investment of a life insurance fund implies a distribution of interest and principal payments which will in all future years be sufficient to meet the net cash outgo on the business in force. This is the only policy which can insulate the fund against adverse effects of changes in interest rates.[6]

If the company guarantees to earn 3 per cent over a thirty year period, it should purchase assets with coupons of at least 3 per cent and maturities of at least thirty years. If securities of shorter maturity than the liability maturities are held, the solvency position of the company is in jeopardy if there is a secular decline in interest rates. If securities of longer maturity than the liability maturities are held, the company will not participate in the increasing yields if a trend of secularly increasing interest rates develops. Thus the "costs" of interest increases and decreases are not symmetrical;

[6] W. M. Anderson, "The Long View of Life Insurance Investment," *General Proceedings*, American Life Convention, 1954, pp. 355–372.

one involves insolvency while the other involves a possible worsening of the competitive position. The fundamental premise of this point of view is that the certainty of protection against insolvency is more important than the chance of earning higher yields.

Increased default risk securities are acceptable within this portfolio so long as the additional coupon premium appears more than sufficient to compensate for the additional risk. No specific liquidity balance is recommended. "The circumstances of the life insurance business are not such as to require a significant liquid position with the consequent loss of yield which this entails."[7]

In summary, while the first portfolio was defensive toward default risk, this portfolio is defensive toward income risk and suggests the purchase of long maturities. Interviews with life investment officers make it apparent that "keeping long" is viewed as a general aim, and does not require the attainment of any specific average maturity.

The Competitive or Yield Portfolio, Emphasis on High Yield

> An active investment policy is a policy which relates the distribution of the investments held at any time to the economic conditions anticipated. This policy involves a willingness to vary the individual investments and to vary the proportions of different groups and classes (and maturities) of investments readily and if considered necessary, often. . . .[8]

Many of the investment risks associated with life insurance are unavoidable,[9] and excessive efforts devoted to reducing these risks are not only unrewarding but dangerous in that they divert attention from the possibility of increasing yield. Increased yield compensates for increased risk.

Moreover, the competitive portfolio investors believe it is both *necessary* to increase yield, to maintain the long-term competitive growth situation of the company within the industry, and *possible* to increase yield, by maintaining a flexible approach toward investment.

The second point relating to the *possibility* of increasing yield is not obvious. Why should losses incurred through mistaken judgments be less than gains incurred through correct judgments? The answer given by these writers is that many institutional investors are constrained in their choice of securities by legal, traditional, governmental, and other restraints. This

[7] *Ibid.*

[8] A. C. Murray, "The Investment Policy of Life Assurance Officers," *Transactions*, Vol. 16 (1937).

[9] For example, the many call provisions prevent income security from ever really being obtained and unless Governments are purchased default risk is never zero.

causes yield spreads or "pockets" to develop from which a "free" investor is able to pick and choose to his advantage.

Several methods of increasing yield are mentioned within the literature and these are outlined here for future reference.

1. Choose maturities which increase yield by choosing the maturity having the largest maturity yield differential. This is termed *following the maturity yield function* and may include either choosing securities:
   (*a*) From among the entire range of maturities.
   (*b*) From among the maturities longer than 10 or 15 years. Investment officers state that they would never purchase very short maturities (commercial bank type maturities) because they are long-term investors.
2. Form expectations of the cyclical pattern of business activity and of interest rates, then invest accordingly. This is defined as *cyclical policy*.
   (*a*) Go short in low interest periods, possibly sell currently high priced long maturities.
   (*b*) Go long in high interest periods, possibly sell short maturities.
3. Form expectations of the average level of the long-term interest rates over an extended future period.
   (*a*) Go short when current long rate is less than expected long rate.
   (*b*) Go long when current long rate is above expected long rate.

Besides purchases which increase yield, it is possible to make sales which increase yield. The different portfolio writers take different views on the desirability of incorporating sales into investment policy. The capital-security writers believe that securities should be held to maturity. The income security and competitive writers suggest that securities be sold whenever yield can be increased. The precise meaning of increased yield will be examined in the next section.

In conclusion, the competitive portfolio affirms the advantages of increased yields while not denying the importance of default and income risk. Also the writers suggest sizeable liquidity holdings as a transactions balance to facilitate opportune purchases.

It is the purpose of the empirical study to reveal to what degree these idealized portfolio views describe and aid in the analysis of the actual portfolios during the postwar period.

AN EMPIRICAL INVESTIGATION OF FOUR COMPANIES

The results and analysis of an intensive empirical examination of four legal reserve life insurance companies of the United States are presented in the following section. Before presenting the analysis it is necessary to describe the empirical study.

The discussion of each company commences with a description of the company derived from facts concerning the company and from impressions gained from interviews with various investment officers. Following the descriptive paragraph there is a paragraph of investment objectives which summarizes the results of the portfolio analyses, and a paragraph which summarizes the major changes in the distribution of portfolio assets during the period studied. Then the analysis follows under the headings Yield, Maturity, Trading, Liquidity, and Cyclical Policy. Default risk is not discussed under a separate heading because few data concerning this risk are available. The aim is to establish the pattern of investment behavior as well as the motivation for the behavior whenever possible.

Within the study, primary emphasis is placed on an examination of investment flows rather than on portfolio stocks. The motivations and objectives underlying an investment decision are quite directly revealed by examining flow statistics (decisions to sell and to purchase) while these investment motivations are disclosed only indistinctly and with a time lag by examining the changing stock of portfolio assets. Furthermore, an examination of the stocks can never disclose turnover within a year, that is, the volume of securities which either mature in less than one year or are sold and repurchased during the same year. Also an examination of stocks cannot disclose the extent to which assets were changed through volition of the life company rather than through calls and redemptions made by the borrowers. For these reasons the actual holdings of the portfolio assets will be referred to only occasionally.

The four companies studied were chosen to obtain a partial representation of the insurance industry in relation to geographic location, age, size, rate of growth of company, and the mutual or stock organization of the company. The companies are designated as companies A through D in ascending order of asset size. There is no secrecy about the companies' identities since the source Schedules[10] are public documents.

Acquisitions are defined as the par value[11] of all securities purchased during a year by one company. Disposals are defined as the amount of

[10] These Schedules are the source of almost all data used in the study. They are called Supporting Schedules or Commissioner's Schedules and are submitted along with the annual statements which give the income and reserve information. Because a standardized report form is required by all states, comparability of the data is not a serious problem. The computation system utilized was the IBM 650 of the Yale University Computation Center.

[11] The unit of measurement for all computations is the par unit. A security purchased for $80 with a par value of $100 is added into the yearly Acquisition total as $100. The actual price paid influences only the calculated maturity yield.

cash[12] received for all repayments of principal for any reasons such as maturity, call redemption, sales, prepayment,[13] etc.

Information describing each bond held by the companies was coded onto IBM cards so that the information obtained concerning bonds is extensive and rich in detail. The most crucial missing piece of information is default risk. No measurement of this is ventured by the companies and none is ventured in this study. Information concerning mortgages and equities relates only to the aggregates so that detailed analysis of these investment assets is not possible.

The life company investment process may be viewed as the yearly exchange of a Disposal package of yield and maturity for an Acquisition package of yield and maturity. Given the existing market prices and rates, ideally the theory should predict both the size and the content of the two packages.

A summary of the statistical results is given in summary Tables 1 through 4. The left side of the table (columns 1 through 7) gives a summary of the year's investment operations; the right side presents details of the bond operations. The tables are designed to be read horizontally.

Column 1 (Cash Flow) is 100 times the ratio of the par value of Acquisitions of bonds during the year to the par value of Disposals (Sales, Calls, Prepayments, and Maturities) during the year. Normally this measure of cash flow into bonds will exceed 100 because of premium and investment income. A figure under 100 indicates a large shift of funds away from bonds.

Column 2 (Sales) is 100 times the ratio of the par value of sales of bonds during the year to bond holdings at the end of the previous year. This number would be small for an inactive portfolio policy, which would rely on maturing bonds to provide funds to meet liquidity needs or to take advantage of new investment opportunities.

Column 3 (Calls) is 100 times the ratio of the par value of calls during the year to bond holdings at the end of the previous year. Calls measure disposals of bonds forced on the life company by the decision of the borrower to exercise a call option.

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[12] Disposals are also measured in terms of par units. A prepayment of $70 on a security which cost $700 and has a par value of $800 is added into Disposals as $80. Calls, Sales, etc. are also converted to par equivalents.

[13] Prematurity payments, called prepayments, have developed in diversity since the war primarily in the corporate sector where direct placements have facilitated this personalized arrangement. The securities contain clauses which specify the terms and options of prepayment. These state the extent to which any one year's amortization payments may be increased, whether payments must be increased if profits increase, for how many years payments can be increased, whether "balloon" repayments exact penalty interest charges, etc.

Column 4 (Liquidity) is 100 times the ratio of average daily holdings of liquid assets to bond holdings at the end of the year. Liquidity securities are defined as those with maturities less than two years. An attempt is made to exclude from the measure replacement purchases within the year of securities with term less than one year. Thus to keep one dollar invested in 90-day bills for a year requires acquisitions of four dollars. But it should be and is counted in the measure only as one dollar. In general this adjustment is made by multiplying the dollar amount of each acquisition of a security with maturity less than one year by the fraction of a year represented by its maturity.

Column 5 (Turnover) shows the ratio of bond holdings at the end of the previous year to Disposals during the year. This is an approximation to the average number of years the company holds a bond, as implicit in its behavior during the year.

Column 6 (Disposals and Acquisitions) has two entries for each year. The upper entry refers to Disposals; the lower entry to Acquisitions. Each entry consists of two parts, e.g., 1.6 | 60. The number before the bar, e.g., 1.6, is the *maturity yield*, y_m, in per cent per annum, of the package of Disposals or Acquisitions to which it refers. The number after the bar is the average year of maturity, e.g. 1960, of the package. Maturity yield is computed from interest coupons and purchase prices, distributing any difference between purchase price and the par value receivable on maturity equally among the years to maturity. Thus the 1947 entry for Company A says that the company disposed of bonds maturing on average in 1960, which would have, if held to maturity, yielded the company a return of 1.6 per cent per annum on their original purchase costs. Likewise during 1947 this company acquired bonds with an average maturity of 18 years, at prices such that their yield to maturity would be 2.5 per cent per annum.

Column 7. The two figures in column 7 attempt to measure the cost of the "trade" of Disposals for Acquisitions. The first number, Appreciation (App) is the appreciation of the Disposals: the capital value realized by their disposition less their original cost, expressed as a percentage of cost. The second number "$y_{hp} - y_m$" is the *trading yield*, y_t, the difference between the *holding period yield*, y_{hp}, for the Disposals and the *maturity yield* for the same assets. The holding period yield of a bond is its yield over the period it was actually held, including the change in capital value as well as interest coupons. The capital gain or loss is allocated equally over the time the bond was held. Thus in 1947 Company A disposed of bonds which had appreciated 0.4 per cent and obtained a yield on them 0.5 percentage points higher than it would have by holding them to maturity.

Table 1 Summary Table for Company A*

		Sales	Calls	Liq		All Bonds			Governments			
	Cash Flow (1)	Bonds (%) (2)	Bonds (%) (3)	Bonds (%) (4)	Turn-over (5)	y_m/mat. (6)		App, $y_{hp} - y_m$ (7)	% of Total (8)	y_m/mat. (9)		App, $y_{hp} - y_m$ (10)
1947	185	15	3.8	5.4	5	1.6 2.5	60 65	76S +0.4, +0.5	61 75	1.6 2.3	60 64	+0.8, +0.4
1948	180	43	2.1	8.5	2	2.1 2.7	62 60	95S 0, +0.1	85 48	2.0 2.0	61 53	
1949	68	59	1.2	15.0	2	2.1 2.4	58 74	97S +0.6, +0.4	60 60	1.5 1.8	52 57	+0.6, +0.2
1950	117	49	0.4	4.4	2	2.6 3.3	64 77	92S +2.0, +1.1	50 29	2.0 1.9	56 56	+0.5, +0.1
1951	144	30	1.9	6.7	3	2.6 3.0	65 76	79S +0.2, +0.2	72 54	2.2 2.5	56 65	84S −0.1, 0
1952	27	9	2.3	4.0	5	3.0 3.4	61 69	40M, 47S +1.6, +1.0	52 26	2.2 2.2	53 55	39S, 60M +0.8, +0.1
1953	253	25	0	4.1	4	3.3 3.6	65 75	91S +1.3, +0.8	45 20	2.6 2.8	56 62	92S +0.2, +0.1
1954	181	15	8.0	0.9	4	3.5 3.1	75 80	57S, 31C +2.8, +1.2	21 13	1.8 1.6	56 58	72S, 27M
1955	148	20	2.5	3.8	4	3.4 3.1	75 79	84S, 10C +1.5, +0.3	33 37	2.7 2.5	65 75	+2.0, 0
1956	207	17	1.1	4.3	5	3.6 3.9	72 76	89S 0, +0.3	33 20	3.1 3.4	60 58	−0.6, −0.1
1957	290	7	1.9	5.3	7	4.0 4.7	63 74	45S, 41M +0.4, +0.5	69 26	3.4 4.0	58 60	50M, 10C

* If there are two entries for one year, the upper line refers to disposals, the lower line to acquisitions. y_m = Maturity yield; y_{hp} = Holding period yield; App = Appreciation; E = Exchange; Liq = Liquidity; S = Sales; C = Calls; PP = Prepayments; M = Maturities; n/a = Not available.

<table>
<tr><th colspan="3">Pol. Subdivisions</th><th colspan="3">Public Utilities</th><th colspan="3">Industrials</th></tr>
<tr><th>% of Total (11)</th><th>y_m/mat. (12)</th><th>App, $y_{hp} - y_m$ (13)</th><th>% of Total (14)</th><th>y_m/mat. (15)</th><th>App, $y_{hp} - y_m$ (16)</th><th>% of Total (17)</th><th>y_m/mat. (18)</th><th>App, $y_{hp} - y_m$ (19)</th></tr>
<tr><td></td><td></td><td></td><td>19
21</td><td>3.0 | 62
2.9 | 67</td><td>+0.9, +0.5</td><td>13
3</td><td>4.0 | 54
3.0 | 72</td><td>100C
+0.4</td></tr>
<tr><td>27</td><td>2.8 | 62</td><td></td><td>9
10</td><td>3.3 | 73
3.4 | 79</td><td>60C
0, +0.9</td><td>4
13</td><td>3.0 | 63
3.4 | 68</td><td>50C, 50S</td></tr>
<tr><td>14
21</td><td>2.8 | 62
3.1 | 78</td><td>+1.7, +0.6</td><td>12
5</td><td>3.1 | 71
3.0 | 79</td><td>+1.1, +0.4</td><td>14
11</td><td>2.9 | 71
3.5 | 68</td><td>+1.1, +0.6</td></tr>
<tr><td>30
41</td><td>3.2 | 72
3.9 | 84</td><td>30C
+3.6, +2.5</td><td>10
3</td><td>3.0 | 74
3.4 | 77</td><td>+2.6, +0.9</td><td>9
7</td><td>2.5 | 71
3.5 | 68</td><td>5C
+3.9, +2.7</td></tr>
<tr><td>15
16</td><td>3.5 | 77
3.9 | 83</td><td>30C
+2.0, +0.9</td><td>4
16</td><td>1.9 | 62
3.3 | 76</td><td>70C
+0.7, +1.2</td><td>6
11</td><td>3.7 | 60
3.6 | 74</td><td>+0.3, +0.8</td></tr>
<tr><td>21
13</td><td>4.0 | 74
3.9 | 74</td><td>30C
+3.8, +1.7</td><td>12
36</td><td>2.7 | 75
3.5 | 77</td><td>70C
+1.5, +1.3</td><td>9
20</td><td>4.4 | 59
4.2 | 69</td><td>5C
+5.0, +2.3</td></tr>
<tr><td>24
6</td><td>4.0 | 75
4.9 | 77</td><td>+2.3, +0.8</td><td>15
45</td><td>3.1 | 72
3.6 | 82</td><td>+3.0, +2.5</td><td>9
16</td><td>3.8 | 74
3.9 | 74</td><td>+1.2, +1.1</td></tr>
<tr><td>21
4</td><td>4.2 | 87
3.6 | 74</td><td>+3.7, +1.1</td><td>36
41</td><td>3.7 | 81
3.2 | 83</td><td>66C
+1.9, +0.9</td><td>18
13</td><td>4.0 | 70
3.6 | 74</td><td>40C
+5.9, +2.3</td></tr>
<tr><td>9
4</td><td>4.4 | 81
3.9 | 84</td><td>30C
+1.1, 0.09</td><td>21
29</td><td>3.6 | 80
3.4 | 85</td><td>30C
−0.1, +0.2</td><td>17
9</td><td>3.6 | 74
3.5 | 74</td><td>+0.4, 0</td></tr>
<tr><td>5
2</td><td>3.3 | 64
4.4 | 75</td><td>−1.9, −0.3</td><td>35
37</td><td>3.7 | 82
3.9 | 85</td><td>8C
+0.3, +0.5</td><td>15
19</td><td>4.1 | 71
4.2 | 72</td><td>27C
+1.8, +0.9</td></tr>
<tr><td>6
6</td><td>6.1 | 72
4.4 | 81</td><td>50M
−0.3, −1.0</td><td>8
32</td><td>4.9 | 83
5.0 | 86</td><td>+1.4, +1.3</td><td>11
31</td><td>4.8 | 72
5.0 | 74</td><td>33C</td></tr>
</table>

Table 2 Summary Table for Company B*

<table>
<tr><th rowspan="2"></th><th rowspan="2">Cash Flow (1)</th><th>Sales Bonds (%) (2)</th><th>Calls Bonds (%) (3)</th><th>Liq Bonds (%) (4)</th><th rowspan="2">Turn-over (5)</th><th colspan="2">All Bonds</th><th colspan="3">Governments</th></tr>
<tr><th></th><th></th><th></th><th>y_m/mat. (6)</th><th>App. $y_{hp} - y_m$ (7)</th><th>% of Total (8)</th><th>y_m/mat. (9)</th><th>App. $y_{hp} - y_m$ (10)</th></tr>
<tr><td>1947</td><td>131</td><td>6</td><td>2</td><td>0</td><td>12</td><td>2.5 | 63
2.9 | 72</td><td>21C, 75S
+2.3, +1.1</td><td>75
26</td><td>2.2 | 64
2.5 | 68</td><td>+2.3, +0.5</td></tr>
<tr><td>1948</td><td>85</td><td>16</td><td>1</td><td>0</td><td>6</td><td>2.4 | 68
2.8 | 72</td><td>92S
+0.3, +0.1</td><td>96
26</td><td>2.3 | 69
1.6 | 52</td><td>+0.2, +0.1</td></tr>
<tr><td>1949</td><td>197</td><td>7</td><td>1</td><td>1.7</td><td>9</td><td>2.1 | 59
2.8 | 72</td><td>20M, 71S
+1.4, +0.6</td><td>79
10</td><td>1.7 | 56
1.3 | 50</td><td>+1.0, +0.2</td></tr>
<tr><td>1950</td><td>44</td><td>15</td><td>4</td><td>0</td><td>5</td><td>2.6 | 66
3.0 | 74</td><td>18C, 79S
+2.3, +0.6</td><td>67</td><td>2.3 | 64</td><td>+1.8, +0.2</td></tr>
<tr><td>1951</td><td>97</td><td>49</td><td>1</td><td>0.2</td><td>2</td><td>2.8 | 69
2.9 | 73</td><td>94S
−0.5, −0.3</td><td>90
59</td><td>2.6 | 69
2.8 | 74</td><td>−0.5, −0.15</td></tr>
<tr><td>1952</td><td>180</td><td>6</td><td>3</td><td>0</td><td>11</td><td>3.2 | 65
3.6 | 73</td><td>28C, 65S
−1.3, −0.2</td><td>30</td><td>2.7 | 65</td><td>−2.2, 0</td></tr>
<tr><td>1953</td><td>140</td><td>15</td><td>1</td><td>0.3</td><td>5</td><td>2.8 | 64
3.2 | 70</td><td>20M, 75S
0, −0.1</td><td>76
46</td><td>2.5 | 64
2.5 | 64</td><td>−1.9, −0.2</td></tr>
<tr><td>1954</td><td>191</td><td>3</td><td>9</td><td>0.9</td><td>12</td><td>3.5 | 68
3.4 | 79</td><td>47C, 40S
+1.8, +0.4</td><td>11</td><td>2.8 | 65</td><td>+3.3, +0.3</td></tr>
<tr><td>1955</td><td>120</td><td>13</td><td>2</td><td>0.8</td><td>5</td><td>2.9 | 67
3.3 | 75</td><td>23M, 66S
−1.4, −0.1</td><td>65
62</td><td>2.5 | 66
3.1 | 76</td><td>−1.9, −0.3</td></tr>
<tr><td>1956</td><td>175</td><td>4</td><td>1</td><td>1.1</td><td>13</td><td>3.4 | 74
4.2 | 74</td><td>18M, 19C, 56S
−1.6, −0.3</td><td>32
2</td><td>2.8 | 76
3.8 | 77</td><td>15C
−0.7, −0.2</td></tr>
<tr><td>1957</td><td>190</td><td>7</td><td>1</td><td>0.6</td><td>10</td><td>3.0 | 68
4.1 | 72</td><td>13M, 13C, 70S
−4.6, −0.3</td><td>67
34</td><td>2.5 | 67
3.1 | 70</td><td>−4.6, n/a</td></tr>
</table>

* If there are two entries for one year, the upper line refers to disposals, the lower line to acquisitions. y_m = Maturity yield; y_{hp} = Holding period yield; App = Appreciation; E = Exchange; Liq = Liquidity; S = Sales; C = Calls; PP = Prepayments; M = Maturity; n/a = Not available.

<table>
<tr><th colspan="3">Pol. Subdivisions</th><th colspan="3">Public Utilities</th><th colspan="3">Industrials</th></tr>
<tr><th>% of Total (11)</th><th>y_m/mat. (12)</th><th>App, $y_{hp} - y_m$ (13)</th><th>% of Total (14)</th><th>y_m/mat. (15)</th><th>App, $y_{hp} - y_m$ (16)</th><th>% of Total (17)</th><th>y_m/mat. (18)</th><th>App, $y_{hp} - y_m$ (19)</th></tr>
<tr><td></td><td></td><td></td><td>25
50</td><td>3.2 | 65
3.0 | 77</td><td>100C</td><td>23</td><td>2.9 | 65</td><td></td></tr>
<tr><td>3
8</td><td>4.4 | 63
3.2 | 74</td><td>50M, 37S</td><td>47</td><td>3.2 | 77</td><td></td><td>16</td><td>3.6 | 60</td><td></td></tr>
<tr><td>6
17</td><td>3.8 | 75
2.9 | 78</td><td>50M</td><td>8
46</td><td>2.9 | 71
2.9 | 77</td><td>83C
−0.7, 0.0</td><td>4
22</td><td>3.1 | 57
3.1 | 64</td><td>45S
−0.25, −0.3</td></tr>
<tr><td>10
11</td><td>3.1 | 71
3.0 | 71</td><td>75S, 20M
+2.8, +0.3</td><td>15
63</td><td>3.1 | 72
2.8 | 79</td><td>80C</td><td>7
22</td><td>3.2 | 63
3.5 | 65</td><td>25S, 50C
+2.8, +0.4</td></tr>
<tr><td>12
1</td><td>4.0 | 63
3.3 | 66</td><td>30S, 67M
+0.9, n/a</td><td>4
16</td><td>2.8 | 72
3.4 | 77</td><td>94S
−1.9, −0.3</td><td>6
16</td><td>3.1 | 62
3.6 | 68</td><td>70S
−0.8, −0.4</td></tr>
<tr><td>18
7</td><td>4.4 | 60
3.2 | 65</td><td>25S
+2.4, n/a</td><td>21
28</td><td>3.0 | 71
3.5 | 79</td><td>10C, 90S
−2.1, −0.1</td><td>28
52</td><td>3.6 | 57
3.7 | 74</td><td>60C, 33S
0, −0.6</td></tr>
<tr><td>3</td><td>4.5 | 55</td><td>25M, 55S
+7.6, +1.0</td><td>6
11</td><td>3.0 | 72
3.9 | 79</td><td>94S
−4.5, −0.5</td><td>13
27</td><td>3.5 | 64
4.0 | 71</td><td>20C, 61S
−1.7, −0.7</td></tr>
<tr><td>11</td><td>4.0 | 64
3.1 | 83</td><td>70C
+1.7, −0.4</td><td>30
36</td><td>3.5 | 76
3.3 | 82</td><td>45C, 45S
+2.3, +0.2</td><td>41
31</td><td>3.7 | 64
3.7 | 71</td><td>60C, 33S
+1.4, +0.4</td></tr>
<tr><td>2
6</td><td>4.1 | 59
3.3 | 83</td><td>25S, 25M
+1.8, −1.5</td><td>12
10</td><td>3.0 | 78
3.5 | 81</td><td>80S
−2.3, −0.3</td><td>19
21</td><td>3.8 | 66
4.0 | 67</td><td>30S, 33C
+1.7, 0</td></tr>
<tr><td>7
19</td><td>3.6 | 75
4.1 | 88</td><td>40S, 35C, 25M
+2.7, +0.4</td><td>26
5</td><td>3.1 | 78
3.8 | 84</td><td>90S
−2.7, −0.6</td><td>33
62</td><td>4.1 | 69
4.3 | 70</td><td>10M, 30C, 37S
−1.6, −1.0</td></tr>
<tr><td>3</td><td>4.9 | 72</td><td></td><td>9
8</td><td>3.3 | 77
4.5 | 66</td><td>70S
−7.5, −0.5</td><td>19
37</td><td>4.4 | 62
4.9 | 71</td><td>15S, 50C
−5.2, −2.2</td></tr>
</table>

Table 3 Summary Table for Company C*

<table>
<tr><th rowspan="2"></th><th rowspan="2">Cash Flow (1)</th><th>Sales</th><th>Calls</th><th>Liq</th><th rowspan="2">Turn-over (5)</th><th colspan="2">All Bonds</th><th colspan="3">Governments</th></tr>
<tr><th>Bonds (%) (2)</th><th>Bonds (%) (3)</th><th>Bonds (%) (4)</th><th>y_m/mat. (6)</th><th>App, $y_{hp} - y_m$ (7)</th><th>% of Total (8)</th><th>y_m/mat. (9)</th><th>App, $y_{hp} - y_m$ (10)</th></tr>
<tr><td>1947</td><td>96</td><td>10</td><td>3.5</td><td>0.5</td><td>4.2</td><td>2.7 | 67
2.9 | 66</td><td>+3.3, +1.1</td><td>81
45</td><td>2.6 | 69
2.4 | 63</td><td>62S, 38E
+3.3, +1.0</td></tr>
<tr><td>1948</td><td>96</td><td>35</td><td>0.4</td><td>4.0</td><td>1.8</td><td>2.1 | 62
2.7 | 63</td><td>32E
+0.5, 0</td><td>88
66</td><td>2.0 | 61
2.2 | 60</td><td>70S, 30E
+0.5, −0.3</td></tr>
<tr><td>1949</td><td>95</td><td>10</td><td>2.4</td><td>0.2</td><td>6</td><td>2.7 | 68
3.3 | 67</td><td>19E
+0.2, −0.2</td><td>57
6</td><td>2.4 | 68
0.9 | 49</td><td>96S, 4C
+0.2, −0.2</td></tr>
<tr><td>1950</td><td>72</td><td>11</td><td>4.7</td><td>0.2</td><td>5</td><td>2.8 | 70
3.4 | 69</td><td>9E
+0.8, −0.2</td><td>50
1</td><td>2.5 | 71
2.5 | 62</td><td>100S
+0.8, −0.1</td></tr>
<tr><td>1951</td><td>84</td><td>14.4</td><td>2.5</td><td>3.7</td><td>2.6</td><td>2.5 | 64
3.2 | 64</td><td>19E
+0.2, +0.1</td><td>60
36</td><td>2.2 | 64
2.4 | 60</td><td>49S, 35M
−0.1, −0.3</td></tr>
<tr><td>1952</td><td>106</td><td>4.6</td><td>6.2</td><td>2.2</td><td>3.9</td><td>2.9 | 62
3.7 | 65</td><td>14E
−1.5, 0</td><td>19
22</td><td>1.8 | 52
2.1 | 52</td><td>86M, 14S
0, n/a</td></tr>
<tr><td>1953</td><td>97</td><td>4.7</td><td>3.3</td><td>2.6</td><td>4.2</td><td>2.7 | 60
3.6 | 62</td><td>17E
−0.3, −0.2</td><td>51
43</td><td>2.2 | 57
2.4 | 54</td><td>63M, 24S
−0.3, 0</td></tr>
<tr><td>1954</td><td>95</td><td>5.8</td><td>6.3</td><td>0.9</td><td>3.9</td><td>2.6 | 63
3.6 | 64</td><td>13E
+1.1, +0.7</td><td>38
42</td><td>1.3 | 55
1.8 | 55</td><td>66M, 28S
+0.8, n/a</td></tr>
<tr><td>1955</td><td>100</td><td>3.8</td><td>3.3</td><td>1.4</td><td>4.6</td><td>2.6 | 61
3.8 | 65</td><td>11E
−1.2, −0.4</td><td>52
51</td><td>1.8 | 56
1.8 | 56</td><td>83M, 17S
−1.2, n/a</td></tr>
<tr><td>1956</td><td>94</td><td>13.5</td><td>3.0</td><td>3.5</td><td>2.3</td><td>3.5 | 61
3.7 | 62</td><td>8E
−2.2, −0.2</td><td>48
29</td><td>2.7 | 60
2.6 | 57</td><td>53S, 42M
−2.1, −0.3</td></tr>
<tr><td>1957</td><td>102</td><td>4.2</td><td>3.3</td><td>2.1</td><td>3.4</td><td>3.5 | 62
4.2 | 64</td><td>14E
−0.4, −0.9</td><td>25
16</td><td>3.2 | 64
3.2 | 59</td><td>50S, 33E
0, −0.6</td></tr>
</table>

* If there are two entries for one year, the upper line refers to disposals, the lower line to acquisitions. y_m = Maturity yield; y_{hp} = Holding period yield; App = Appreciation; E = Exchange; Liq = Liquidity; S = Sales; C = Calls; PP = Prepayments; M = Maturities; n/a = Not available.

<table>
<tr><th colspan="3">Pol. Subdivisions</th><th colspan="3">Public Utilities</th><th colspan="3">Industrials</th></tr>
<tr><th>% of Total (11)</th><th>y_m/mat. (12)</th><th>App, $y_{hp} - y_m$ (13)</th><th>% of Total (14)</th><th>y_m/mat. (15)</th><th>App, $y_{hp} - y_m$ (16)</th><th>% of Total (17)</th><th>y_m/mat. (18)</th><th>App, $y_{hp} - y_m$ (19)</th></tr>
<tr><td>1</td><td>3.1 | 67</td><td></td><td>7
25</td><td>3.2 | 64
3.0 | 75</td><td>85C, 12E
+1.8, +1.1</td><td>11
29</td><td>3.4 | 60
3.5 | 62</td><td>78C, 11.4E
+0.8, n/a</td></tr>
<tr><td>3</td><td>3.1 | 70</td><td></td><td>7
16</td><td>2.9 | 75
3.1 | 77</td><td>76E, 19S
+3.1, +0.4</td><td>4
15</td><td>3.1 | 59
3.3 | 62</td><td>48C, 37M + PP
+0.3, 0</td></tr>
<tr><td>2</td><td>3.2 | 70</td><td></td><td>17
40</td><td>2.9 | 75
3.1 | 74</td><td>88E, 4S, 4C
−0.2, −0.1</td><td>25
52</td><td>3.0 | 63
3.4 | 64</td><td>48C, 17S
−0.1, −0.2</td></tr>
<tr><td>1
6</td><td>2.9 | 65
3.3 | 71</td><td>50M, 50S
+6.4, +1.8</td><td>23
29</td><td>3.0 | 75
3.2 | 76</td><td>41C, 34E, 21S
−0.8, −0.5</td><td>25
56</td><td>3.3 | 63
3.6 | 64</td><td>60C, 10S, 27M + PP
+2.0, +0.3</td></tr>
<tr><td>2
2</td><td>3.0 | 73
3.2 | 80</td><td>+6.0, +1.3</td><td>13
20</td><td>3.0 | 74
3.3 | 74</td><td>57E, 31S
0, −0.1</td><td>25
40</td><td>2.9 | 58
3.4 | 61</td><td>60M + PP, 21C, 13S
+0.5, +0.2</td></tr>
<tr><td>3</td><td>3.1 | 71</td><td>67S, 26PP
+4.7, +1.3</td><td>18
16</td><td>2.9 | 76
3.5 | 77</td><td>52E, 38S
−4.4, −0.1</td><td>59
59</td><td>3.3 | 61
3.9 | 65</td><td>44M + PP, 39C
−1.4, −0.5</td></tr>
<tr><td>2
2</td><td>3.0 | 80
3.7 | 83</td><td>50S
+2.5, +0.8</td><td>12
18</td><td>3.6 | 69
4.1 | 72</td><td>63E, 13C, 13S
−1.7, −0.8</td><td>34
37</td><td>3.2 | 60
4.2 | 64</td><td>46M + PP, 36C, 13S
−1.1, −0.7</td></tr>
<tr><td>2
4</td><td>3.1 | 76
4.0 | 91</td><td>85C, 13S
−0.2, −0.1</td><td>20
15</td><td>3.4 | 73
3.8 | 76</td><td>45C, 27E, 20S
+4.5, +3.2</td><td>38
39</td><td>3.4 | 65
4.3 | 67</td><td>36C, 33M + PP, 16S
−0.5, −0.4</td></tr>
<tr><td></td><td></td><td></td><td>8
7</td><td>3.3 | 72
3.9 | 77</td><td>51S, 30PP
−1.6, −0.9</td><td>39
41</td><td>3.5 | 65
4.5 | 75</td><td>38C, 25PP, 24E
−0.4, −0.6</td></tr>
<tr><td></td><td></td><td></td><td>7
8</td><td>3.4 | 73
4.0 | 76</td><td>48E, 33S, 19PP
−2.9, −0.4</td><td>45
56</td><td>4.4 | 61
4.4 | 63</td><td>62M, 14C, 5S
−3.2, −1.4</td></tr>
<tr><td></td><td></td><td></td><td>3
9</td><td>4.0 | 73
5.4 | 78</td><td>62PP, 32E
−5.5, −1.5</td><td>67
68</td><td>3.6 | 60
4.5 | 63</td><td>69M, 11PP, 12C
−4.8, −1.2</td></tr>
</table>

Table 4 Summary Table for Company D*

	Cash Flow (1)	Sales Bonds (%) (2)	Calls Bonds (%) (3)	Liq Bonds (%) (4)	Turnover (5)	All Bonds y_m/mat. (6)	All Bonds App, $y_{hp} - y_m$ (7)	Governments % of Total (8)	Governments y_m/mat. (9)	Governments App, $y_{hp} - y_m$ (10)
1947	117	6.9	1.0	0	12	2.5 | 60 3.0 | 67	−0.5, −0.2	79 13	2.3 | 61 2.5 | 64	−0.6, −0.2
1948	97	10.4	0.3	0.3	7	2.1 | 65 3.3 | 60	+0.1, +0.1	93 35	2.1 | 65 2.6 | 52	+1.4, +0.4
1949	80	8.3	1.3	0.2	8	2.1 | 53 3.5 | 63	+0.4, +0.1	85 25	1.8 | 52 1.0 | 49	+0.7, +0.3
1950	73	17	4.5	1.6	3	2.2 | 60 2.8 | 60	+1.4, +0.2	82 56	2.0 | 59 1.6 | 52	+1.4, +0.6
1951	96	57	1.3	8.3	1.7	2.0 | 58 2.8 | 60	+0.3, +0.3	96 78	1.9 | 58 2.2 | 56	+0.3, +0.3
1952	120	3	2.9	5.0	3	2.2 | 56 3.2 | 62	−2.7, −0.2	86 64	1.9 | 54 1.8 | 52	−3.1, −0.4
1953	120	4	0.6	3.1	4	2.5 | 56 4.0 | 61	−3.1, −0.2	77 53	2.1 | 54 2.1 | 53	−3.1, −0.4
1954	110	2	3.4	3.5	3.6	1.6 | 58 3.2 | 70	+3.0, +1.0	75 61	0.9 | 55 0.8 | 54	−0.4, 0
1955	120	0	2.7	3.4	4.4	2.0 | 57 3.1 | 70	0, +0.1	83 66	1.6 | 55 1.6 | 55	100M
1956	120	3	2.5	2.5	4.7	2.0 | 58 4.1 | 68	−7.5, −0.6	78 55	2.6 | 58 2.7 | 56	14S −7.5, −0.7
1957	125	3	1.2	1.6	6.5	3.3 | 61 4.2 | 69	−5.0, −0.1	75 47	3.1 | 60 2.7 | 57	−4.4, −0.3

* If there are two entries for one year, the upper line refers to disposals, the lower line to acquisitions. y_m = Maturity yield; y_{hp} = Holding period yield; App = Appreciation; E = Exchange; Liq = Liquidity; S = Sales; C = Calls; PP = Prepayments; M = Maturities; n/a = Not available.

<table>
<tr><th colspan="3">Pol. Subdivision</th><th colspan="3">Public Utilities</th><th colspan="3">Industrials</th></tr>
<tr><th>% of Total (11)</th><th>y_m/mat. (12)</th><th>App, $y_{hp} - y_m$ (13)</th><th>% of Total (14)</th><th>y_m/mat. (15)</th><th>App, $y_{hp} - y_m$ (16)</th><th>% of Total (17)</th><th>y_m/mat. (18)</th><th>App, $y_{hp} - y_m$ (19)</th></tr>
<tr><td>6
2</td><td>3.8 | 49
4.1 | 88</td><td>100M
−10.0</td><td>7
22</td><td>3.3 | 62
3.0 | 71</td><td>81C</td><td>7
62</td><td>3.2 | 62
3.1 | 65</td><td>70C</td></tr>
<tr><td>2</td><td>2.9 | 50</td><td>100M</td><td>9</td><td>3.3 | 68</td><td></td><td>4
54</td><td>3.3 | 57
3.5 | 64</td><td>35C, 50PP</td></tr>
<tr><td>2
3</td><td>2.8 | 49
4.5 | 64</td><td></td><td>2
9</td><td>3.8 | 61
3.2 | 75</td><td>50C
+0.7, 0</td><td>11
62</td><td>3.2 | 63
3.6 | 66</td><td>83C, 16PP</td></tr>
<tr><td>1
1</td><td>2.7 | 56
4.0 | 93</td><td></td><td>6
15</td><td>3.2 | 67
3.0 | 75</td><td>91C
+1.5, +0.3</td><td>11
27</td><td>3.2 | 63
3.4 | 67</td><td>83C
+1.1, +0.3</td></tr>
<tr><td>2</td><td>3.3 | 85</td><td></td><td>3</td><td>3.2 | 71</td><td></td><td>4
17</td><td>3.5 | 59
3.8 | 68</td><td>51C, 43M + PP
0, +0.1</td></tr>
<tr><td>1</td><td>4.1 | 54</td><td>100M</td><td>5
9</td><td>3.0 | 74
3.4 | 77</td><td>93C
0, 0</td><td>8
27</td><td>3.7 | 62
3.9 | 83</td><td>52C, 37M + PP</td></tr>
<tr><td></td><td></td><td></td><td>1
5</td><td>3.8 | 61
4.1 | 68</td><td>16C, 83M + PP</td><td>21
42</td><td>3.5 | 62
4.6 | 69</td><td>12C, 71M</td></tr>
<tr><td></td><td></td><td></td><td>6
6</td><td>3.9 | 62
4.0 | 74</td><td>82C
0, −0.1</td><td>13
33</td><td>3.8 | 66
4.0 | 99</td><td>56C, 43M + PP</td></tr>
<tr><td></td><td></td><td></td><td>2</td><td>3.7 | 70</td><td>11C, 85PP
+3.5, +1.0</td><td>15
34</td><td>3.7 | 68
3.7 | 98</td><td>74C, 26M + PP</td></tr>
<tr><td>2</td><td>4.4 | 70</td><td>28C, 25S
−11.0, 0</td><td>3</td><td>3.4 | 72</td><td>38PP, 58S
−9.8, −0.9</td><td>16
45</td><td>3.5 | 66
4.3 | 82</td><td>68C, 12PP
−11.5, −1.4</td></tr>
<tr><td>1</td><td>4.0 | 67</td><td>50S
−9.1, −1.0</td><td>2</td><td>3.3 | 70</td><td>22C, 15S
−11.8, −1.1</td><td>4
52</td><td>3.8 | 64
4.7 | 79</td><td>−11.9, −1.5</td></tr>
</table>

Columns 8, 11, 14, 17. These columns refer to four particular types of bonds. The upper number gives Disposals of bonds of this type as a percentage of total Disposals of bonds during the year. For example, in 1947, 61 per cent of Disposals and 75 per cent of Acquisitions by Company A were government bonds. The four percentages in any row do not necessarily add to 100 because the four types of bonds tabulated are not exhaustive.

Columns 10, 13, 16, 19. These columns give, for each category of bonds, the same statistics for Appreciation and Trading Yield described for column 7. These usually refer only to sales, even if sales are a small portion of the disposal flow for that category. In some cases the figures refer to calls, and these are indicated by underlining.

In some cases, information on the composition of Disposals is given in columns 7, 10, 13, 16 and 19 above the main entry. The figures are percentages of Disposals of the relevant bond category which are Sales (S), Calls (C), Maturities (M), Prepayments (pp) and Exchanges (E).

It is apparent what constitutes a lengthening of maturity: the maturity of the asset sold is less than the maturity of the asset purchased.

To explore what constitutes a gain in yield, it is necessary to distinguish four different yields, three relating to the original asset and one relating to a new asset. The original maturity yield, y_m, and the holding period yield, y_{hp}, have been defined and discussed previously. There is also the current maturity yield y_m', which is the yield which an investor would make by buying the original asset at the current price and holding it to maturity. Knowing any two of the three yields, the third can be found because the weighted sum of holding period yield and current maturity yield must always be equal to the original maturity yield.[14]

For comparison, there is the maturity yield y_m'' on some newly issued security at the time the old security is sold.

The purpose of presenting the interrelationships between these different

[14] Let the holding period be designated by *hp* and the time remaining to maturity as *tr*, then the following linear approximation describes the relationship:

$$y_m = \frac{hp(y_{hp}) + tr(y_m')}{hp + tr}$$

where

$hp + tr$ = original maturity, and
y_m = original maturity yield
y_m' = current maturity yield
y_{hp} = holding period yield
y_t = trading yield = $y_{hp} - y_m$

These relate to the same security viewed over different periods of time at different market prices.

yields is to isolate the correct yield alternatives *at the time an asset is sold.* The two alternatives are: (1) do not sell the security, thus obtain the current yield to maturity y_m' on the old asset and forego purchasing some new market asset with a new maturity yield y_m''; (2) purchase a new market asset with acquisition maturity yield y_m'' and thus sell the old asset foregoing the remaining maturity yield y_m' on that asset. In this study when the motivation for a sale is analyzed, one of the tests used will be a comparison of y_m' with y_m''.

Since y_m' is not given in the summary tables it will be helpful to know under what conditions it will be sufficient to compare only y_m'' and y_m to determine if trading increased yield. The two conditions are as follows. When trading yield is positive and new yield is greater than original maturity yield of the old asset, there is necessarily a gain of yield; that is, if $y_{hp} > y_m$, then $y_m' < y_m$ (by footnote 14). Hence, if $y_m < y_m''$, then necessarily $y_m' < y_m''$, and trading gives a gain of yield.

Within the study maturity is divided into 10 quinquennial classes designated by K's (not shown in the summary tables). Each K class includes 5 years with the subscript denoting the particular five year period. For example, K_0 represents all securities having maturities from 1 to 5 years in the future from the current date; K_1, all having maturities from 6 to 10 years in the future; and K_9, those having maturities beyond 46 years in the future.

COMPANY A

Company A, a stock company, is the smallest of the companies studied and one of the fastest growing companies in the country. Its assets were 160 million in 1946 and over 700 million in 1957; this is a 340 per cent increase compared to an industry average of only 100 per cent. Portfolio management policies appear extremely consistent throughout the period. The company is known within the industry for its aggressive sales policy and its very active investment policies.

Investment Objectives

From the portfolio analysis it is concluded that this company invests as if the following directive were followed: a diversified bond portfolio should be maintained and mean portfolio maturity should normally be longer than 20 years. Sales and purchases should be actively utilized whenever portfolio yield can be increased without invalidating the maturity and diversification constraints. In order to carry out this trading policy, a liquidity position of short maturities must be maintained. Thus, as will be shown, this company invests as if it were maximizing expected yield subject to maturity, diversification, and liquidity constraints.

Distribution of Assets

Figure 1 shows the allocation of funds among mortgages, bonds, and stocks in the upper half and among bond categories in the lower half. Both figures indicate an unusual condition shared by few United States life companies in 1947; the distribution of assets inherited from the wartime period was an acceptable distribution or allocation even in the postwar period. That the portfolio was in balance in 1947 can be inferred from the policy of the ensuing years in which all assets were increased and none decreased. Governments were not sold, but were slowly increased throughout the period. The bond-mortgage composition reveals a faster increase of mortgages (shorter-term assets) than bonds until 1951, and thereafter a faster increase of bonds (longer-term assets). Moreover, since 1951 mortgages have increased faster than bonds during low interest periods and bonds have increased faster than mortgages during high interest periods.

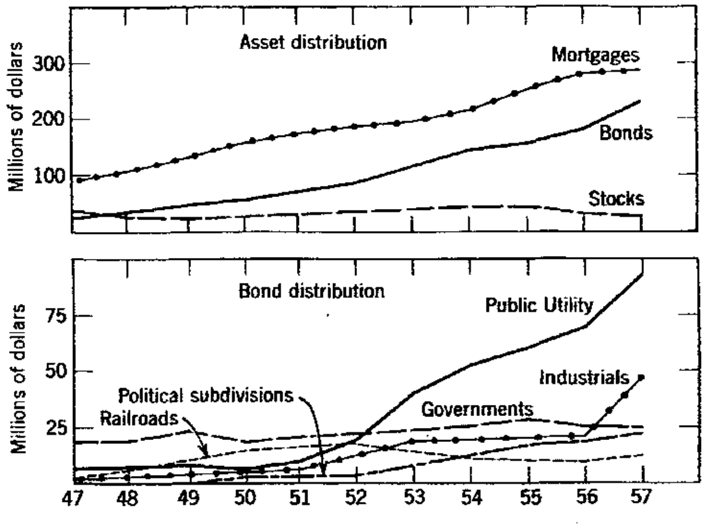
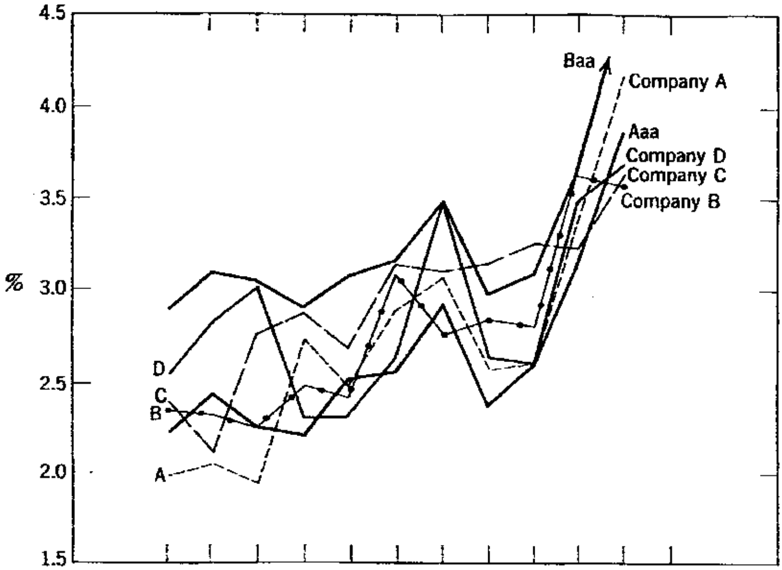


Figure 1 Company A.

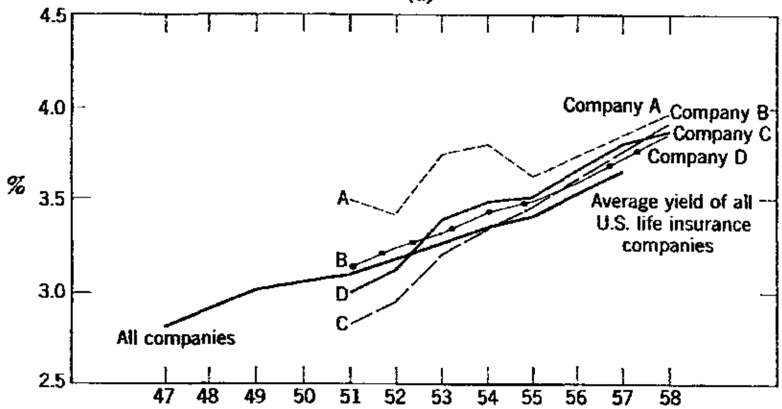
Yield[15]

Acquisition yield (Figure 2*a*) has consistently remained near those of Companies B and D, but increased more than B and D from 1955 to 1957.

[15] The new issue yields of market securities having a Moody's Aaa and Baa rating are depicted in Figure 2*a*. This graph portrays the cyclical patterns of interest rates as well as the generally rising trend of rates during the postwar period.



(*a*)

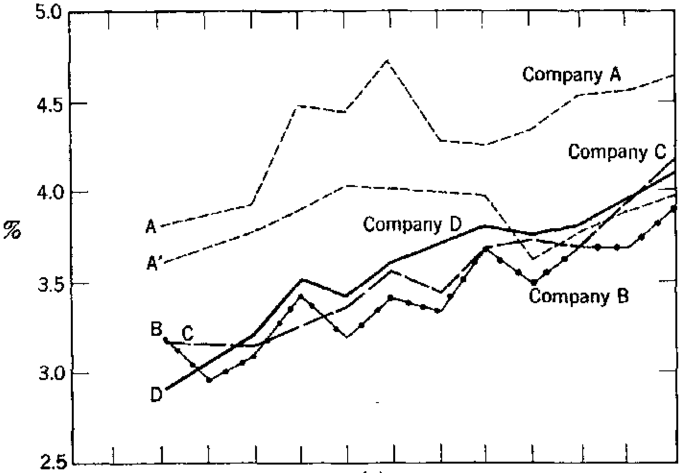


(*b*)

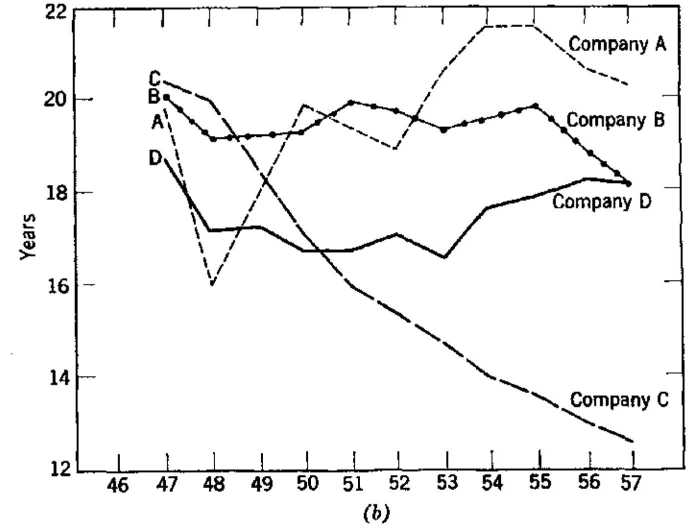
Figure 2 (*a*) Mean acquisition yield. Baa and Aaa yields are Moody's rating for new issues. (*b*) Net portfolio yield. Yield before taxes, exclusive of capital gains and inclusive of investment expenses: as reported in the Commissioner's Schedules; yields before 1953 and after taxes.

Yield on a gross basis inclusive of capital gains and losses is, however, consistently above the gross yields of the other companies. The company's policy of large sales has produced continual capital gains. The comparison of gross yields is given in Figure 3*a* and is discussed further under Trading.

The interrelationship of liquidity balance and Acquisition yield is strikingly revealed by comparing Figure 2*a* and 4. Since the maturity yield



(a)



(b)

Figure 3 (*a*) Gross mean portfolio yields. Gross portfolio yield for each year is defined as [capital gains − capital losses + interest and dividend income]/[end of year value of all admitted portfolio assets]. A′: net portfolio yield (net of capital gains) for Company A. (*b*) Mean maturity of bond holdings.

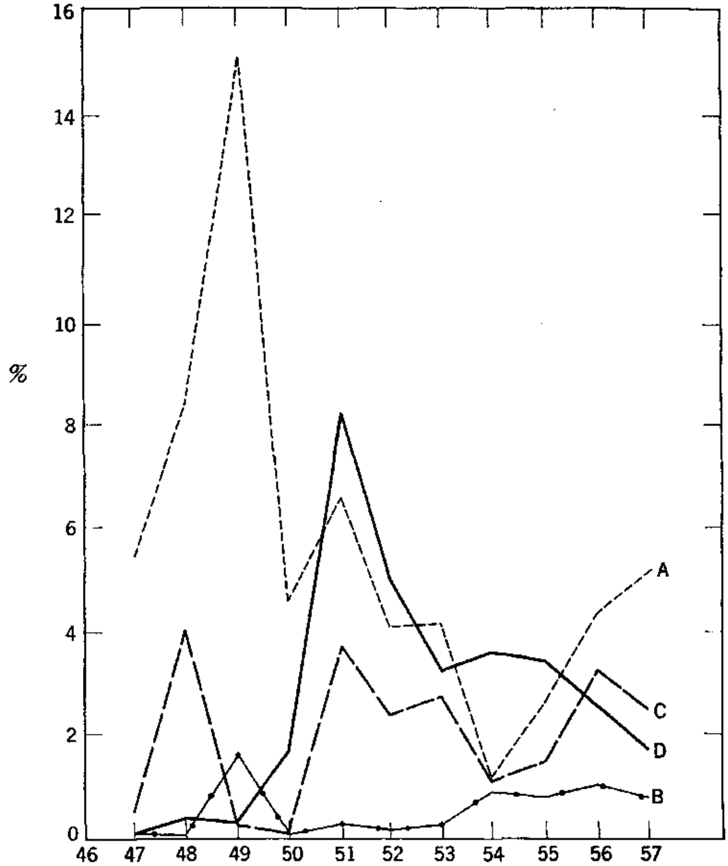


Figure 4 Liquidity ratio. Approximate average daily holding of liquid assets during the year as a percentage of bond holdings at the end of the year.

function normally slopes upward (Table 6), an increase of liquidity balance means less increase of yield than if liquidity balance had remained constant or decreased. That is, if life companies keep liquidity constant, their Acquisition yields will, as an approximation,[16] move parallel to the Baa and Aaa market yields (new issue yields). The Baa yield should act as a "ceiling" because the valuation procedures, which all the legal reserve companies operate under, do not allow amortization of securities with default ratings below Baa. For this reason companies purchase few of these riskier securities.

[16] The distance between Baa and Acquisition yields is influenced by, in addition to liquidity, the proportion of long-term Governments purchased. For this company, this is small and relatively constant (Figure 1).

The three years of large liquidity balances, 1947 to 1949, cause a very low acquisition yield. In 1950, when the liquidity balance falls precipitously, the acquisition yield increases sharply to almost meet a declining Baa yield. In 1951, market Baa yields increase, but Company A's yield decreases because of an increase in liquidity balance. The inverse relationship between liquidity balance and yield is also evident in the later years, although not in 1956 or 1957 because of the nearly horizontal maturity yield function then.

Maturity

Bond maturity averages 20 years and is the longest of the companies studied (Figure 3*b*). Yet call protection seems the weakest with an average of 2.3 per cent of bond holdings called in each year.

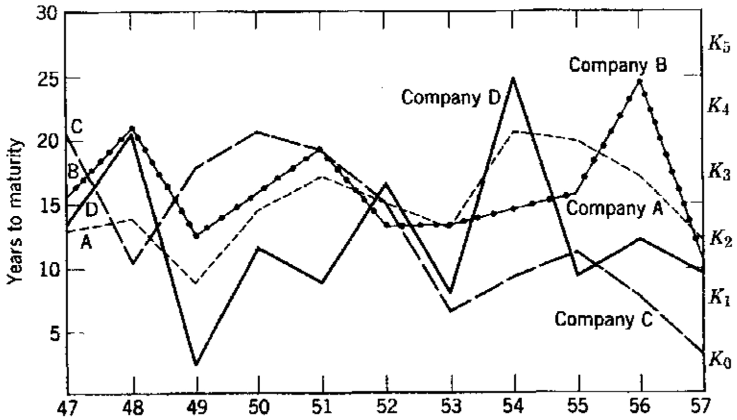


Figure 5 Mean maturity of sales.

In 1948 the average maturity of bond holdings was quite short at 16 years (10 per cent of the bonds were liquidity assets, i.e., had maturities of less than two years). By 1955 the average maturity had been increased to 21.7 years (Figure 3*b*). This was accomplished largely by an extensive purchase of Public Utilities which averaged almost 40 per cent of bond allocations from 1952 to 1956 with a mean maturity date of 1982, or 28 years. To some extent, this lengthening of maturity was offset by large sales in the same maturity range as purchases (summary table, columns 11, 14, and 17, also Figure 5).

The fluctuations in the maturity of Acquisitions are shown in Table 5.

1954 and 1955 are the only two years in which the maturity of Acquisitions is not consistent with a policy of moving toward the high

Table 5 Average Maturity of Acquisitions

Year	49	50	51	52	53	54	55	56	57
Average years to maturity	15	21	25	17	22	26	24	20	17

point of the maturity yield function (between K_3 and K_9) (Table 6 and Figure 6).[17]

The acquisition maturities observed are consistent with the policy directive: maximize yield by choosing the maturities longer than K_3 that have the highest yield, but whenever possible purchase long-term securities. That is, purchase long maturities if the yield foregone is not "too" large.

Table 6 Maturity Yields by Maturity Classes

Year	K_0 1–5 years	K_1 6–10 years	K_3 16–20 years	K_5 26–30 years	K_7 36–40 years	$K_{8 \text{ or } 9}$ over 40 years
47	2.0	3.0	2.6	2.7	—	—
48	1.9	2.1	3.2	3.1	3.1	—
49	1.3	4.6	2.8	3.5	3.1	3.5
50	1.6	4.9	3.3	3.1	3.2	4.0
51	2.2	4.7	3.1	3.0	4.0	4.1
52	2.7	3.6	3.7	3.8	3.3	3.3
53	3.0	4.6	3.9	3.6	5.1	4.0
54	1.6	5.0	3.7	3.1	3.2	3.4
55	2.0	5.2	3.6	3.3	3.2	—
56	3.6	4.8	3.7	4.0	3.8	3.9
57	4.1	5.1	5.0	5.0	4.0	—

Note: When yield of K_8 or K_9 is underlined it indicates that at least 5 per cent of Acquisitions were made in this long maturity category.

Trading Policy

This company is unique in that during most of the postwar years the percentage flows into and out of the bond categories have been nearly equal. A large sale of Railroads has been coupled with a large purchase of Railroads. This may indicate a policy of trading within a bond diversification constraint. The policy seems to be: "buy at a discount and sell at a premium, and moreover, do this every year, not just during

[17] This is the relevant portion of the maturity yield function for a company which is not willing to get into very short assets since such a short position is speculative (causes too much income risk).

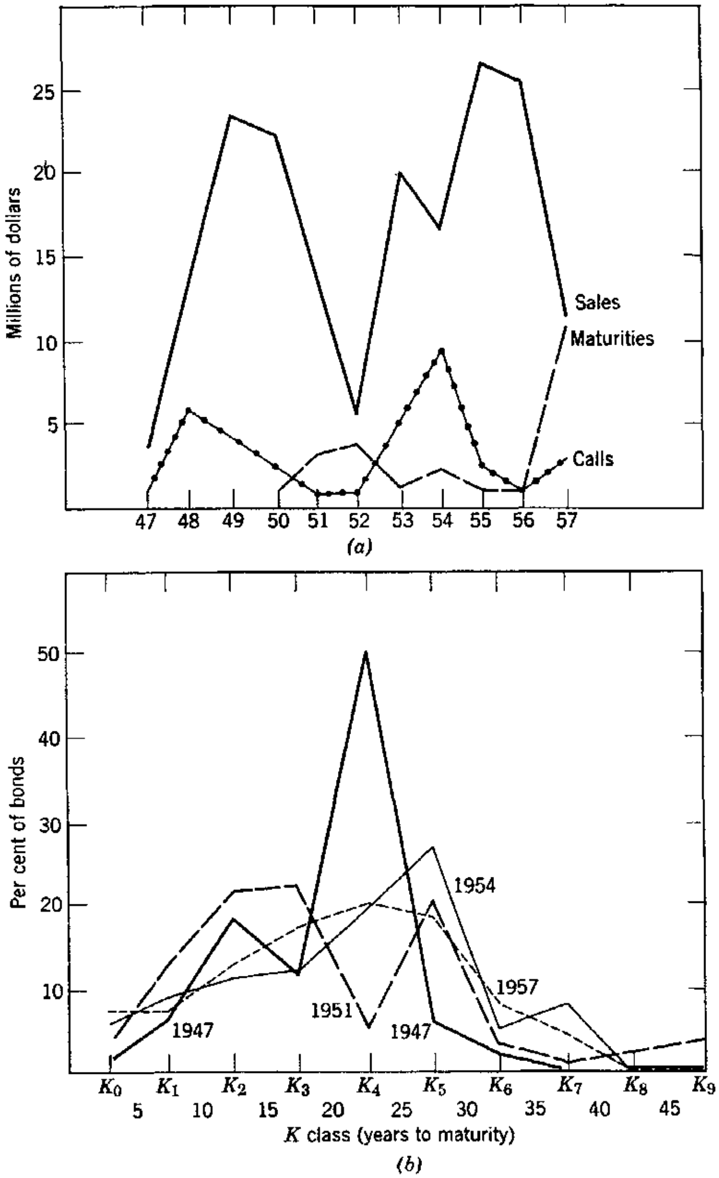


Figure 6 (*a*) Disposal cash flow (Company A). (*b*) Maturity distribution (Company A).

cyclical swings." The maturity constraint on trading activities is portrayed quite strikingly in the summary table (column 6) which shows that except for one year, 1948 (to be discussed under liquidity), the maturity of Acquisitions was always longer than that of Disposals. Consistent sales of short maturities are not made, which indicates sales are not used to lengthen maturity. The trading policy is not oriented toward increasing cash flow to purchase mortgages or stocks since the cash flow ratio is almost always above 100 per cent.[18]

After 1951, short maturities were sold in 1952 to 1953, and 1956 to 1957 (high interest periods) and long maturities were sold in 1954 to 1955 (low interest period). This pattern, shown in Figure 5, is consistent with a cyclical policy of sales to increase yield.

This sales policy is just one aspect of the overall trading policy of the company. The dual objectives of the policy are high trading yield and high maturity yield. The first objective is apparent in all years; the latter is evident in almost all years since trading yield is positive and y_m'' (Acquisition yield on new security) is greater than y_m (Acquisition yield on original security). The major trading accounts were Railroads, Public Utilities, and Industrials. The mean annual trading yield for the bond portfolio for the eleven years was +0.30 and for each of the above three bond categories +0.57, +0.96, and +1.1. The mean holding period for bonds sold was very short, between one and two years. Thus when securities are sold, for example Railroads-1952, the appreciation of 3.8 per cent is over a one year holding period so that coupled with coupon payments the holding period yields on many of these securities amount to ten per cent.[19] The Industrial account through 1950 to 1954 shows very large trading yields and Appreciations (capital gains), again over very short holding periods. After 1951, purchases and sales of Railroads, Public Utilities, and Industrials are excellent examples of a company trading for holding period yield and maturity yield.

In all cases, even where maturity yield of the new purchase is *less* than original maturity yield of the security sold, a gain of maturity yield is accomplished as well as a trading profit, with very little change of maturity.

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[18] In two years this is not so. In 1949 and 1952 sales were probably made to provide cash flow to purchase mortgages or equities since only 68 and 27 per cent of bond cash flow was reinvested in bonds in the two years.

[19] A specific and fairly representative example of this trading activity is the following: In January, 1952, Southern Pacific debentures due in 1996 with coupon rate of 2.75 per cent were purchased at a cost of $43,000. In July these securities were sold for a consideration of $46,000. Coupon interest received for the 6 month holding period was $764. Thus the percentage yield for 6 months was 3,764 divided by 43,000 or 8.8 per cent. This is equivalent to a 17 per cent yield on an annual basis.

Although the dual motivation for the trading policy is apparent, it is not obvious how the company was able to turn a trading profit in each account in each year. None of the other companies has a comparable record. A conjectural explanation is that the company, in a sense, acts as an underwriter by picking up special purchases, holding and seasoning them for a year or so and then selling them to various outlets and brokers that it has developed through the years.

Liquidity

The liquidity balance (Figure 3) averages 5.5 per cent of bond holdings over the entire period. Since direct placements are used less by this company than by the other companies, the high liquidity balance does not seem explicable as a precautionary balance.

In 1947, 1948, 1949, and 1951, there is a possibility that the balance was used occasionally as a short-run speculative balance. During these years the company probably expected higher interest rates and maintained a higher than normal liquidity balance. Three of the companies follow a pattern of large liquidity increases in 1951. This is probably a joint result of expectations of higher rates after the anticipated Federal Reserve-Treasury accord and an attempt to "backup" the large Forward Commitments made before Regulation X, a direct control on real estate credit, went into effect. However, it should be noted that the liquidity balances computed are yearly averages and the balances fluctuated a great deal during the year.

After 1951, the fluctuation of the balance is not consistent with that of a speculative balance since it is largest in high interest years and smallest in low interest years. The cost of maintaining the balance was less than for the other companies because it was held in Notes and Certificates and higher yielding Canadian Bills. The liquidity cost, defined as yield on K_4 minus yield on K_0, averaged 1.1 per cent. After 1951, there is an inverse correlation between size of the liquidity balance and the cost of obtaining the balance. Thus there is some indication that the size of the balance is related to the "cost" of obtaining the balance.

The remaining possibility is that the balance is a transactions trading balance. The very high rate of sales (25 per cent of bond holdings per year) after very short holding periods (one or two years) makes this the most likely explanation of the liquidity balance for years after 1951.

Cyclical Policy

Within the asset distribution decision there is apparent after 1951 a policy of increasing bond placements during peak interest periods and of increasing mortgage placements during low interest periods. This behavior is consonant with a policy either of going long at interest peaks and short in troughs, or of placing funds into bonds and mortgages according to the relative rate spread. Some companies use investment rules such as: invest in mortgages when the bond-mortgage differential falls to less than 0.3. This type of rule would cause the investment behavior noted because mortgage rates, especially on guaranteed mortgages, have been more "sticky" than bond rates during the postwar years.

In conclusion it is interesting to ask whether, in regard to the three investment views discussed previously, the policies of this company are representative of: (*a*) a small, fast-growing, stock, high-income-risk company[20] investing defensively in long-term securities, or (*b*) a competitive company maximizing expected yield by following the maturity yield function and its expectations of future interest rate developments.

The flexible allocation of funds toward mortgages and bonds as well as the consistently high sales volume and trading yields all support the competitive viewpoint.[21] Furthermore, as the maturity discussion showed, the maturities of Acquisitions are consistent with a policy of "following" the maturity yield function to increase yield.

Yet the complete answer is not so simple. The extremely long Acquisition maturities in 1954 and 1955 are against the slope of the yield function. This is strikingly shown in the drop of mean Acquisition yield by over 0.5 per cent in these years; this fall is directly attributable to the policy of going long and could have been avoided by purchasing shorter term maturities. The yield on K_3 maturities was greater than the yield on K_7 maturities by 0.5 in 1954 and by 0.4 in 1955. Furthermore, the yield on Industrials (K_3 and K_1) was 0.4 per cent larger than the yield on Public Utilities (K_6 and K_7) in 1954.[22]

The conclusion reached is that the investment observed is that of a sophisticated investor very aware of both income-risk and yield and hence balancing these two goals in a manner similar to that predicted by a combination of the income-security and the competitive view of life company investment.

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[20] Income risk is most severe for a stock company which lacks the safety margin of dividend loadings in the policy premiums. Income risk is also high for a young, fast growing company because the liability maturities are long, that is, new policies are usually taken out by young people and there are few old policies outstanding.

[21] Discussion with investment officers of the company confirms this interpretation; they state that the portfolio is continually adjusted to take into account changing expectations of future interest rate patterns.

[22] It might be noted that, on the average, for all the companies there is a cost (yield foregone) by going *either* long or short, that is, there is a hump in the maturity yield functions.

COMPANY B

Company B is a Midwestern company founded in 1879 as a mutual company. Its assets totaled 890 million dollars in 1957. Its rate of growth is equal to the industry average; assets have doubled from 1947 to 1957. The company is considered within the trade as a smart, but conservative, investor.

Investment Objectives

This company invests as if its investment plan were: Hold a minimal amount of liquidity and if more is needed sell Governments or take a bank loan. Governments should be used in a dual role of providing liquidity and maturity. Acquisitions should be made to increase yield so long as default risk does not increase beyond an acceptable level and mean bond maturity remains near twenty years. Sales should be made whenever maturity yield can be increased, even if trading losses are incurred.

Asset Distribution

Figure 7 depicts the asset distribution and bond distribution. After 1949 the major placements were in Industrials and Mortgages with the

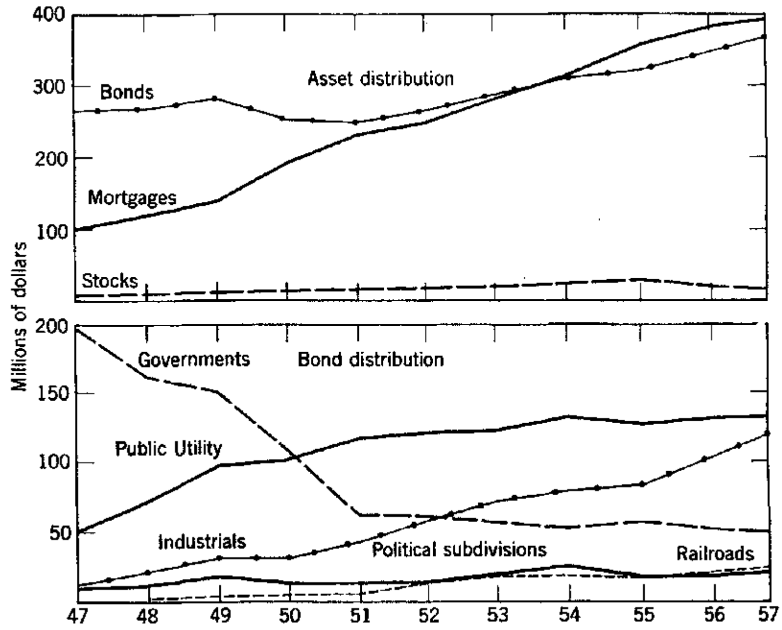

Figure 7 Company B.

growth of one asset inversely correlated with the growth of the other asset.

Governments were sold to produce cash flow until 1951 and since have remained nearly constant in absolute terms. During this latter period, Governments have been continually purchased and liquidated as is shown in the summary Table 2.[23] Generally, the Governments purchased were Bills and Notes, but some 83's and 95's were also purchased, even during periods of tight money. Some of the long-terms were subsequently sold.

Yield

Acquisition yield moves parallel to the Baa yield except as it is influenced by purchases of long-term Governments (Figure 2*a*). The liquidity balance is very small and so does not influence Acquisition yield as it did for Company A. During 1951, 1953, 1955, and 1957, sizeable quantities of long-term Governments were purchased (summary Table 2, columns 8 and 9); in each of these years Acquisition yield decreased even though Baa and Aaa market yields increased.

Companies A and B purchase similar maturities, so that a difference of acquisition yields should indicate a difference of default risk. The results of such a comparison are inconclusive. The acquisition yields on Industrials for both companies are very similar to the new issue Baa yields. The comparison does suggest that both companies purchase largely Baa grade Industrials.

Company B purchases more long-term Governments than does A; this may indicate a desire for lower default risk. Alternatively, the Governments may be purchased for liquidity and marketability. Since it is not possible to discern the motivation of the purchases of Governments, little can be said concerning default risk.

Maturity

The mean maturity date of Acquisitions has not increased over the period; it was 1972 in 1947 and it was 1972 in 1957. The consequence of not increasing year of maturity of Acquisitions over the period is a decline of mean bond maturity. It fluctuates near twenty years until 1955 and then falls sharply to 18.2 years by 1957 (Figure 3*b*).

The maturity distribution of securities is shown in Figure 8*b*. The changes in the distribution are similar for all companies; postwar trades have changed the portfolio from a highly peaked Governments distribution to a flattened Industrials and Public Utilities distribution. By

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[23] Some of these purchases and sales are only paper transactions since they represent refundings and exchanges.

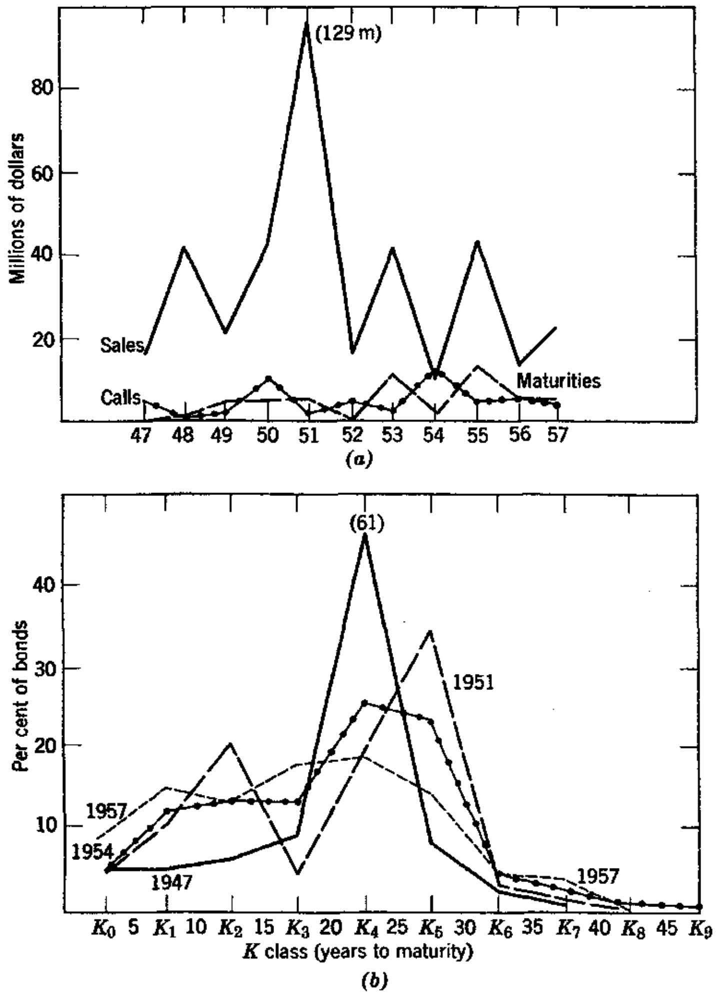

Figure 8 (*a*) Disposal cash flow (Company B). (*b*) Maturity distribution (Company B).

1951 the purchase of 15 year Industrials and 30 year Public Utilities had created a bi-modal distribution. Acquisitions thereafter were more diversified as to maturity, and the curve successively flattens out, although in both 1954 and 1957 the aging of the peaks is seen as they shift left. This aging process has not been counterbalanced by a purchase of long maturities as is shown by the consistently low right tail of the distribution.

The fluctuations of the maturity of Acquisitions are strikingly parallel to those of Company A (Figure 9).

During most years, except 1954, the selection of maturities is consistent with a policy of "following" the yield curve—when yield K_7 is greater than yield K_3 it pays to go long and conversely. For example, the high cost of going long (0.6 loss of yield) in 1953, 1956, and 1957 caused the company to choose shorter maturities of 17, 18, and 15 years, respectively.

As was the case for Company A, 1954 is inconsistent with a policy of maximizing yield by "following" the maturity yield function. In this year maturity of purchases increased sharply because of an allocation of 70

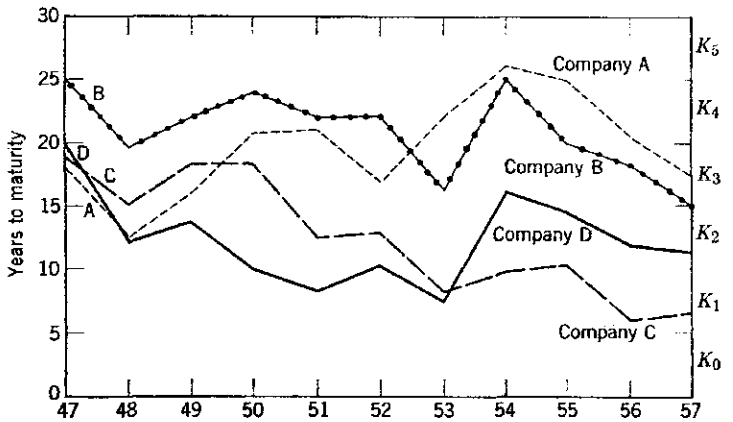

Figure 9 Mean maturity of acquisitions.

per cent of Acquisitions into non-industrial Bonds with yield-maturity of 3.2/82 (Figure 9). The remainder went into Industrials with a much shorter maturity but higher yield, 3.7/71. This 70 per cent allocation into 30 year securities is quite remarkable and represents a strong defensive policy of increasing income security, perhaps in expectation of a downturn in future rates or as a means of reducing income risk. In addition, the relatively small 30 per cent allocation to high yield, but low maturity, Industrials is an example of a company foregoing increased yield in order to obtain increased income security. Thus the explanations of the choice of maturities for companies A and B are strikingly similar: an attempt to stay long, but a willingness to go shorter if the yield differential is sufficiently large.

The call redemption percentage of bond holdings is the lowest of the four companies, averaging 1.7 per cent per year.

Trading

The sales volume, one-half the volume of Company A, still averaged 13 per cent of bond holdings per year. Though average annual trading yield was a respectable +0.15, it will be argued that this company sold securities to increase maturity yield, not trading yield. The trading yields were positive, averaging +0.6 per year, prior to 1950 while after 1950 sales were made at a trading loss of about −0.15 per year. The positive trading yields prior to 1951 were made on Governments purchased during the war at a discount and sold after the war during the support policy of the Federal Reserve.

The majority of sales were made to create cash flow to take advantage of attractive bond Acquisition yields. The sales have increased maturity yield in each year, and by an average of 0.5 per cent. The only substantial maturity loss occurs in Public Utilities-1957, the year of the largest gain of yield. Perhaps this indicates that for a sufficiently large yield a shorter maturity is acceptable. Whereas Company A trades for both trading profits and increase of maturity yield, this company trades only for increase of maturity yield.[24] Lengthening of maturity is not a major objective since long maturities are sold.

The frequent purchase and sale of Governments appear to be related to many factors including liquidity needs, expectations of trading profits, and long-term investment needs. The long-term Governments purchased during 1955 to 1957 were obtained at a yield differential from high grade Corporates of about 0.4 to 0.5 per cent. This is the only company which had purchased long-term Governments during recent years and held them through 1957.

Liquidity

The policy of this company is to hold a small and constant liquidity balance and to borrow when further funds are needed (Figure 4).[25] An estimate of the liquidity balance is about one-half of one per cent of bond holdings. This is by far the lowest balance of any of the companies. The extent of the borrowing is not known since the loans are not reported even though the interest cost appears on the income statement. The loans are estimated on the basis of yearly interest costs.

The percentage of Disposal flow originating in Government sales was above 65 per cent in three years after 1951. Yet these sales did not

[24] Of course, what matters is total return, not how the return is obtained. Still, it is interesting to determine how the yield is obtained since different methods of increasing yield involve different investment risks.

[25] This is the only company that borrowed funds consistently. It is often felt within the industry that borrowing is "bad" practice because it indicates weakness. That this fallacy has a following is even supported by Company B because it always pays off its loans before the end of the year so that no "borrowed funds" liability shows on the balance sheet.

significantly decrease the holdings of Governments because continual purchases of both long and short-term maturities were also made. Thus it appears likely that Government holdings, including long-term maturities, acted as a pool of liquidity which was used as needed, but not without an average capital value depreciation of 2 or 3 per cent.

The above analysis suggests there were three sources of liquidity: liquid assets, bank loans and sales of long-term Governments.

Cyclical Policy

There is little evidence of a cyclical liquidity or maturity policy. The spread between acquisition and disposal maturity is contrary to a cyclical policy of increasing trading yield; it is largest in 1954 and smallest in 1956 and 1957. Likewise, the maturities of sales do not follow a cyclical pattern of long sales in 1954 and shorter sales in 1953 and 1956 to 1957 (Figure 5).

In summary, the investment policies of this company are representative of a blend of the: income security portfolio, a desire for long securities (especially since 1954), the competitive portfolio, a willingness to make sales which cause capital losses but which increase maturity yield. Possibly the capital security portfolio is also represented if the periodic purchases of long-term Governments are interpreted as means of reducing the credit risk of the portfolio. But it is interesting to note that neither the Acquisition yields nor the liquidity balance indicate a capital security portfolio, but rather indicate a vigorous competitive portfolio.

COMPANY C

Company C, one of the oldest mutual companies in the United States, was founded in New York during the 1840's. Its assets were two and one-half billion dollars in 1957, which placed it toward the middle of the largest life companies. The rate of growth of this company from 1947 to 1957 was low; its gross assets increased only 37 per cent. During recent years, this company has become known for its aggressive policy of increasing yield and in 1957 and 1958 had one of the highest mean Acquisition yields of all United States life companies.

Investment Objectives

The company invests as if the following investment plan were followed: Maximum yield is a primary consideration, even if this should entail the purchase of short maturities of eight to fifteen years or increased default risk. The higher risk securities should be purchased only after careful research has disclosed that the added interest premium appears more than sufficient to compensate for the added risk. These higher default risk loans should generally be amortizable and of short maturity so that close contact is maintained with the borrowing company. Maturity should not be a major investment consideration, except to the extent that increased maturity increases default risk. Short-term Industrials are generally more desirable than long-term Industrials and Public Utilities because of their higher yields (in excess of increased default risk). Sales should be made whenever maturity yield can be increased. In order to make opportune purchases and to conduct the sales policy, it is necessary to maintain a liquidity balance.

Asset Distribution

This company's bond holdings are large relative to mortgages as can be seen in Figure 10. Even though bond holdings have declined 15 per cent since 1947 and mortgages have grown continuously, mortgages in 1957 are less than bonds. This is the only company in which this is so. Equities (common and preferred) increased continually from 1.9 per cent of portfolio assets in 1947 to a 1957 level of 5 per cent. The slow decline of bond holdings and the continual increase of mortgages may indicate a condition of dissatisfaction with the bond-mortgage shares. The Governments have been pared considerably, but this coupled with a low

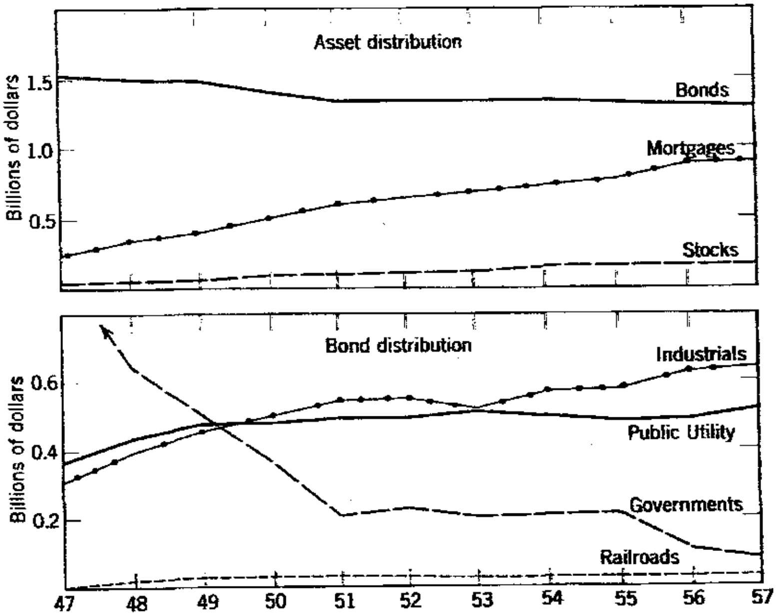

Figure 10 Company C.

rate of new premium inflow has not been sufficient to increase mortgages to a level equal to bond holdings. It is as if this company's objectives were similar to the other companies, but its achievements are viewed in slow motion due to its slow rate of growth.[26] All other companies had obtained a bond-mortgage balance by 1951.

Liquidity balances are held about equally in Treasury Bills and Commercial Paper. After 1951 the balance remained close to 5 per cent of bond holdings.

Yield

Acquisition yield is consistently high and consistently immune to cyclical interest fluctuations.

The high yields are directly related to a policy decision of the company made around 1950 to purchase certain high coupon securities. At this particular time, a study by the company research department in conjunction with the National Bureau of Economic Research revealed specific bond categories and grades which consistently had high yields inclusive of default losses. These yield "pockets" or areas were further explored and efforts were made to purchase these securities.

The change in company policy is partly revealed by a comparison of market Baa yields and Industrial Acquisition yields of this company. Prior to 1951, Industrials yield an average of 0.05 per cent less per year than do the Baa bonds while after 1951 the Industrials yield on average 0.33 per cent more than the Baa's. (Since most of these loans are made by direct placement, a comparison with Baa market yields does not reveal their default rating.)

The constancy of the yields after 1951 is quite striking. Where small declines do take place they are caused much more by changes in the liquidity balance than by cyclical interest fluctuations. For example, the declines of yield in 1948, 1951, and 1956 are caused by increases in the liquidity balance (Figures 2*a* and 4). The reason for the lack of strong cyclical fluctuations may be the extensive use of Forward Commitments which are usually made at the existing market rates of interest. This may tend to smooth out and lag yield fluctuations.

Maturity

Mean acquisition maturity is short at 12.7 years. As shown in Figure 9, maturity decreases from 19 years in 1947 to 7 years in 1957. Each year, the company purchases, on the average, a one year shorter maturity.

[26] Company officials state that the company does not aim for a specific bond-mortgage allocation; the heavy mortgage purchases were made because of their favorable yield. This is, of course, not inconsistent with the explanation given above.

The longer maturities in the earlier years were a result of large purchases of Public Utilities and the decreasing maturities in recent years resulted from the increased purchase of Industrials. This general pattern of large purchases of Public Utilities to 1952 and large purchases of Industrials since then is reflected in each of the companies studied.

The result of decreasing the maturity of Acquisitions and of selling the existing Governments is a sharp decline in the mean maturity of the bond portfolio. This uninterrupted decline of bond maturity is the most striking aspect of the portfolio (Figure 3*b*). This is the only portfolio in which *no* maturity constraint is apparently placed on purchases or sales (Figures 5 and 9).[27]

It seems probable that the consistent decline of maturity represents a search for higher yield, that is, a climb up the maturity yield function. This conjecture can be tested by comparing the "cost" of going long for each year to determine whether Acquisition maturity is directly correlated with the "hump" or high point of the maturity yield function. Table 7 indicates the K class having the highest maturity yield for this company,[28] the cost of going long into K_5 maturities, and the cost of going very long into K_7 maturities.

The "hump" of the yield function has been quite short, usually between 7 and 12 years. The average cost of going long has been a 0.7 per cent loss of yield and the cost of going very long has been 0.9 per cent.[29] After 1951, there is a close correlation between "hump" and Acquisition K class, except for 1953 and 1957. This steeply declining yield function beyond K_1 and K_2 is sufficient to explain why a company not concerned with income-risk would remain short at 12.7 years. It does not explain why maturity policy is inflexible (a range around 12.7 of only two years). There are two possible explanations for this inflexibility.

First, it may be that there is insufficient depth to the market in the K_6 to K_9 range, so that if increased placements were attempted the yield would quickly fall and further increase the cost of going long. While

[27] This statement is only a partial truth since "maturity" actually consists of two dimensions, listed maturity and call or refunding protection (which is not published in the company Schedules). Company officials stress that, though they purchase shorter maturities, they always obtain fairly stringent protection against refunding. Hence the "maturity" is longer than for another company, *ceteris paribus*, which obtains little call protection.

[28] Each company's Acquisition maturity yields are a sampling from the large population of all yields available that year. Since the companies are differentiated by location, special knowledge, personnel, etc., each company's maturity yield function of Acquisitions is different.

[29] Part, but certainly not all, of this difference is accounted for by the lower default risk on long maturities.

Table 7 A Comparison of Maturity Yield Differentials and Acquisition Maturities

Year	47	48	49	50	51	52	53	54	55	56	57
K class of Acquisition Maturities	3	3	3	3	2	2	1	2	1	1	1
K class of highest yield (K_{high})	2	2	1	0	1	1	3	2	1	1	3
Yield K_{high}- Yield K_5	0.8	0.5	0.6	0.7	1.2	1.2	0.3	0.8	0.8	0.5	0.0
Yield K_{high}- Yield K_7	0.8	0.5	0.7	0.8	1.0	1.4	0.6	0.8	1.5	n/a	n/a

this is possibly the case in the very long maturities where only Railroads and Special Revenues may be available, it is certainly not the case for the K_5 and K_6 range of Public Utilities. It is improbable that the market is as thin as this explanation requires.[30]

Second, the overall policy directive may be to specialize and concentrate purchases in short-term Industrials, given the average declining K_2 to K_9 maturity yield structure of recent years. This would explain the majority of placements since the yield function has normally penalized long placements. After the yield curve has remained shifted to an upward sloping curve for one or two years, the premium of going long might cause a change in top policy directives.

Trading

Sales average 10 per cent of bond holdings per year and are comparable in size to those of Company B. The average annual trading yield was barely negative at −0.02. Sales followed a familiar pattern: between 1947 and 1951, three quarters of all Governments held in 1947 were liquidated without incurring a trading loss.

Long-term Governments were sold from 1947 to 1951 and from 1955 to 1957 to provide cash flow. The large fluctuation in sales volume is almost entirely accounted for by the sales of long-term Governments. After 1951 Governments were used as a source of liquidity by continually selling and replenishing maturities of less than five years. Notes and Certificates purchased early in one year were sold as needed, sometimes before the end of the same year or in the next year. Thus the Government account was used to generate cash flow to reshuffle portfolio assets and

[30] Certainly *some* purchases of these maturities could have been made as is proved by the purchases of Companies A and B.

to provide liquidity in a manner similar to Company B, though to a lesser extent.

Data relating to sales of Public Utility bonds show a significant gain of maturity yield ($y_m'' - y_m'$) in each year though the gain of maturity is always small. Thus it appears that the sales are made and capital losses sustained in order to increase maturity yield. However, this cannot be considered an intensive trading policy because the sales are only a small per cent of Public Utilities held, and furthermore, because the *gain* of maturity yield and the *volume* of sales are not closely related. It is probable that the sales of Industrials were also made to increase maturity yield. But since this account includes commercial paper placements, it is not possible to compare y_m' and y_m''.

The only other substantial trading account, Political Subdivisions, reflects a different type of trading activity. From 1950 through 1953 sales were made to obtain attractive trading profits as well as to increase maturity yield (summary Table 3, column 13). The holding period averaged 3 years and holding period yield was above 4.5 per cent on a 2.9 per cent coupon security. Trading yields decreased each year and became negative in 1954, after which sales were terminated.

Liquidity

Before 1951 liquidity was provided by large liquidations of Governments; after 1951 liquidity was provided by scheduled maturity flows from short-term assets. This is shown in Figure 11.[31] Table 8 shows the average daily holdings of commercial paper, Treasury bills, certificates, and the total of these liquidity items.

Table 8 Liquid Assets (Average Daily Holdings in Millions of Dollars)

	47	48	49	50	51	52	53	54	55	56	57
Commercial paper	—	10	2	—	29	16	13	3	0	15	9
Treasury bills	7	50	1	—	20	9	7	6	9	9	0
Certificates and notes	—	—	—	2	—	4	15	2	10	20	18
Total Liquid Assets	7	60	3	2	49	30	35	11	19	44	27
Liquid Assets/ Bonds (in per cent)	0.5	4.0	0.2	0.1	3.7	2.2	2.6	0.9	1.5	3.4	2.1

[31] The maturity flow is a relatively horizontal line after correction is made for average daily holding. For example, the large increase in 1956 is caused by the increased purchase of commercial paper of very short term which must be "turned-over" frequently.

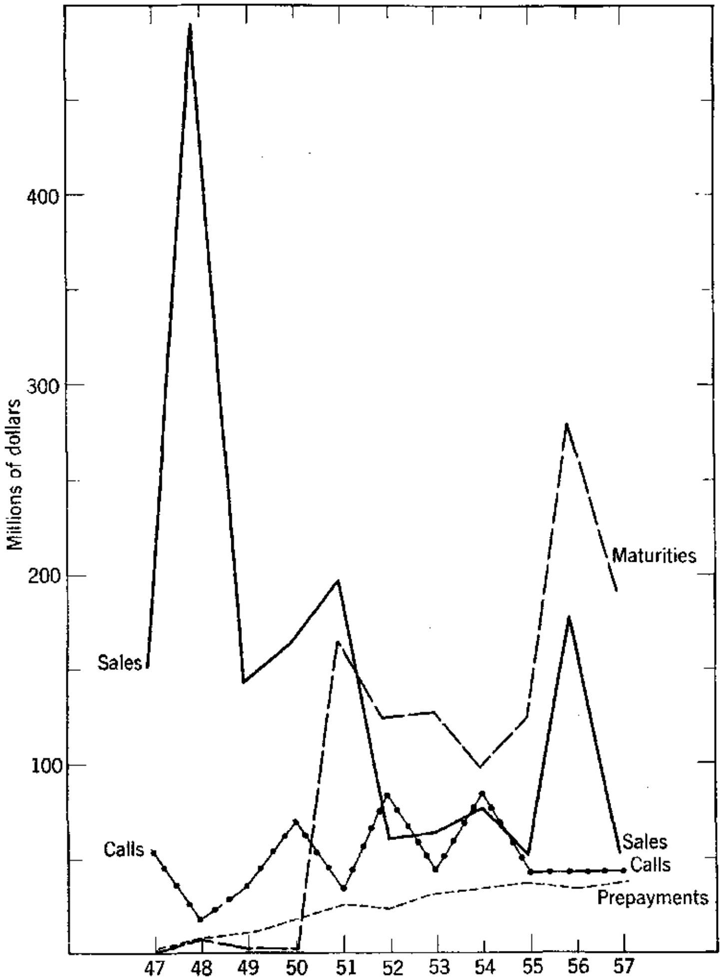

Figure 11 Disposal cash flow (Company C).

This is the only company studied which extensively utilizes commercial paper for its liquidity needs. The total purchases are very large, up to 150 million dollars in some years. But the maturities are very short (around three weeks) and are probably carefully tailored to coincide with some of the Forward Commitments.[32]

[32] A technique increasingly employed by life companies is to purchase bills or paper of amount and maturity equal to the terms of some particular Forward Commitment, say to Company Z. Then the bills are transferred to Company Z's bank at appropriate discount, and the life company's obligation is completed. When the bills mature the bank credits the proceeds to Company Z's demand deposit.

In 1948 the liquidity balance was increased probably in expectation of higher future rates. The 1951 Treasury bills were purchased in early April probably as a precautionary balance to hedge the very large mortgage Forward Commitments scheduled in fear of selective controls on mortgage credit.

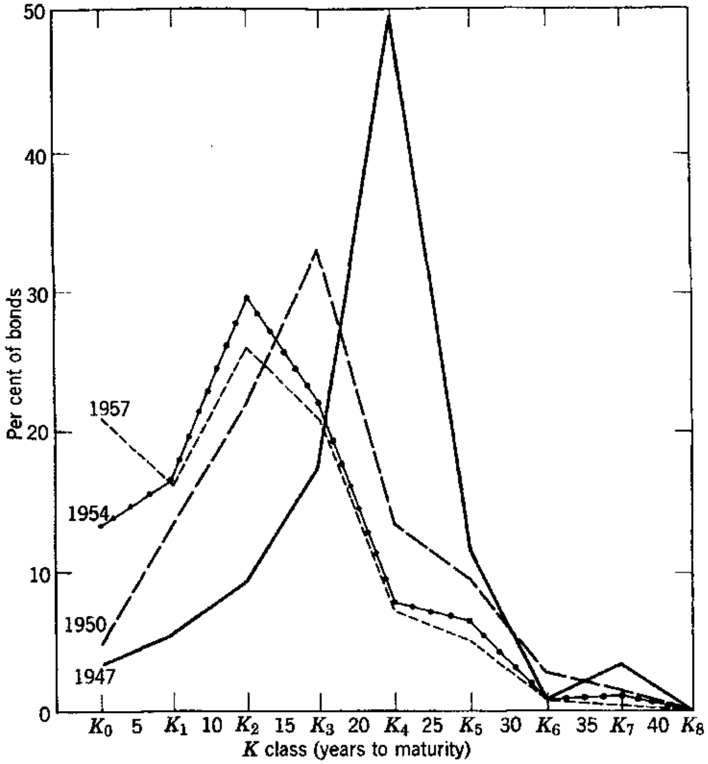

Figure 12 Maturity distribution (Company C).

After 1951 the liquidity balance averages 2 per cent of bond holdings. The balance tends to be highest in high interest years which is the converse of a speculative liquidity policy. However, in high interest years the maturity yield function is quite flat, so the cost of liquidity is lower. Investment officers state that the balance is held as a transactions balance to make opportune purchases and as a precautionary balance to hedge Forward Commitments.

Cyclical Policy

There is very little evidence of a cyclical liquidity or maturity policy (see Figures 4 and 5).

In summary, the investment policies of this company are representative of the competitive portfolio. Acquisitions are chosen primarily in order to increase yield. Sales are made to increase maturity yield.

COMPANY D

Company D, a mutual company, is one of the largest life companies in the country; invested assets were over ten billion dollars in 1957. It has the largest mortgage loan department in the country which places about 800 million dollars annually. The company is known within the industry for its independent investment policies and requirements.

Investment Objectives

The company invests as if the following objectives were being followed: Place new funds, in fairly fixed proportions, into mortgages and industrial bonds with the term of the bonds determined by the default risk,[33] the existing maturity yield structure, and the maturity requirements of the portfolio. Long-term Industrials should be sought to counterbalance the very short-term maturity element of the liquidity balance. This balance must be held as a precautionary balance because of the large Forward Commitments continually placed in the mortgage and industrial markets. Primary reliance should be placed on mortgage loans for generating yield. Industrials should be used to provide diversification, income-security and, to a lesser extent, yield.

Asset Distribution

This company maintains its own mortgage sales staff throughout the country and hence has a high fixed cost independent of the volume of mortgage flotations. The company states that its Mortgage Department is the first line of fund placement with bonds fulfilling a somewhat residual role. Figure 13 shows that the increase of mortgages has been nearly constant since 1951. The Acquisition/Disposal ratio of bonds has also remained constant since 1951, at 120 per cent (summary Table 4, column 1). The high fixed cost of the mortgage sales department apparently justifies a constant flotation of mortgages independent of relative mortgage-bond yields. Since 1951, the bond-mortgage ratio has been kept nearly constant. Common stocks have remained at 1.5 per cent of the portfolio.

The movements within the bond portfolio are remarkable for their simplicity: an exchange of Governments for Industrials with a slight

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[33] This conclusion was obtained from interviews with the investment officers. They state that loans to less recognized and more risky companies are kept small in size, short in maturity, and amortizable.

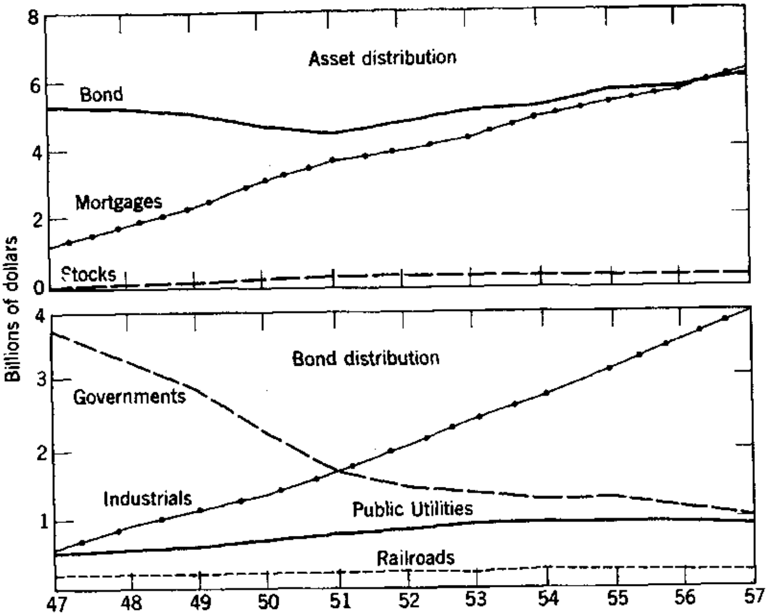

Figure 13 Company D.

increase in Public Utilities. Sales of Governments decline after 1951 but show no indication of stopping completely. Railroads are inactive and other securities are insignificant.

Yield

Acquisition yield is significantly influenced by the size of the liquidity balance held. For example, the decline of yield from 1949 to 1951 and the increase of yield from 1951 to 1953 are much sharper than the changes of market yields during these years. This accentuated change of yield is partly caused by the respective increase and decrease of the liquidity balance over these years.

The Acquisition yield fluctuates widely and tends to be relatively high in high interest years and low in low interest years.

Maturity

Until 1953 the bond portfolio continually shortens as Governments (1970's) are sold and liquidity and Industrials, K_3, are purchased. It is difficult to speak of maturity policy since it is so greatly influenced by liquidity policy, yet there does seem to be a distinguishable maturity policy of purchasing continually shorter maturities until 1951 or 1953. After 1953 there appears a notable shift toward long maturities. This is shown by the termination of Government sales and the increase in Acquisition maturity from around 10 years prior to 1953 to over 17 years after 1953 (Figure 9).

Mean Acquisition maturity of Industrials remained close to 1966 prior to 1953; thereafter it ranged from 1980 to 1999. In each year after 1952, there was a placement of one or more 50 million, 100 year Industrial loans to the very highest grade Industrial borrowers.[34] These loans are convertible after eight years, at the option of borrower or lender, into 25 year sinking fund bonds with a coupon of 3.5 per cent. The cost of making these long loans can be partially measured by comparing the yield in K_3, the primary Industrial placements maturity with the yield in K_9, the longest maturity. The average cost since 1952 is 0.5 per cent. An alternative measure of the "cost" of the long placements is a comparison of mean Industrial Acquisition yields and K_9 yields; between 1952 and 1957 the Industrial yield averages 0.33 per cent greater than the K_9 yield. Yet neither of these measures is satisfactory because neither allows for the extremely low default risk on the very long-term securities.

From the preceding data, especially the consistency of placements into the K_9 maturity range, it can be inferred that a conscious maturity policy was initiated after 1952. The magnitude of this shift in Acquisition maturity is shown in Figure 9. It seems likely that the very short maturity position, caused by the liquidity position deemed necessary after 1951, soon caused the portfolio maturity to fall below an acceptable level. By 1953 a vigorous policy of purchasing extremely long maturities was initiated as an offset to the liquidity balance. Figure 3*a* shows that mean bond maturity had fallen by 1953 to 16.7 years, an 11 per cent decline since 1947. By 1956 mean bond maturity had been restored to 18.2 years, making up 75 per cent of the previous decline. Even though the long placements had maturities of 100 years they were treated as if their maturity were only 50 years because of the convertibility options. Were the bonds treated as 100 year maturities, the mean portfolio in 1956 would be 20.8 years. Regardless of which measure is appropriate, the increase of maturity, while maintaining a 3 per cent liquidity balance, is impressive.

Previously this company, along with most other life companies, had been partially swamped in 1944 to 1945, 1947, and 1949 with large cash inflows from refundings during these low interest years. The long loans

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[34] Actually five loans were made, one each to Chrysler, Union Carbide, Olin Mathieson, Goodyear and IBM during the period 1951 to 1954. The loans were made on a Forward Commitment or package basis, some proportion of the total loan to be deliverable each year for two or three years. Thus the continuing placements after 1954 do not represent new loans, but the fulfillment of prior commitments.

placed after 1951 had call protection and were made to prevent a repetition of the former refundings. It is a major tenet of this company's investment policy to obtain refunding protection on all loans for the entire life of the security. In order to obtain this protection they are willing to take a slightly lower yield and to allow the doubling of the mandatory sinking fund for any one year. One of the primary reasons this company is not willing to purchase market securities, according to company officials, is the inadequate call protection written into these securities.[35]

After 1954, with the upturn in rates and demand for funds, no more of the very long loans have been made. It is probable that the increasing yields in the K_3 to K_5 range (16 to 30 years) made the longer rates appear less attractive. Company officials state that an additional, and important, reason for not placing additional long loans was that they absorbed too large a proportion of investable funds. Demand for funds increased so

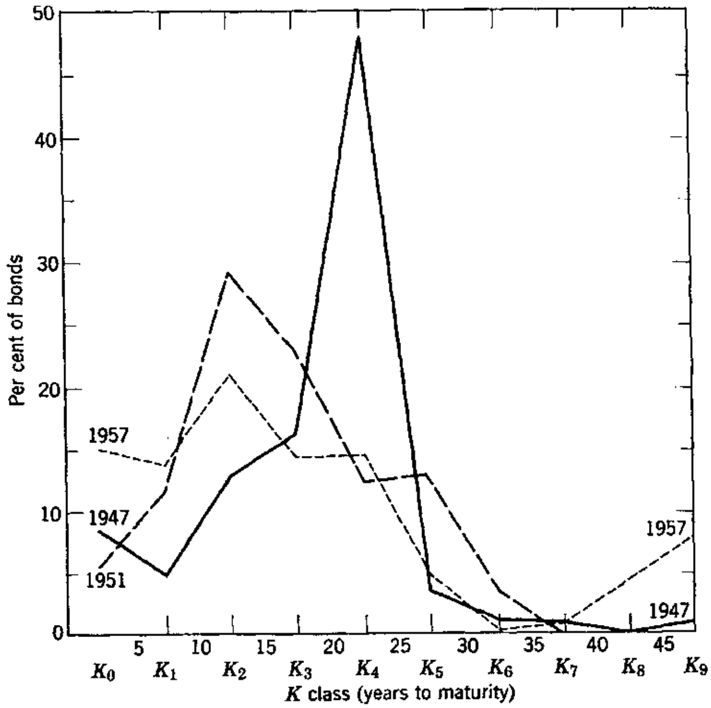

Figure 14 Maturity distribution (Company D).

[35] In some cases such as Public Utility bonds, the Federal Power Commission will, for some reason, not allow what many life companies consider adequate call protection. This factor partly explains the current lack of interest in the utility bonds.

rapidly after 1954 that the company found itself pressed to meet all the requests of its old customers. For these new placements the terms, except for refunding protection, were tailored to suit the needs of the borrowing companies, and maturity declined as yield sharply increased from 1955 to 1957.

Over the entire period the dispersion of the maturity distribution of bonds increases. This is shown in Figure 14.

Trading Policy. Figure 15 depicts two different sales periods. The first period, from 1949 to 1951, is a period of sales of Governments to provide cash flow. An average of 500 million dollars of Governments per year were disposed of from 1947 to 1949. The two years 1950 to 1951 provide a striking termination to this first period; during these two years, 3 billion dollars of Governments were sold, equal to one-half of the 1949 Government holdings, as ominous rumblings of a break in the support policy were heard from Washington. This operation was conducted at a trading profit of 0.3 per cent. The proceeds of these sales were partly placed for temporary holding into liquidity assets.

During the second period, commencing in 1951, sales dropped to 3 per cent of bond holdings, and 90 per cent of these sales were Treasury bills and hence fall under a discussion of liquidity. The remaining 10 per cent (15 to 20 million dollars) represent a few sales of Public Utilities and Industrials each year. Investment officers state that these sales are made to eliminate low coupon securities and thus increase cash flow during periods of high interest rates. Most of the securities sold had coupons less than 3 per cent and were purchased between 1944 and 1947.

Liquidity

The pattern through time is similar to that of the other companies; prior to 1951 liquidity was available from the cash flow generated by the sale of Governments while after 1951 liquid assets were held to provide liquidity (Figures 4 and 15). The size of the balance, though averaging 3 per cent of bond holdings since 1952, is responsive to the long-term rate of interest; the high long-term interest rate in 1953 and 1956 to 1957 seems to have caused a reduction of the liquidity balance even though the "cost" of holding the liquidity balance declined to the lowest figures for the period. This is consistent with a policy of placing as much as possible in medium and long maturities (K_3 to K_9) when the current long-term rate of interest is high relative to the expected long-term rate.

From the previous description of the liquidity balance it is clear that, except for 1951, the balance is not held for speculative purposes. If it were, this would entail the rather courageous withholding of funds through the 1953 high; this seems unlikely.

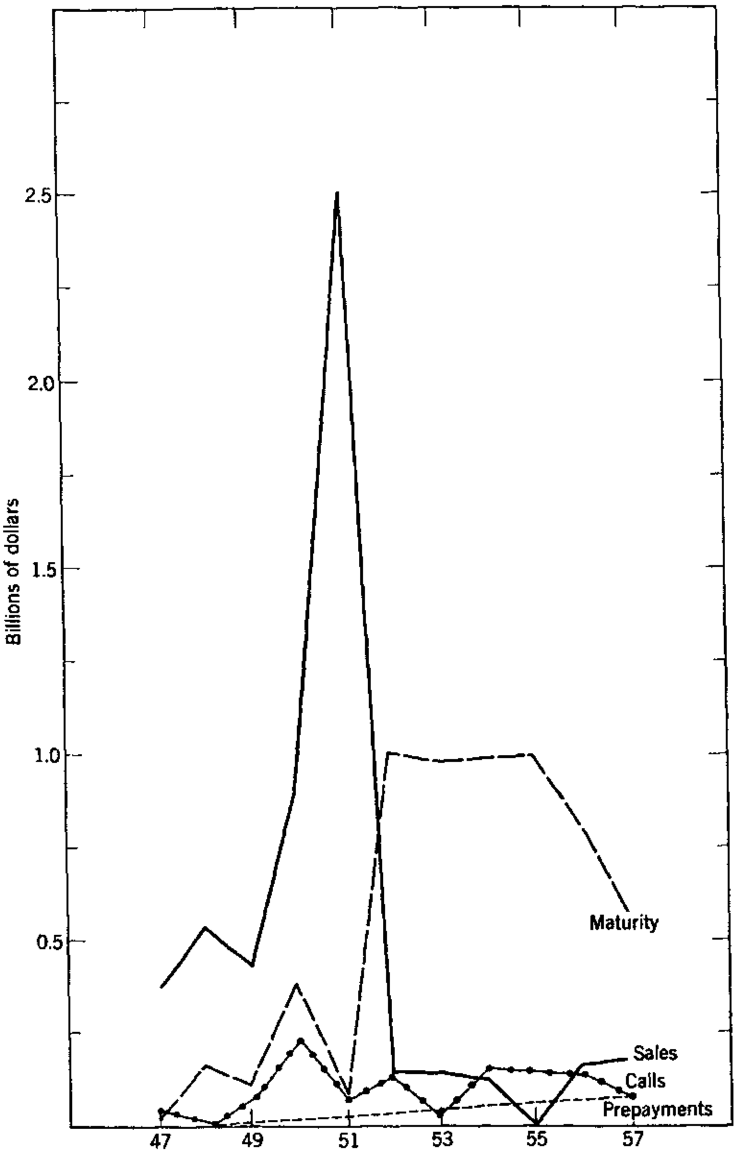

Figure 15 Disposal cash flow (Company D).

The liquidity balance is most likely both a transactions balance to facilitate Acquisitions and a precautionary balance to hedge Forward Commitments. The latter is necessary because the company places annually by Direct Placement about 800 million of mortgage loans and about 600 million of Industrial loans.

Yet if the volume of Forward Commitments is inversely related to the long-term interest rate (in periods of tight money, finding attractive loan placements is no problem), then even the previous conclusion concerning the long-term interest elasticity of the Liquidity balance is jeopardized. The balance is smaller in 1956 and 1957 because the volume of Forward Commitments is smaller.

Cyclical Policy

The policy followed during 1948 to 1949 and 1951 was apparently based on expectations of increasing rates in the near future. In several of these years they purchased 1 to 5 year, 1.5 per cent, Governments while selling the longer 2½ per cent Governments (1948). This is consistent with expectations of higher Industrial and Public Utility yields in the near future. Then in 1950 to 1951 the large sales of Governments were made in expectation of the Accord. However, this is political prevision rather than cyclical policy. After this early period there are no consistent evidences of following cyclical policy based on interest expectations.

In summary, the policies of this company are oriented toward both income-security and yield.

A COMPARISON OF THE FOUR COMPANIES

Yield

It is remarkable that, in spite of the diversity of maturity, liquidity, and sales policies, the net portfolio yields of the four companies remain so similar (Figure 2*b*). However, when yield is defined to include capital gains and losses, the experience of Company A departs sharply from that of the other three companies (Figure 3*a*). The yield performance of this company is impressive, especially since the gain from trading (A–A′) is also accompanied by a gain of maturity yield. On a gross yield basis this company has been earning 4 per cent since 1949. For the other three companies there are no consistent differences between yield inclusive of capital gains and losses and net yield.

The four companies consistently earn a net yield above the average for the industry (Figure 2*b*). Over the period, Company C has shown the greatest relative increase, moving from lowest to second position (Figure 2*b*). Company B has lost the most ground, moving from second to fourth place.

Maturity

The mean bond maturity of Company C declines generally from 1947 to 1957 (Figure 3*b*). The mean maturity of Company D declines prior to 1953 and afterwards increases as a policy of purchasing long maturities is initiated. These two companies represent the strongest contrast of maturity policies—the first represents a policy of "following" the maturity yield function while the second represents a policy of obtaining income-security. The portion of the yield curve referred to is the portion of the curve which is applicable to life companies, from K_2 to K_9. The very short categories of K_0 and K_1 represent liquidity maturities for life companies and there is *no* evidence from this study to indicate that the companies move into this short maturity range because of current or expected yields.

For all the companies except C, there is evidence of a joint policy of "following" the maturity yield function and of purchasing income-security.[36] The degree of correlation observed between Acquisition maturities of each company and the high points or "humps" of the maturity yield functions of each company suggest that the maturity yield differentials are a factor in the life company investment decision. For example, the large placements of life companies into short-term Industrials and away from long-term Public Utilities is to a large extent caused by the declining maturity yield function during recent years.

It is of course conceivable that the supplies of maturities in each year have fluctuated in a manner such that the acquisition maturities observed are the mean of average maturities offered for that year. It is doubtful that the maturity mix fluctuates so widely.

When maturity is examined from the turnover and holding period approach, similar results are obtained. Turnover is defined as bond holdings at the end of the previous year divided by disposals, including sales, calls, prepayments, and maturities. Net turnover is computed using disposals other than sales.

The most interesting aspect of Table 9 is the large impact of sales on the turnover of the portfolio—the difference between gross turnover inclusive of sales (1) and net turnover exclusive of sales (2). It is largely true that "life companies have brought the large cash flow and high

[36] The lengthening of portfolios in 1954 is generally not consistent with following the yield function and, moreover, going long during an interest downturn is not the most beneficial policy for long-term yield. As a possible explanation, the sharp decrease of liquidity balances and the striking increase of Acquisition maturity during 1954 suggest that the companies were acting defensively and going long to hedge against a further decline of long-term yields. There are many instances in the past where life companies' fear of income-risk led them to go long at just the wrong time, at the bottom of an interest cycle (e.g., 1937 and 1944).

Table 9 Turnover (Average of All Eleven Years)

	A	B	C	D
(1) Average gross turnover (in years)	3.4	7.3	3.8	5.2
(2) Average net turnover (exclusive of sales, in years)	26	32	14	21

turnover upon themselves"; they cannot blame calls and redemptions for the high rate of turnover of their portfolios during the postwar years.

Liquidity

Prior to 1951 the liquidity balances of the companies (except A) are small as sales of Governments provide a ready source of liquidity. After 1951, all the balances decline to a level around 3 per cent of bond holdings, except for Company B which maintains a minimal balance of 0.5 per cent of bond holdings. In no company is there evidence of a cyclical policy after 1951; Company C in 1948, Company D in 1951, and Company A in 1949 represent possible speculative liquidity holdings. It appears that the income-risk associated with building up a liquidity balance in anticipation of more favorable future interest rates is so extreme that none of the companies practices such a policy.

Trading (Sales)

All the companies have a developed, and apparently consistent, sales policy. Yet the companies differ extensively in relative volume and motivation of sales. The larger relative volume of sales is made by the smaller companies. This is consistent with the feeling within the industry that only the small companies are able to make large sales without upsetting the market.

Before 1951, Governments are sold in order to revamp the portfolio asset distribution. The objectives of the sales policies after 1951 include sales to generate cash flow to purchase mortgages (Company A), sales to generate cash flow to purchase bonds and increase maturity yield (all companies), sales to obtain capital gains (Company A), and sales to obtain liquidity (all companies but especially Company B).

Cyclical Policy

The lack of evidence of such policy has been noted.

CONCLUDING COMMENTS

Although the companies all produce a very similar product, each utilizes a different production function consisting of diverse combinations of the "factors," yield, income-certainty, capital-certainty, and default safety. Moreover, the general impression gained from the study is that these diverse investment patterns represent rather sophisticated investment behavior; taboos and legal restrictions play a small role in explaining life company investment.

If the diversity and sophistication of the investment policies of these four companies is at all representative of the investment policies of all United States life companies, then it is appropriate to conclude with a few remarks concerning: (*a*) an appraisal of the theory, (*b*) monetary and debt policy, and (*c*) the capital markets. The previous conclusions have been specific; the following are general.

Theory and Data

These remarks relate to the adequacy of the viewpoints and theories expressed in the survey of the literature.

The Slope of the Maturity Yield Function. The theory expressed in the income-security portfolio suggests there is a strong presumption for life companies to "go long," somewhat independent of the slope of the yield function. This implies that, if many institutions have preferences similar to those of life companies, there will be a declining maturity yield function.

This is opposite to the slope suggested by Hicks in his *Value and Capital*, "most people would prefer to lend short,"[37] i.e., most people prefer capital-certainty to income-certainty. Thus Hicks argues that higher interest rates must be offered on long-term securities in order to induce people to depart from short, "safe" securities. This may be a correct interpretation of individuals' preferences; it is clearly an invalid interpretation for life insurance companies.

The preceding analysis has shown that the maturity yield functions of the companies studied have been downward sloping from K_2 to K_9 during most years since 1951. Although the shorter portion of the curve (K_0 and K_1) does steepen and flatten as cyclical interest fluctuations take place, the longer portion of the yield curve remains unaffected by the shorter-term gyrations. The generally downward slope of the yield function is consistent with the hypothesis that the "income-certainty" lenders outweigh the "capital-certainty" lenders relative to existing maturity supplies.[38] Put differently, "widows and orphans" outnumber

[37] J. Hicks, *Value and Capital* (Oxford: Oxford University Press, 1939), p. 146.

[38] Cf. "Culbertson on Interest Structure: Comment" by the author, *Quarterly Journal of Economics*, LXXII (November 1958), p. 601, for a sketch of a theory of the maturity yield function on which the above conclusions are based.

"commercial banks." There also is evidence from this study that the yield function of non-Governments leads a separate life from the yield function of Governments. The two functions often slope in different directions from K_2 to K_9. A study of these differentials might provide information on the degree of substitution between non-Governments and Governments.

Default Risk. The extent of the interactions between default risk and maturity was one of the unexpected, and in this writer's opinion, important findings of this study.

In effect, the life investment officers state that they can make a somewhat objective judgment concerning the near future, but only a subjective guess about the distant future. Thus the 30 year security of Company Z is more risky than the 5 year note of Company Z. This time-dimension of default risk would cause an increasing maturity yield function (all other factors being equal) were it not for risk differences among the individual companies. Thus the default risk premium consists of two components: (1) time risk and (2) company risk. If the mix of default grades of securities were equal in all maturity ranges, then the yield function would slope upward because of factor (1). However, if there is a form of rationing from the supply of funds side of the market which forces risky companies to issue short securities, then factor (2) may cause a declining yield function [unless offset by factor (1)].[39]

There is strong evidence from interviews that life companies do impose a form of risk/maturity rationing. The companies seem to say, we will assume more risk if compensated by a higher coupon yield, but we reserve the right to choose the maturity of the security. Thus life companies assume increased company risk for decreased time risk and increased coupon yield. This factor partly explains the shortening maturities of life companies during the postwar period. Life companies have attempted to broaden their lending markets in order to absorb increased placements without a rise in default risk.

Moreover, if the life companies set a ceiling on the amount of default-risk they are willing to accept, it may be impossible to purchase a long portfolio. If there are only a few blue-chip corporations, then there is necessarily only a small supply of acceptable long-term securities for life companies. It is essential that the theory of life company investment and the theory of the maturity yield function be modified to take into consideration the interdependence of maturity and default risk. Furthermore, in dealing with empirical data, it is essential that a procedure be

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[39] Thus the previous conclusion that the desire for income-security causes the declining maturity yield function is not the only possible explanation of this phenomenon.

devised which permits identification of the interacting variables which determine yield, such as company risk, time risk, and maturity yield differentials. Without identification of the effect of each of these on yield, statements about maturity yield functions and default risk differentials are spurious.

Liquidity. The theory also gives insufficient attention to the interrelationship between trading policy to increase yield and the liquidity balance necessary to implement such a policy. Furthermore, the interviews indicate that all the large companies also hold liquidity as a precautionary balance to hedge their Forward Commitments.

Maturity. The maturity predictions of the theory are borne out in general terms. This can best be stated in the negative: it is not possible to explain the investment decision of life companies satisfactorily without recourse to the explanatory variable demand for maturity *qua* maturity. The importance of this theoretical prediction is heightened by the circumstance that the companies probably would have purchased even more maturity were it not for the higher default risk of long maturities. There is no indication that the companies aim for specific target maturities; rather they purchase income-security in general terms. This includes refunding and call protection which should be treated (but was not in this study) as a dimension of maturity.

Governments. The conscious implementation of a long maturity policy clashes with the finding that few long-term Governments were purchased for permanent holding. It is difficult to explain this in terms of relative yields; in several instances the twenty and thirty year Government rate approached four per cent. Furthermore, the Aaa-Government interest differential has changed very little since 1950. The following supposition is suggested. It may be that the pressure from the borrowing side of the market forces the life companies to try to meet the loan demands in periods of tight money so that when the companies are in need of placements they can count on developed outlets for their funds. This "residual" theory of demand for Governments is similar to the "availability doctrine" whereby banks take care of their regular loan customers first and purchase Governments only when they have "residual" demand. Though there were residual loanable funds during the 1930's and 1940's, during the postwar period the loan market has been "tight" and has not produced a need for residual placements in Governments.

Diversity. The diverse patterns of investment among companies appear explicable as the result of (1) differences of risk estimates (both of the life insurance situation and of market assets) and differences of preferences toward risk and return, and (2) differences of opportunity.

It is extremely difficult to disentangle risk estimates and preferences. For example, Company C probably estimates the life company risks differently than does Company D. On the other hand, Company C had poor earnings records during 1945 to 1947 and subsequently a low rate of growth and these factors may have stimulated Company C to increase yield vigorously, even if that involved high income risk. That is, Company C and Company D may estimate income risk similarly and yet Company C may place more emphasis on increasing yield because of the company's need to maintain or restore its competitive position within the industry.

The difference of opportunity is related to company size. It would be impossible for the large companies to have a vigorous sales policy similar to that of Company A. The smaller companies are able to move around in the market much more freely. They can afford to purchase smaller size securities and specialize in smaller markets than the larger companies.[40] It seems likely that if Companies A and D were netted of this "difference of opportunity," their portfolio policies would be much more similar.

The large companies, on the other hand, have special markets available to them. They reach national mortgage markets through agency arrangements, etc., and they deal extensively in Forward Commitments, Lease-backs and other sophisticated means of loan placements. Their cost-savings in investment and insurance operations (economies of scale) are probably substantial through the use of electronic computation and data handling equipment.

Undoubtedly many of the observed differences in investment are caused by differences in motivation and ability and attitudes of the top directors of the companies. To "explain" adequately the observed differences, these personality factors would have to be explored in detail.

Period Studied. The period studied is not sufficiently long to adequately study institutions with liability maturities exceeding fifty years. For instance, the investment officers of Company D state that income-security is one of their primary objectives; they always specify almost complete call protection in Direct Placements. Yet over a ten year period this long-run policy is not observable. Also the effect on future cash flow of current purchases of amortizable Industrials is not revealed.

Monetary and Debt Policy

Two of the most significant conclusions of the study have a bearing on monetary and debt policy. The two conclusions are complementary:

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[40] As a general rule the small companies have about the same number of securities as the large companies, only the dollar value of each security is much smaller.

maturity is chosen partly to increase yield on the basis of maturity yield differentials and partly to increase income-security independent of maturity yield differentials. Responsiveness to maturity yield differentials has implications for the "Bills Only Doctrine" and desire for long maturities has implications for debt policy.

Bills Only Doctrine. This is a Federal Reserve practice initiated in 1953 whereby open market operations are conducted by the exchange of only the shortest-term securities, Treasury bills.

The theory which underlies this practice assumes that any change in the short-term rate caused by an altered supply of Treasury bills will induce market investors to purchase or sell long-term and medium-term bonds until the long-rate is in line with these investors' expectations of future conditions and rates. The essential premise of the theory is that there are investors in the market who are willing to substitute short maturities for long maturities (or medium maturities) whenever they believe maturity yield differentials are "out-of-line" with their expectations.

Life companies do not belong to the investor group described above. Life companies do not switch from K_9 to K_0 or conversely. Yet life companies do substitute within the K_2 to K_9 range of Government and non-Government maturities. Thus life companies perform at least *part* of the maturity substitution required by the Bills Only Doctrine.

Yet the finding that the non-Government maturity yield function is often of different slope from the Government yield function brings up a question of a different order. If the maturity yield function of Governments is upward sloping during easy money periods while the yield function of Industrials remains downward sloping, this may imply that long-term Governments and long-term Industrials are not close substitutes, whereas long and short-term Governments are close substitutes. These are merely conjectures. The different slopes suggest that further study of the changing maturity yield differentials of Governments and Corporates over the interest cycle will provide information on the securities and maturities which are close substitutes with Governments.

There is also evidence that the long-term Industrial rate of interest is quite stable; it does not follow the long-term Government rate closely. This has implications concerning the efficacy of monetary policy in controlling the Corporate long-term rate by changing the Government long-term rate.

Debt Policy. These concluding comments have considered the paradoxical fact that life companies do not purchase Governments despite the high income-security, excellent call protection and very small yield sacrifice they entail. It was suggested previously that a plausible explanation is that life companies desire income-security but are under continual pressure to meet the needs of their borrowing clientele. The life companies can fulfill *both* objectives by purchasing long-term Railroads, Public Utilities (Companies A and B), and long-term Industrials (Company D). The Government securities are in the same maturity range and hence offer no special inducement to life companies in terms of income-security.[41]

However, the Treasury might be able to tap the latent desire for income-security of life companies by issuing a very long-term bond, one that does not compete with existing market maturities. It appears that the latent desire for income-security has already produced the prototype of the suggested security. This is the 100 year bond of Company D. The envisaged issue should have a 50 to 100 year maturity, a 3.5 to 3.9 per cent coupon and be noncallable and preferably a "tap" issue. The "tap" issue means the security would be available for purchase from the Treasury for an extended period. This security would fit perfectly the avowed policy of the Treasury to "tailor securities to the needs of investors."

Pin-In Effect. There is no evidence that life companies are constrained in their sales of securities by capital losses. In fact, much of the portfolio analysis consisted in demonstrating that life companies willingly assume capital losses so long as the new Acquisitions yield is more than the existing maturity yield on the old securities. Opportunity cost is the determinant of action as economic theory predicts.

Capital Markets

Since 25 per cent of all private funds invested each year come from life companies, it is apparent that the demands of these investors, in terms of maturity, amortization requirements, etc., will significantly shape and influence market offerings. This large block of "knowledgeable" funds, 17 billion dollars annually, provides a continual testing and judgment of default risk differentials, maturity yield differentials, etc. In addition, the large volume of liquidity assets held by life companies increases the perfection of the Treasury bill market and helps to develop new markets such as the commercial paper market.

The types of loans placed by life companies have radically changed during the postwar years. These new loan forms determine the efficiency with which the country's savings are utilized which, in turn, affects the nation's economic growth.

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[41] The lower yield probably just offsets the greater call protection and default safety.

Contrary to previous pessimistic predictions, the large growth of direct placements has not stifled the public placements market; rather, it has acted as much to develop new loan markets as it has to supplant existing loan markets. A study by the Securities and Exchange Commission reveals that whereas only 3 per cent of public issues are in amounts less than one million dollars, over 40 per cent of direct placements are in amounts less than one million dollars. This is further illustrated by Company D which in 1955 formed a special loan department for placing small industrial loans. This department places loans at a volume of over 100 million dollars per year which originate in the regional field offices.

In conclusion, the impression gained from these vigorous and diverse patterns of investment is that life companies are dynamic and knowledgeable investors. They are specialists who "push" capital funds into new areas thereby increasing the perfection of the capital markets. The extent to which these intermediaries have transformed the capital markets is a rich field for further study.

Cumulative Author Index

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