AN EMPIRICAL INVESTIGATION OF LIQUIDITY, PROFITABILITY, AND RISK AMONG SELECTED MANUFACTURING INDUSTRIES, 1952-1971

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CHAPTER I

INTRODUCTION

Purpose of the Study

The purpose of this study is to determine by using aggregate data if there are consistent empirical relationships among three separate and distinct variables: corporate liquidity, profitability, and risk. More specifically, the study is designed to examine selected measures of these variables for a number of different manufacturing industries on a temporal cross-section basis for a selected period as defined in the Quarterly Financial Report for Manufacturing Corporations published jointly by the Federal Trade Commission and the Securities and Exchange Commission.[1]

Aggregate data have been selected for use in this study for two reasons. The primary reason is that the few extant studies of liquidity, profitability, and risk have emphasized the use of individual firm data to test the models in question. There is no intuitive reason to believe the results of this study may differ depending on whether aggregate data or individual firm data are used as long as these data are grouped into homogeneous categories. The data reflect financial policy as is determined by a group of firms facing the same exogenous variables. However, it is important to rigorously test the model to see if the aggregate data using industry categories can be used to show the existence of liquidity, profitability, and risk relationships. The

emphasis here is on firms collectively. Using aggregate data is a point of departure from existing studies. The second reason for using aggregate data is availability. Aggregate data in an accurate, consistent, and concise form are more readily available.

Financial theory assumes three characteristics of the firm--liquidity, profitability, and risk--are interrelated. If liquidity is defined as the ability of the firm to meet maturing obligations over its planning horizon, then the amount of liquid resources on hand and the rate at which these resources become available during this period would be the key to the measurement of liquidity. Profitability (or cash flow) would directly bear on the rate at which resources become available to the firm. Risk may be measured in terms of the variance of the after-tax profitability of the firm, a measure which would include the effects of both financial and operating (or business) risk. The variance of net profits after taxes is a measure of the composite risk of the firm. The composite risk posture assumed by management would bear on the amount and rate at which obligations come due and the amount and rate at which resources to pay the obligations become available. In any case, any relationship among liquidity, profitability, and risk is of direct concern to financial managers.

Liquidity, profitability, and risk levels are closely tied to the level of working capital. The appropriate level of working capital for a firm is determined by management decisions concerning liquidity and the maturity schedule of its debt obligations. Further, management is influenced by an assumed inverse relationship between profitability and risk at higher levels of liquidity. This relationship is premised on the implicit or explicit assumption that often the more liquid assets

yield a lower return than the return from other assets. Above some ideal level, liquid assets become redundant, serving no useful function and in addition penalizing the firm with respect to profitability. The smaller the proportion of more liquid assets relative to total assets, the higher the profitability on total assets. Management is also influenced by an assumed direct relationship between profitability and risk at extremely low levels of liquidity. Consequently, an optimal level of working capital is assumed for any given firm at any given ~~firm at any given~~ time, i.e., one which will maximize profitability.

The proportion of current liabilities relative to total financing may also affect the return on total assets. For example, profitability will be higher to the extent that short-term financing has a lower total out-of-pocket cost than long-term financing.

These assumptions concerning the theoretical effects of the levels of current assets and current liabilities upon profitability suggest that the level of working capital should be very low. However, risk considerations suggest otherwise. If risk is defined as the probability of being unable to meet maturing obligations, the lower the level of working capital, the higher is the risk to the firm. In sum, the levels of profitability and risk theoretically affect the level of liquidity directly. Consequently, the emphasis of this study is upon examining a selected model of the relationships among the levels of risk and profitability and the level of liquidity developed from existing financial theory.

Central Issue

Given the purpose of the study, the first task is to formulate a

model relating various measures of liquidity, profitability, and risk and relate this model to underlying financial theory. The second task is to empirically test the model in an effort to determine the extent to which the presumed relationships exist upon the sample data.

This study is formulated to increase our understanding through an empirical analysis of a conceptual model used to explain the relationship among liquidity, profitability, and risk--a relationship which is often taken as axiomatic within the literature. In the most general terms, the central issue to be investigated is whether there is a consistent cross-temporal relationship between liquidity, variously measured, as the dependent variable and profitability and risk, both variously measured, as the independent variables. The model is of the form such that it is expected as the level of profitability increases and the level of risk decreases, the level of liquidity is increased. Conversely, as the level of profitability decreases and the level of risk increases, the level of liquidity decreases. This implies that the liquidity variable and the profitability variable should have opposite signs.

To a great extent, the decision as to which of the variables is dependent and which is independent is arbitrary. Consequently, liquidity, profitability, and risk are all both dependent and independent; none is purely dependent or independent. There are controllable and uncontrollable elements in all of these variables. The variables are independent in that financial decision-making can have an effect on any or all. They are dependent in that exogenous variables can also influence their levels. The primary factors distinguishing liquidity from profitability and risk with respect to dependency is the rapidity

with which exogenous factors can influence the level of liquidity. For this reason, liquidity has been classed as the dependent variable and profitability and risk the independent variables.

Scope of the Study

Two factors considerably narrow the scope of this study: the nature of the sample data and the definitions and measurement techniques for liquidity, profitability, and risk. With respect to the nature of the sample data, manufacturing corporations are the only category of firms surveyed. Financial institutions, service corporations, transportation corporations, and utilities, among others, have not been surveyed. Further, only the period from 1947 to the present is covered. The reason for this restriction is that publication of the Quarterly Financial Report did not begin until 1947. However, this 25-year period is sufficiently long to be representative of cylical economic activity and secular trends. Therefore, in sum, the scope of this study is limited by the sample data to selected manufacturing firms from 1947 to the present.

With respect to the measurement techniques for liquidity, profitability, and risk, it should be emphasized that the purpose of this study is not to determine the "best" measures. Rather, the purpose is to empirically test a conceptual model based upon existing financial theory. The model is used to explain the relationships among alternative combinations of certain measures. Consequently, the scope of this study has also been restricted to a relevant group of measurement techniques which have commonly been used in the past in the case of all

three concepts--liquidity, profitability, and risk--and those which have been found to be empirically useful in predicting financial failure in the case of one concept--liquidity. A conclusion as to the effectiveness of the measures of liquidity, profitability, and risk is not intended to be a consequence of this study.

Limitations

Certain limitations to this study exist. In this connection, this study proposes a cross-section analysis of an assumed relationship, where the relationship involves excluded dynamic considerations such as lagged adjustment and expectational factors. Kuh[2] and Vogel and Maddala[3] have discussed the difficulties of using such an analysis in a dynamic situation. They recognize that the variance of given data over time is attributable to two factors: differences among the various categories into which the data are grouped and individual differences over time. Excluded variables may be significantly different in terms of their effects in either time series or cross-section analyses. Because these variables may cause a significant bias, Kuh argues that cross-section regression estimates may be misleading unless the analysis is based upon a rectangular data array of a number of cross-sections of much the same individuals. Otherwise, cross-section and time-series regression coefficients cannot validly be compared. Consequently, care must be exercised in this study to arrive at unbiased cross-section estimates with no specification biases other than exclusion of dynamic variables.

A second possible limitation related to the question of whether any existing relationship among the variables should be examined on the

individual firm (micro-level) or the industry (macro-level) level. The macro-level approach is the one emphasized here because the data as presented are in the industry groupings established by the Standard Enterprise Classification system. Furthermore, the individual firm is exposed to much the same independent variables as the industry as a whole and would be expected to react in a similar fashion. Therefore, examination of the aggregate data permits a valid analysis of the relationship between the liquidity, profitability, and risk variables on the individual firm level. Further, as noted above, there is no intuitive reason to believe the results of this study would differ using aggregate or individual firm data.

Another limitation is that the sample as derived from the QFR is heavily weighted with large manufacturing corporations. More specifically, it consists of (1) approximately one-fortieth of all manufacturing corporations with total assets under $1 million, (2) approximately one-fourth of all manufacturing corporations with total assets of $1 million to $5 million, (3) approximately three-fourths of all manufacturing corporations with total assets of $10 million and over. Consequently, any generalization of the results of this study to smaller manufacturing corporations would certainly be more hazardous at the very least than generalization to large ones.

As noted above, corporations not classified as manufacturers have not been considered. Consequently, generalization of the results to financial institutions, service corporations, transportation companies, and utilities among others could not be justified at least empirically. Also, as noted above, only a restricted number of liquidity measures have been considered.

Finally, with regard to the industry classification scheme, it should be noted that large corporations often embrace many industries. Diversification means that the classification of a company into a particular industry is often somewhat arbitrary. The major operation of a diversified company often determines the industry into which it is placed. Consequently, the companies comprising any given industry may not be perfectly homogeneous in nature. However, this lack of homogeneity of industry categories would not be rectified by resorting to individual firm data. The industry data are based upon individual firm data. The diversification-based homogeneity could not be eliminated simply by aggregating individual firm data to draw conclusions about industry categories since the heterogeneity is inherent in the individual firm data comprising the categories and not the categories themselves. As noted above, these firms are mostly very large and, as such, very diversified. Use of individual firm data would not gain the study additional benefits. Consequently, the use of aggregate data will not limit the study with respect to any conclusions which may involve the industry classification scheme based upon the results obtained.

Overview and Organization

In Chapter II, the literature concerning the assumed nature and relationships of liquidity, profitability, and risk is examined. Note is made of a number of references which axiomatically assume that relationships between liquidity, profitability, and risk exist in one form or another. Cross-sectional and time-series empirical studies on the micro- and macro-levels are also noted. Concepts and problems

in the definition and measurement of liquidity are then discussed. Finally, existing micro- and macro-level models of liquidity demand are examined.

Based on past empirical studies, theoretical work, and statements of the relationships, with recognition of the measurement problems involved, a model relating liquidity, profitability, and risk is developed in Chapter III. The model is stated as a series of hypotheses. The sampling procedure and sample data used to test the model are also discussed.

In Chapter IV, empirical tests are made of the hypotheses developed in the previous chapter. The multiple regression model developed in Chapter III is used in employing the QFR data and the various proposed measures of liquidity, profitability, and risk. The results are compared on a temporal cross-section basis between and among industries. Tests of the model are provided by the magnitudes of the regression coefficients. The model is analyzed and interpreted in light of the results obtained.

Finally, the conclusions and summary to be derived from the tests of the model are presented in Chapter V. The implications of the results for the literature concerned with the relationships are discussed, and suggestions for possible future research in the area are made.

FOOTNOTES

[1]Hereafter referred to as the QFR or the Quarterly Financial Report.

[2]Edwin Kuh, Capital Stock Growth: A Micro-Econometric Approach (Amsterdam, 1963), Chapters 5 and 6, pp. 173-210.

[3]Robert C. Vogel and G. S. Madalla, "Cross-Section Estimates of Liquid Asset Demand by Manufacturing Corporations," Journal of Finance, Vol. 22, No. 5 (December, 1967), pp. 557-575.

CHAPTER II

REVIEW OF THE LITERATURE

Framework for the Review

First, a theoretical construct examining the relationships between liquidity, profitability, and risk and the factors which bear on these variables is examined. Then, various statements concerning the assumed relationships are reviewed to establish their axiomatic nature. Next, the literature concerning various aspects of the liquidity, profitability, and risk variables is examined. More specifically, studies of liquidity trends and predictability of financial failure are reviewed, and the problems in the definition and measurement of liquidity are discussed--all with the intent to tie the discussion in with the model which is central to the study here. Finally, empirical research on existing theoretical models concerning liquidity and liquidity demand are analyzed. These studies may be categorized within a two by two matrix representing the approaches taken by each: temporal cross-section or dynamic and micro- (individual firm) or macro-level (aggregate of individual firms).

One type of study which is extremely important to this study is noticeable by its absence from the literature. The literature is almost totally devoid of the empirical study which synthesizes and integrates the assumed relationships among liquidity, profitability, and risk. This is surprising in light of the many axiomatic statements concerning

the relationships. Consequently, this study embarks on new territory. The lack of such a study is a major motivating factor behind this study.

Theoretical Construct

Within the literature of finance, it is frequently taken as axiomatic that there is some kind of relationship between corporate liquidity, profitability, and risk. Usually the relationship is expressed as a tradeoff between liquidity on the one hand and profitability and risk on the other. In this context, "tradeoff" is taken to mean an inverse relationship between liquidity and profitability. The lower the profitability and the higher the composite risk is, the higher the liquidity and vice versa.

Liquidity, defined as the ability to meet maturing obligations as they come due during the planning horizon of the firm, is dependent upon the availability of cash. The conversion of assets into cash requires various lengths of time to consummate the conversion and entails various amounts of uncertainty associated with the dollar amount that may be realized. For example, the conversion of plant and equipment into cash usually requires a greater length of time and entails a greater uncertainty concerning the dollar amount to be received than the conversion of marketable securities into cash. Further, in a forced sale where a time constraint is placed on the conversion period, the dollar amount which will be realized becomes even less certain.

From a theoretical standpoint, market expendiencies make liquidity a desirable attribute which may be reflected in the value of the firm. If a forced sale of assets in bankruptcy results in a lesser dollar

amount being realized than would have been in a more relaxed atmosphere, then the stockholders as residual claimants to the dollar amounts realized would be obviously worse off. In turn, this would be reflected in the value of the firm. Therefore, stockholders may benefit from liquidity to the extent that it reduces the likelihood of bankruptcy.

It is often assumed that management should act to maximize stockholder wealth. The amount of liquidity which management should maintain in order to maximize stockholder wealth is dependent upon the probability of bankruptcy, the costs associated with the forced sale of assets, and any costs associated with maintaining a given level of liquidity. Whether management actually does act to maximize the value of the firm is an entirely different question. The goal described above is the assumed normative goal of the firm, the one which should be pursued as a necessary but not sole criterion for the efficient allocation of resources in the economy as a whole and in the firm per se.

In this study it is assumed that the probability of bankruptcy and costs associated with the forced sale of assets will be reflected in the variable called risk. The risk that is involved is called composite risk and is reflected in the variability of earnings. It is measured by the coefficient of variation of earnings. It is further assumed that any costs associated with maintaining a given level of liquidity will be reflected in the variable called profitability.

As noted above, management decisions concerned with liquidity bear directly on the assets acquired and the liabilities assumed by the firm. These decisions are also affected by an assumed tradeoff between the profitability and risk variables. Decisions concerning the liquidity of assets deal with the conversion of assets into cash. Decision areas

include the management of cash and marketable securities, accounts receivable management, inventory management, and the management of non-current assets. The emphasis here is on the management of liquid assets. It is assumed that liquid assets, in particular cash and marketable securities, yield less than the less liquid assets. Therefore, from the standpoint of the asset mix of the firm, the greater the proportion of liquid assets is relative to total assets, the greater the profitability of the firm. But at the same time, the greater this proportion of liquid assets is relative to total assets, the less the risk of the firm.

From the standpoint of the liabilities assumed by the firm, profitability is affected by differences in the costs of current and noncurrent liabilities. If current liabilities have a lower explicit cost than long-term liabilities, then management would tend to assume a greater proportion of current liabilities. Current liabilities would also be preferred cost-wise to the extent that long-term financing becomes seasonally or cyclically unnecessary for the firm.

This further emphasizes the relationships among liquidity, profitability, and risk. The low proportion of current assets to total assets and high proportion of current liabilities to total liabilities implies that management should opt for a low working capital level, i.e., a small amount of liquidity, to maximize profitability. On the other hand, the small amount of liquidity implies a greater amount of risk to the firm, a higher probability of bankruptcy. The net result is an optimal level of liquidity, one where, given the risk posture that management wishes to assume, profits will be highest.

Statements of the Relationship

The statements of the assumed relationships among liquidity, profitability, and risk vary from one source to another. These statements do always make explicit the variables that are to be considered dependent and those to be considered independent. For example, in an attempt to develop several propositions that would serve as the foundation of a theory of working capital, Walker states:

> Total capital in a business enterprise consists of fixed and working capital, and the firm's profitability is influenced by the ratio of working capital to fixed capital. Our first proposition is directly concerned with this concept; it may be stated as follows: <u>If the amount of working capital is varied relative to fixed capital, the amount of risk a firm assumes is also varied and the opportunity for gain or loss is increased</u>. This principle implies that a definite relationship exists between the degree of risk that management assumes and the rate of return. Moreover, the principle assumes that this relationship can be changed by changing the level of working capital.[1]

He further argues that risk, among other things, "means the risk of not maintaining adequate liquidity," and working capital varies directly with the level of production and risk assumed by the management.

Similarly, Parther and Wert comment:

> The amount of liquid assets required by a business firm depends on many factors, including its credit position or ability to borrow in case of need. Because liquid assets are not used in production, keeping too large a percentage of resources in this form reduces profits. Hence management is responsible for maintaining the correct balance between safety and profitability. Since the liquidity and profit objectives are conflicting, the manager of the firm must constantly reach compromises between these goals.[2]

In this case, the authors are more inclusive in their definition of liquidity. Included are cash or near-cash items that may be converted into cash without loss or delay (such as money market instruments) in addition to the ability to borrow.

Flink and Grunewald discuss this tradeoff in much the same vein:

> By its very nature, liquidity represents funds that are not used in the operations of the firm. In effect, the financial manager "trades" profitability for liquidity. If he overstresses liquidity, the firm foregoes profitable opportunities. If he overemphasizes profit, he endangers the firm's ability to meet bills and notes when payment is due. The ratio of cash and cash equivalents to short-term liabilities reflects the financial manager's ability to maintain an effective balance between liquidity and profitability.[3]

The authors have related liquidity here to both cash and near-cash items relative to current liabilities.

Curran has similar observations:

> . . . [T]he composition of long-lived assets and liabilities has a direct impact on profitability and ultimately on the market value of the owners' equity. But the level of working capital has a more indirect effect. The day to day task of financial management is to meet the firm's obligations as they come due. In the long run, profitability depends on liquidity. The direct function of working capital management is to keep the firm from bankruptcy. Within this context, of course, the firm can manage its current assets so as to add to the owners' profits. But management's decision to invest a dollar in non-operating rather than operating assets is usually a choice in favor of lower profits. The implication is that by so doing, it raises, or at least does not lower, the market value of the owners' equity.[4]

In contrast to the above authors, Curran has tied this tradeoff directly to the normative goal of the firm, the maximization of the market value of the owners' equity. Further, the tradeoff is expressed as a rule, but not one without exception.

Van Horne notes:

> Working capital management usually is considered to involve the administration of current assets--namely, cash and marketable securities, receivables, and inventories--and the administration of current liabilities. . . . Determining the appropriate levels of current assets and current liabilities, which determine the level of working capital, involves fundamental decisions with respect to the firm's liquidity and the maturity composition of its debt. In turn, these decisions are influenced by a tradeoff between profitability and risk . . . We assume . . . also that the

> cash and marketable securities held by the firm (hereafter called liquid assets) yield a return lower than the return on investment in other assets.[5]

Here, liquid assets have been restricted to cash and marketable securities. Further, the assumption that these assets yield less than other assets has been made very explicit.

Cohen and Robbins, citing the example of one company, the Cincinnati Milling Machine Company, during the 1958 to 1963 period, generalize:

> /The/ tendency for companies to become cash-poor as the tide of economic prosperity rises and cash-rich as it runs out is a well-known economic phenomenon. . . . The pressure on company finances during boom years is reflected in the business drive for loans and the high interest rate of these years as compared with a reversal of such conditions during period of economic decline. The financial implications of these movements may be deceptive. A weakening of the cash position in a favorable economic environment may suggest the need or difficulty of raising capital for further expansion rather than a shortage of funds to take care of current needs. On the other hand, a strong cash position when the economic outlook is bleak may be the forerunner of actual financial difficulties. If the depression is sufficiently deep, the company's liquid status may become eroded and its cash inflows may dry up, and it may be unable to take care of its obligations as they fall due.[6]

In spite of the susceptibility of the apparent generalization from one company and one relatively short time period, the authors have taken note of the difficulty in interpreting commonly used methods of measuring liquidity. In either case, with a weak or strong cash position, they emphasize the possible negative effects on the firm.

Weston and Brigham take note of the tradeoff between risk and profitability and relate it to the normative goal of the firm:

> An increase in cash position . . . reduces risk, but since cash is not an earning asset, converting other assets to cash also reduces profitability. Similarly, the use of additional debt raises the rate of return, or profitability, on the stockholders' net worth; at the same time, more debt

> means more risk. Financial analysis seeks to strike the particular balance between risk and profitability that will maximize the wealth of the firm's stockholders.[7]

These authors have defined liquidity in terms of cash balance.

Table I (pp. 19-20) summarizes all of these statements concerning the relationship of liquidity, profitability, and risk. In any case, this somewhat confusing group of statements has certain common characteristics. First, there is no common definition given to liquidity. As defined above, "liquidity" from the narrowest standpoint is simply cash. From the broadest standpoint, it is working capital, measured by the difference between current assets and current liabilities. In at least one case above, borrowing capacity is considered to be part of the firm's liquidity. Second, there most commonly is no explicit definition for profits or profitability. More specifically, the intended profit figure is not specified, i.e., whether it is net operating profit, net profit after provision for income tax, net profit plus extraordinary items, or even some other profit figure. Third, there is no explicit definition of risk, although most seem to imply the probability of financial failure. However, financial failure includes the entire spectrum of possibilities between technical insolvency, a temporary inability to meet current maturing debts, and insolvency at the other extreme, a condition where liabilities exceed assets. Finally, the variables are not explicitly designated as dependent or independent. This is likely the result of the fact that they are really interdependent.

TABLE I

SELECTED RELATIONSHIPS OF THE RELATIONSHIP BETWEEN LIQUIDITY, RISK, AND PROFITABILITY

	Author(s)	Synopsis of Statement	Relationship to Hypotheses to be Tested	Measures of Variables Implied
(1)	Walker	Profitability and risk are influenced by the ratio of working capital to fixed capital.	Does not make explicit which of the three variables are considered dependent and which are independent.	Working capital is a measure of liquidity; no other measures are implied.
(2)	Prather and West	Management is responsible for maintaining a balance between safety and profitability and liquidity.	Seems to imply that liquidity is the dependent variable and profitability and risk are the independent variables.	No measures are implied.
(3)	Flink and Grunewald	The financial manager "trades" profitability for liquidity but if the former is overemphasized, the firm incurs undue risk.	(Same comment as (2) above.)	No measures are implied.
(4)	Curran	Management's decision for non-operating rather than operating assets is a choice in favor of lower profits and concurrently lesser risk.	(Same comment as (1) above.)	No measures are implied.

TABLE I (Continued)

	Author(s)	Synopsis of Statement	Relationship to Hypotheses to be Tested	Measures of Variables Implied
(5)	Van Horne	Working capital management includes fundamental liquidity decisions which are influenced by a tradeoff between profitability and risk.	(Same comment as (2) above.)	No measures are implied.
(6)	Cohen and Robbins	A strong liquidity position may be a reflection of a current economic boom or a forerunner of financial difficulty.	(Same comment as (2) above.)	No measures are implied.
(7)	Weston and Brigham	An increase in liquidity reduces risk and profitability. Additional risk in the form of debt can increase profitability. A particular balance between risk and profitability will maximize stockholders' wealth.	(Same comment as (2) above.)	No measures are implied.

Studies of the Various Aspects of the Relationship

In light of the widespread assumption that there are some relationships between liquidity, profitability, and risk, it seems that there would be a plethora of empirical studies serving as a basis for them. This is not the case. As a matter of fact, there are selected empirical studies which only indirectly support such generalizations. However, there is related literature which is concerned with limited aspects of assumed liquidity-profitability-risk relationships.

Liquidity Trends

One category of studies which has dealt with liquidity and liquidity demand is that which has examined the decrease in corporate liquidity since World War II. Jennings took a pessimistic look at various liquidity and debt ratios over this period and concluded that the deterioration in liquidity represents a challenge to corporate officials to attain a satisfactory balance between liquidity and earnings.[8] Cossaboom examined the ratio of cash and marketable securities to current liabilities of manufacturing firms during this same period and made suggestions as to what might be done to avoid vulnerability to future liquidity "squeezes."[9] In contrast, Tommeraasen concluded that this "squeeze" observed over the post-war period was the result of "successfully applied modern cash management methods and techniques" in order to achieve lower cash balances and not the result of forces producing unexpected results.[10] Further, he argued that former higher balances were not necessarily desirable. Jacquette, in examining bank liquidity between 1961 and 1966, concluded that if liquidity declined

during this period as it seemed, then either the banking system was maintaining inadequate liquidity or, more likely, carried excessive liquidity in the past.[11]

These studies indicate that the secular trend in liquidity is downward. If the assumptions concerning an optimal level of current assets--one in which the costs associated with bankruptcy and with maintaining redundant current assets--are indeed borne out, then an increase in profitability and a concurrent increase in risk would be expected over this period ceteris paribus.

Predictability of Financial Failure

Another category of studies dealing with some aspects of the liquidity-profitability-risk relationship is concerned with financial ratios and the predictability of financial failure using financial ratio analysis. In an early study, Fisher found that the logarithm of the average risk premium on a firm's bonds can be estimated by a linear function of the logarithms of four variables: the coefficient of variation of the firm's net income after all charges and taxes over the last nine years, the length of time the firm has been operating without forcing its creditors to take a loss, the ratio of the market value of the equity in the firm to the par value of the firm's debt, and the market value of all outstanding, publicly traded bonds of the firm.[12]

Horrigan later investigated the statistical nature of selected financial ratios and found that they were approximately normally distributed, exhibited a high degree of collinearity, were correlated over time, and were subject to wide dispersion.[13] In a later study, similar to Fisher's, Horrigan found that certain financial ratios and

accounting data (total assets, a long-term solvency ratio, a short-term capital turnover ratio, a long-term capital turnover ratio, a profit margin ratio, and a dummy legal status variable) were useful in determining corporate bond ratings.[14]

Beaver also examined financial ratios as predictors of failure in two separate studies.[15] In an early study covering firms which failed during the 1954 to 1964 period, he reached a number of conclusions: (1) There was a gap between the means of the ratio distributions of failed and nonfailed firms which increased as failure approached. (2) Not all ratios predicted failure equally well. The cash flow to total debt ratio discriminated well throughout the five-year prefailure period, while the predictive power of the liquid asset ratios was much weaker. (3) The ratios did not predict failed and nonfailed firms equally well. Nonfailed firms could be correctly classified better than failed firms, which he noted was unfortunate because of the high costs of the latter. In a later cross section and time series analysis using the same sample of firms over the same time period, Beaver found: (1) Investors recognize and adjust to the new solvency positions of failing firms. (2) The price changes of the common stocks act as if investors rely upon ratios as a basis for the assessments, and the ratio information is reflected in the market prices.[16]

Altman assessed the analytical quality of ratio and analysis applying multivariate discriminant analysis to the problem of the prediction of a corporate bankruptcy.[17] His discrimination ratio model was found to be not only valid but reliable over a number of samples, and predicted bankruptcy up to two years prior to the actual event with rapdily diminishing accuracy as the time period increased. A limitation

of Altman's study, as he pointed out, was that the sample included only publicly held firms for which financial data were readily available. Edmister, using a similar model on a sample of small businesses, concluded that analysis of selected financial ratios is useful for predicting small business failure.[18]

An analysis by Fletcher, which cannot be classified under either of the above headings but has relevance to this particular study, examined the nature of intraindustry variations in corporation financial structures.[19] The study analyzed the financial structures of 124 firms--the chemical, food processing, steel, machine tool, and office equipment and computer industries. The major focus was determination of intraindustry variations in 13 financial ratios classified as measures of activity, liquidity, and earnings. It was hypothesized that corporations within each industry should tend to choose similar optimal financial structures as a result of similarities in business risk, similarities in sources and uses of assets, and similarities in the stability, amount, and rate of earnings. The hypotheses were borne out.

These studies indicate in general that financial ratios can be useful in the prediction of financial failure. Certain of these ratios which have proven to be useful to this end are applied in this study as measures of risk.

Definition and Measurement of Liquidity

The question of the appropriate way to define and measure liquidity is by no means settled. However, any model concerned with the various aspects of liquidity should originate from a statement of the reason or reasons for the necessity of such a concept or from assumed relationships

between liquidity and other variables in order to be useful to financial management. To a greater or lesser extent existing models rely upon such bases, and their respective utilities do lie in the extent to which their purpose for existence is served.

Liquidity is sometimes treated as synonymous with working capital. A number of authors have recognized the shortcomings of this broader definition of liquidity in various ways. Bierman argued for the incorporation of the funds statement in the analysis of liquidity, where funds were defined as equivalent to working capital.[20] Sorter and Benston proposed measuring liquidity by the defensive interval through relating a firm's present ability to pay its debts to the debts it will have to pay in the short run rather than by the current ratio.[21] Coughlan suggested that estimates of future receipts and disbursements may provide a better measure of credit standing than the usual analysis of current assets and current liabilities.[22] Fess proposed that the classification of balance sheet items be done such that the manner in which the resources were to be used by the firm would better highlight the resources available for use.[23] Park noted that the conventional one-year accounting period employed in classifying working capital items may not be appropriate to a company's cash-planning and operating-cycle periods.[24] Huizingh reiterated many of the above criticisms of liquidity as a reporting standard in addition to some new ones.[25] Glickman and Stahl discussed the shortcomings of the traditional treatment of working capital with respect to the balance sheets of firms in certain service industries.[26]

Less commonly, but more appealing conceptually, liquidity includes cash and marketable securities in addition to any unused short-term

borrowing capacity. There is no amount shown on the balance sheet to represent this potential source of liquidity, but yet it represents something which should be considered by financial management in planning for future needs. Lemke recognized that a firm's liquidity depends partly on the matching of cash outflows with cash inflows (or, where the former exceeded the latter, the difference being made up through static cash and near-cash holdings).[27] Further, he pointed out that the necessity for detailed planning is imposed by nonroutine fluctuations in cash flows and proposed a liquidity-flow index in lieu of the current ratio. However, he admitted that the ability of the external analyst to compute this index was nil if companies did not publish projected cash flow data, which they do not. Bosworth was another to recognize that liquidity was dependent to a certain extent on the unused portion of the short-term debt capacity.

These studies indicate that liquidity may be measured in a number of different ways. A representative sample of these measures have been selected and applied to this study as alternative measures for the liquidity variable.

Models of Liquidity Demand

Traditional Motives for Maintaining Cash Balances

If we designate liquidity as the dependent variable, it is important to relate existing models of liquidity demand to this study in order to show the interrelations between liquidity balances and the variables which influence them. Based upon the work of Keynes it is now common to identify three reasons or motives for economic units to

maintain money balances.[29] The first is the transactions motive. Because there is a time lag between money receipts and money expenditures, the economic unit will maintain a certain amount of cash on hand. The amount of holdings for transaction purposes is dependent upon a number of factors. Other things equal, it has been suggested that the average balance declines as the rate of inflows and the rate of outflows increase. Second, it has been suggested that the average balance is smaller, with greater coincidence between inflows and outflows. Third, it is frequently assumed that the demand for transactions balances changes in proportion to income. Finally, it is frequently assumed that the average cash balance held for transaction purposes at a given level of expenditures falls as net interest income obtainable increases.

A second motive for economic units to maintain cash balances is the precautionary motive. Some amount of cash is held in excess of the minimum balance called for by the transactions motive. This excess is commonly called the precautionary balance, and is designed to meet emergencies and to take advantage of bargains. It is often suggested that the demand for precautionary balances increases as the interest rate falls by lessening the opportunity costs associated with these balances. An increase in the demand for precautionary balances could be expected with increases in income since a larger scale of business operations and more financial commitments would increase the need for these balances. Last, the demand for precautionary balances likely is very sensitive to changes in expectations concerning future business conditions. The bleaker the outlook is, the higher the precautionary balance demand.

A third and final motive for the maintenance of cash balances, probably not as significant as the first two motives mentioned above, is the speculative motive. From the broadest standpoint, an economic unit may hold its wealth in any of three forms: money, debt instruments, and goods. Each form has its own particular advantages and disadvantages for its holder. For example, money, while being perfectly liquid, yields no income. Marketable debt instruments, while yielding income, are subject to price fluctuations with changing interest rates. Money and debt instruments differ from goods in that the former do not fluctuate in price as the price level of goods changes. If a choice were to be made between money and debt instruments after satisfying transactions and precautionary motives, it would seem that the economic unit would be better off holding debt instruments, since debt instruments yield interest income while money does not. However, this type of analysis overlooks uncertainty about future returns from bonds, and transactions costs may be prohibitive.

The Keynesian model suggests several things. First, the transactions and precautionary motions suggest amounts of liquidity held for these purposes are directly related to the economic unit's income and inversely related to prevailing interest rates. The speculative motive, while de-emphasized by most Keynesians, suggests balances held for this purpose are inversely related to interest rates and directly related to transactions costs. Taken all together, there would seem to be little disagreement between the Keynesian model and the theoretical construct proposed here. However, the emphasis is somewhat different between the two. The Keynesian model does relate liquidity directly to profitability by indicating that profitability does generate liquidity. Further, the

Keynesian model suggests the greater the amount of liquidity held, the greater the opportunity costs of interest income foregone and the lesser the transactions costs associated with obtaining marketable securities, both of which would be reflected in profitability. However, the Keynesian model ignores the possible effects of risk upon the amount of liquidity held. The theoretical construct employed here emphasizes the effects of both profitability and risk levels upon the level of liquidity.

Donaldson's Model

One of the more comprehensive theoretical analyses of the concept of liquidity, its various aspects, and its relationship to financial management from a micro-standpoint is attributable to Donaldson. His analysis represents an extension of the Keynesian model and is helpful in understanding the relationships among liquidity, profitability, and risk.

Donaldson saw the concept of liquidity inseparable from the broader concept of financial mobility. Here the central problem lay in incomplete information about the need for future funds requirements. The question facing financial management then became: How does or should the firm respond to the knowledge that future funds flows are not precisely known and that from time to time major needs will arise that have not been fully anticipated?[31]

The Liquidity Dimension. In this analysis, two dimensions of the problem were emphasized. The first was that of liquidity and the other was flexibility. Commonly, liquidity is used to designate the degree to which the assets of a firm are in the form of uncommitted purchasing

power, i.e., cash and marketable securities. Not all of this "cash," however, is available for immediate investments. A certain amount is tied up because of the firm's timing of collections and expenditures; another portion is held to meet unexpected needs; and a final amount is held to take advantage of various forms of wealth.[32]

In a broader definition, liquidity includes other sources of corporate purchasing power. The quick ratio and current ratio are two liquidity measures which reflect this. These measures are presumably tests of the ability of the company to pay current obligations out of liquid assets at full value. Liquidity in this liquidation context has more meaning to the short-term creditor than to the long-term creditor or management since continuing investment in current assets other than cash and marketable securities is a necessary part of an on-going concern.

Donaldson has also pointed out that the relationship between short-term bank credit and liquidity and tied it in with his concept of mobility.[33] Unused bank credit is uncertain to a limited extent in terms of amount and availability. However, management's confidence in its banking relationships negates this uncertainty. The ultimate purpose of liquidity is free balances of immediately available purchasing power to implement management's motives. And it is this purpose which is an important part of the concept of mobility.

The Flexibility Dimension and the Concept of Mobility. The second dimension of Donaldson's analysis is that of flexibility. This term is used to refer to capital structure decisions where management is choosing the particular mix of sources of financing. Consideration usually is given first to choosing the mix that minimizes cost and maximizes

value. Secondary consideration is given future needs and the ability to alter the capital structure if needed. Financial mobility then includes alternatives with which to deal with the future.

Financially, business activity is a continuous flow of funds. Management finances various investments as a result of this flow in the hope that profits will result. As time passes, the investments change in response to changing internal and external conditions. Financial mobility is then defined as "the capacity to redirect the financial resources consistent with the evolving goals of management as it responds to new information about the company and its environment."[34]

Liquidity, referring to the stock of uncommitted funds at hand, and flexibility, referring to the stock of funds available through capital market negotiations, are directly related. The capacity to change investments is largely a function of this stock of funds. However, liquidity and flexibility are only two of the key concepts related to managing funds flows. The third concept is that of the regulation of the rate of flows--the rate or realization of inflows and the rate of commitment of outflows. A deficiency in funds flows may be any one or a combination of the following alternatives: an increase in outflows, a decrease in inflows, or a reduction in stock on hand. Therefore, a complete strategy should recognize all three alternatives.

This particular model is internally and not externally oriented. It examines the actual and normative management behavior in order to achieve corporate objectives. It is not concerned with the actual and normative stockholder behavior in order to achieve their financial objectives as is the main emphasis of contemporary financial theory.

In a dynamic economy, threats to the firm originate with some kind of change: external change in consumer behavior, in technology, in competitor actions, or internal change within the firm. Often, where changes can be foreseen, threats can be avoided. The challenge to management lies in the unanticipated change where the firm is significantly affected.

The strategy for management is to anticipate change and to have the capacity to act. Management must anticipate change far enough in advance to permit a sufficiently long response period. Pro forma funds flow statements aid in generating such a period. The continuing problem for financial management is to maintain a balance in fund flows at a point in time and over time, what is called maintenance of flow equilibrium, and to be prepared to respond to changes resulting in deviations from the expected funds flow pattern. Maintenance of flow equilibrium depends upon the reduction of outflows or an increase in inflows. The capacity to control the rate of change of economic resources from form to form and therefore to determine the resource mix is what is termed financial mobility. Its ultimate goal is to establish flow equilibrium.

The usual idea of corporate resources is the left-hand side of the balance sheet. However, this concept of financial mobility requires attention be shifted from resources which have been used in the past to generate income to those which will be available to management in the future. Many assets are given monetary values for accounting purposes, but do not necessarily have equivalent purchasing power. For example, much of the cash balance shown on the balance sheet is caught up in transactions activity and will remain caught up as long as transactions

remain at the same pace. Getting away from the concept of ownership, some resources not shown on the balance sheet are a significant part of flow management. For example, an unused portion of a line of credit can provide funds when funds flow dictate it. Consequently, the determining factors as to the similarity of accounting monetary value and purchasing power are whether an asset or resource can be converted into an alternative form in a given interval and, if so, what is the magnitude of the purchasing power generated.

Another difference between past and future resources is that the latter require more careful assessment. Future resources involve the dimensions of amount, timing, and probability. The assessment of probability attempts to adjust resource values in light of uncertainty. This consideration is usually absent from balance sheet concepts of asset values which are related to historical cost.

A final dimension of financial mobility which is ignored by balance sheet and accounting convention is competitive lead and competitive lag. These terms refer to the extent that past expenditures have given a firm a time span in which management can act before competition cuts into current earning power. These expenditures, like product promotion and research, are a key to a firm's competitive edge which maintains its future earning capacity and gives past investment any real present value. Yet, these expenditures on intangibles are usually not capitalized and are written off against current income during the year incurred. This maintenance of future earnings is particularly significant when fund flows must be modified in response to unexpected events. It is a key resource which reflects the effectiveness of past investment, but is unrecognized on the balance sheet. As was pointed out above, the

financial resources of a firm consist of those assets which it owns and resources which are not owned but are available outside the firm. In a static environment, these resources are finite in amount. A twofold-classification scheme of these resources is helpful in visualizing the concept of financial mobility: (1) Unspecialized resources, which possess available purchasing power without delay (A); and specialized resources, which are committed to uses which do not give them immediately available purchasing power (B and C). (2) Mobile resources, which possess purchasing power during a firm's planning horizon (A and B); and immobile resources which do not (C). It is the resources of categories A and B which are directly related to the concept of financial mobility.

In a dynamic environment, the firm's resources will change in total and with respect to the distribution of the resources among the various categories of resources with their potential mobilities. These shifts occur over the firm's planning horizon in response to changes in financial policies and risk policies. The various positions reflect changing financial mobility in the capacity to respond to the unexpected. Planning precedes each period in which inflows and outflows are projected.

Regardless of planning, pressures on fund flows do occur. The events causing these pressures may be categorized as follows: (1) isolated or random events resulting in rapid changes in outflows or inflows--strikes, fires, etc.; (2) fluctuations around a trend line resulting from changes in competitive position and industry demand; (3) movements to higher trend lines requiring increased scales of operation;

and (4) losses in competitive positions such that major outflows are needed to restore the firm to its former position.

Resources Contributing to Financial Mobility. The resources contributing to financial mobility fall into four categories. The first is that of instant reserves, which consist of cash balances (cash plus marketable securities) and commercial bank borrowing. Cash may be considered a residual resulting from differences in the rates at which assets are converted into liquid form and then converted back into other assets. This residual results from a wide number of events over which management has a greater or lesser control. To the extent that management does control these events, then it can control the level of each. The other component of instant reserves, commercial bank borrowing, may be of considerable significance. The relationship between borrowing firm and bank is often a long standing one, involving mutual trust and continuous communication of relevant information. The short-term loans permit the borrowing firm instant mobility of resources without the cost of holding idle resources.

A second major source of mobility, in addition to instant reserves, is modification of budgeted flows. Response is made by substituting the new need for a planned expenditure in the existing budget. For the most part, the response is made with respect to the reallocation of assets.

A third major resource of mobility is the liquidation of assets. During periods of financial strain when free resources are scarce and needs are abundant, the liquidation of specialized assets does occur and thereby becomes part of the strategy of financial mobility. Those assets most likely to be liquidated are those which contribute nothing

to cash flows or which are even a drain, but which are separable from the business without creating a severe impairment to the earning power which remains.

Finally, the fourth resource of mobility is an increment of long-term financing, either debt or equity. Because of the general unpredictability of the stock market and because of the substantial lead time before issue, equity financing is the less satisfactory of the two as a defense against fluctuations in funds flows. Long-term debt financing often involves direct negotiation from a single lender with whom previous dealings have been made. Therefore, it is much more of a known quantity than equity financing. However, long-term debt capacity is often a reserve in the sense of a restraint on the rate of current spending in order to provide for a higher priority need. This reserve is intended to improve the resources which handle needs quickly and without delay. Therefore, the reserve of long-term borrowing capacity is not so much a response in itself, but rather a means of improving the existing resources of mobility.

Donaldson's model is conceptually appealing. The liquidity and flexibility dimensions and the concept of mobility commingle the concepts and ideas which are the basis of the liquidity, profitability, and risk variables associated with the model developed in this study. Donaldson's liquidity dimension is somewhat broader in scope than the liquidity variable of this model. The liquidity dimension includes unused short-term credit, the amount of which is not readily accessible to the external analyst. Consequently, this variable has been omitted from the liquidity variable of this model.

The flexibility dimension, as noted above, refers to the stock of funds available through capital market negotiations. Management chooses a particular mix of sources of financing to achieve a desired capital structure. Primary consideration is usually given to that mix which minimizes cost and maximizes value. The minimization of costs bears directly on the profitability variable of the model developed here. The maximization of value is a reflection of the market's interpretation of part of the risk inherent in the firm, another variable of this model.

Finally, the concept of mobility refers to the regulation of the rate of funds flows. Resources contributing to financial mobility include the liquidity variable of this model. From this discussion, it is apparent that three variables contained in this model--liquidity, profitability, and risk--are inexorably interdependent as they are in Donaldson's model.

Models Emphasizing Dynamic Variables

Much of the work in the area of individual firm demand for cash centers upon a single-equation model developed by Meltzer.[35] Consequently, this section will deal with the model itself, implications of the model, and the relationship between the motives for holding cash and the model.

Meltzer's model may be stated as follows:

$$M_{ij} = \frac{kr^{\alpha}}{(K_{ij}\ \rho_j)^{\beta}\ S_{ij}^{\beta}}$$

or, logarithmic form,

$$\ln M_{ij} = \ln k + \alpha \ln r - \beta \ln(K_{ij}\ \rho_j) + \beta \ln S_{ij}$$

where,

M_{ij} = the cash balance of the ith firm in the jth industry

k = a model parameter

r = the market rate of interest

S_{ij} = the sales of that particular firm

K_{ij} = a variable whose value varies over the cycle with changes in demand for the firm's product and changes in the capital-labor ratio

ρ_j = the internal rate of return on assets for an industry or class of firms

α = interest elasticity of the demand for money

β = sales elasticity of the demand for money

As Meltzer noted, his model permitted a decrease in velocity (the ratio of sales to cash) despite a rise in the rate of interest or a small rise in sales. However, he did not believe that these movements would dominate sector velocities.

Over time, Meltzer investigated the relationship between the money balances of firms and changes in the "market" rate of interest and noted the complexity of this relationship.[36] From a dynamic standpoint, the relationship became complicated because K changed over time and because consideration had to be given to changes in ρ and r. Treating certain variables as constant, his model was rewritten as,

$$\ln M_{ij} = \ln (\text{constant}) + \alpha \ln r + \beta \ln S_{ij}, \text{ where } \alpha < 0.$$

In this case, α was defined as the interest elasticity of the demand for money. Empirically, Meltzer found $\alpha \simeq -0.9$. Therefore, an increase in market rate accompanied by an increase in sales resulted in a less than proportional increase in cash balances. This analysis suggested that velocity would increase during periods of prosperity and fall during periods of depression.

Meltzer[37] agreed with the empirical findings of Tobin[38] and Baumol.[39] All concurred that a rise in the market rate of interest results in a transfer of cash to securities so that the velocity of cash increases and the ratio of cash to government obligations decreases. An alternative explanation attributed a rise in velocity and interest rates to a transfer from cash and government obligations to assets with residual claims against income. The latter explanation did not require a decline in the ratio of cash to government obligations as did the former. Also, if a reduction in bank loans payable relative to total assets was considered to be a change in liquidity position, then the ratio of government obligations to bank loans should decline.

Using Quarterly Financial Report data, Meltzer found empirical evidence backing the latter hypothesis. However, he did not find a negative correlation between the ratio of cash to government obligations and the rate of interest, which would support the former hypothesis (above). Therefore, his results supported the latter hypothesis over the former for manufacturing firms: The transfer from one asset form to another apparently occurred between cash and government securities, on the one hand, and assets with residual claims on income on the other, at least for the test period.

Meltzer rejected the role of the motives for holding cash balances.[40] However, his discussions did not necessarily preclude the notion that his analysis and findings were consistent with these motives as Frazer pointed out.[41] The relationship between changes in cash balances and changes in sales (Meltzer's sales elasticity of one) might have been implied equal and proportional changes in the need for balances to satisfy all motives. Further, cyclical variations in cash

relative to total assets may reflect speculation in switching asset form to avoid potential losses or realize potential gains resulting from price level changes.

Sprenkle rejected the simple transactions demand for money models out of hand for their failure to explain a significant proportion of the cash balances for large economic units.[42] Models considering the effects of decentralization of cash management and the timing of receipts or payments could explain larger proportions of the actual balances. The latter models, however, varied considerably in their results depending on the assumptions made so as to render them virtually useless. Therefore, most cash balances are held for other than transactions purposes. In fact, the majority are used to compensate banks for their services.

The objective of a macrolevel study by Marcis and Smith was to analyze the determinants of liquid asset demand over time by manufacturing corporations in the United States.[43] Liquid assets were defined as cash and short-term Treasury obligations. Demand functions were derived for nine asset size categories.

Some of the more significant results may be summarized: (1) A large amount of seasonal variability was found for all but the largest group of firms. (2) Real sales levels varied positively with real cash balances for most size groups, but did not do so with Treasury bill holdings. (3) Real current liabilities were also found to vary inversely with changes in corporate real cash balances. (4) Finally, although not clear cut, it appeared that the long-term rate of interest was a more appropriate measure of the opportunity costs of holding liquid asset balances than was the short-term rate.

In summary, these studies by economists emphasizing the Keynesian model incorporating dynamic variables as an explanation for corporate liquidity fail to reach a definitive consensus as to the validity of the three traditional motives. The way is still clear for alternative models of corporate liquidity.

Static Models

An early study by Chudson examined Internal Revenue Service data for 1937 for differences in corporate financial structures among various industries, size classes, and profitability ranges.[44] He found liquid assets as a percentage of sales or total assets were substantially higher for the most profitable firms. Cash to total assets decreased, while government securities to total assets increased with increasing asset size. However, the cash to sales ratio and the government securities to sales ratio both rose with increasing asset size, a finding Chudson attributed to the decreasing sales to total asset ratios of manufacturing corporations.

A study by Selden of postwar IRS data examined velocity by sector and found velocity fell as firm size increased.[45] He attributed this result to a faster decline of the sales to total assets ratio rather than of the cash to total assets ratio. Substitution of other assets for cash occurred as firm size increased as both the government securities to cash ratio and the government securities to total assets ratio increased. Selden argued that this is the result of the higher costs of holding money for small firms than large firms since the cost of borrowing is higher.

Frazer, using 1956 through 1961 QFR data, analyzed corporate financial structures and money demand.[46] He found that the ratio of cash and government securities to current liabilities, his measure of liquidity, increased as the size of the firm increased, while the cash to total asset ratio fell. He concluded that economies of scale exist in cash holdings. Further, this evidence was taken as proof of the existence of the precautionary and transactions motives for maintaining cash balances.

Meltzer used his model to predict changes in money demand and not only over time (the dynamic sense), but also at a given time (the static sense).[47] On a cross-section basis, treating all other variables in his model constant, he arrived at:

$$M_{ij} = \gamma_{ij} S_{ij}^{\beta}$$

Brunner and Meltzer later defended the idea that the sales elasticity for business firms is approximately one ($\beta = 1$) as evidenced by the results from cross-section data.[48] Therefore, he concluded the simple quantity theory of the demand for money provides a good first approximation to the relationship between the money balances of firms and their sales.

Maddala and Vogel, independent of Meltzer, concluded that Meltzer's model was indeed a good first approximation.[49] However, Maddala and Vogel mentioned that it was inappropriate to use sales as a wealth surrogate. Accordingly, they analyzed some data for the logarithms of cash and asset size. Further, both Maddala and Vogel's and Meltzer's studies, involving analyses of industry data, hinted that some industries (consisting primarily of small firms) have sales elasticities greater than one for cash; and, conversely, that some industries (consisting

primarily of large firms) have sales elasticities less than one. A later study by Frazer made this explicit and produced empirical evidence supporting the less than unitary asset size (or sales) elasticity hypothesis for the demand for money.[50]

Vogel and Maddala investigated the usefulness of Internal Revenue Service data in their analysis of corporate money demand.[51] The main conclusions of their investigation were: (1) The difficulty in distinguishing between the wealth and transactions models was emphasized, in contrast to other studies of the demand for liquid assets. (2) A strong argument was made for economies of scale in money demand. (3) Government securities are substituted for cash as manufacturing corporations increase in size. (4) Money balances as a proportion of total assets decreased in the postwar period. This was attributed to rising interest rates and innovations in financial management.

The static model studies again emphasize the Keynesian model as a possible explanation for the maintenance of corporate liquidity. As with the dynamic model studies, there is no consensus as to the validity of the traditional motives.

Summary

It is apparent in reviewing the literature that an assumed relationship between liquidity on the one hand and profitability and risk on the other does exist--at least axiomatically. The cross-sectional and time-series empirical studies on the micro- and macro-levels by the economists do explain corporate liquidity balances to a greater or lesser degree, but using independent variables other than profitability and risk measures. Emphasis is upon the Keynesian model and its

traditional motives.

This study's model, which will be more fully developed in the next chapter, relates liquidity measures as the dependent variables and profitability and risk measures as the independent variables as noted above. The emphasis here is not upon proving or disproving the Keynesian model. Rather, the emphasis is upon embarking from financial theory as a starting point in order to test empirically the existence of this relationship among liquidity, profitability and risk.

FOOTNOTES

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CHAPTER III

THE MODEL AND DATA

Synthesis of the Model

In light of the existing literature of finance and economics, there are a number of factors internal and external to the firm which affect the amount of liquidity maintained by that firm. Some of the more significant internal variables are the size of the firm, the ability of management to predict cash flows, the maturity composition of the firm's debt, the amount of financial and operational fixed obligations, the short-term borrowing capacity of the firm, the willingness of management to assume risk, and the efficiency of liquid asset management. External variables include expected money market conditions, including interest rates, and the willingness of lenders to supply short-term financing to the firm.

From the standpoint of the individual firm, every variable listed above could be expected to affect different firms different ways. A general model would apply to every firm and, further, would likely include virtually every variable listed above. By necessity, the model must be less unwieldly, omitting and simplifying certain variables, in order to test it. All of the various variables listed above except perhaps the efficiency of liquid asset management and the willingness of lenders to supply short-term credit would be directly reflected in

risk, or the ability of the firm to meet maturing obligations. The efficiency of liquid asset management and expected money market conditions would be directly reflected in the firm's profitability. Risk and profitability are key to the model developed here. Aggregation of the individual measures of risk and profitability into industry classifications will then permit us to make statements concerning the effect these variables have on liquidity within the limitations imposed by the available data.

In light of these findings and based on the conceptual appeal of the notion, it is postulated that there is a relationship between liquidity, profitability, and risk. In general, taking a note of the various statements of the relationship noted above and denoting these three variables by L, P, and R, respectively, the cross-sectional relationship is postulated to be:

$$L = f\ (P,\ R)$$

Assuming a general function form, then the relation assumes the form of the multiple regression model

$$L_i^t = \beta_0 + \beta_1 P_j^t + \beta_2 R_k^t + e$$

where β_0, β_1, and β_2 are unknown population parameters to be estimated, e is the random error variable and L_i^t, P_j^t, and R_k^t are the ith, jth and kth measures of the three variables at time t.

As previously noted, the probability and the composite risk associated with a firm are at least partly a function of liquidity. However, that portion of these two variables arising from liquidity is inseparable from the remainder. The effect on the model is that a

downward bias will be asserted upon the population parameters which are to be affected.

The literature noted above is largely devoid of reference to the measurement technique which should be used in the case of the liquidity, profitability, and risk variables. Consequently, various combinations of these measures will be tested in the model.

An m x n x p three-dimensional tabular array should help define the various combinations of liquidity, profitability, and risk measures to be tested in the above model (see Figure 1, page 52). Each i, j, k locus ($i = 1, \ldots, 5$; $j = 1, \ldots, 3$; $k = 1, \ldots, 3$) represents each of the 45 combinations to be tested for each quarter. Each i represents a liquidity measure, each j a profitability measure, and eack k a risk measure. All measures are exactly as defined in the Quarterly Financial Report, except for cash flow, which is defined in the usual manner as net profit after taxes plus depreciation and depletion, both of which are given data.

The criteria used for choosing the various measures of the variables are threefold: the accessibility of the data to the external analyst, the success of some of the measures in predicting the ability of the firm to meet maturing obligations based on prior empirical studies, and the common use of selected measures with the accompanying implication that they represent the ability to meet maturing obligations. These criteria, except for the one related to the liquidity variable, i.e., the success of some of the measures in predicting the ability of the firm to meet maturing obligations, are admittedly somewhat arbitrary. However, the arbitrary nature of the criteria is overcome in the fact that a variety of measures has been selected to

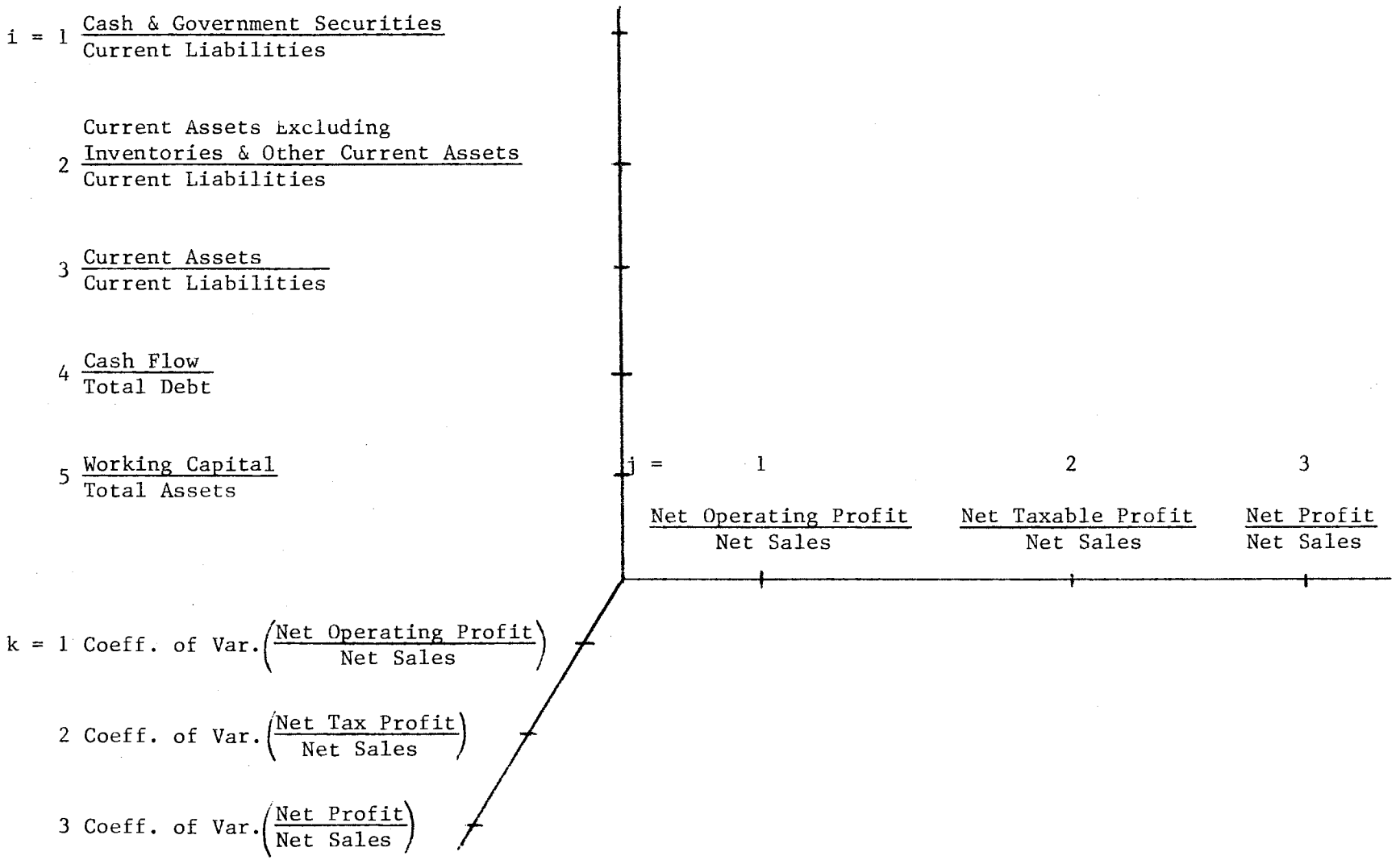

Figure 1. Various Combinations of Liquidity, Profitability, and Risk Measures to be Tested

represent each variable. The selection of a variety of measures is indicated because as was noted in Table I, pages 19 and 20, only rarely was a measure specified with each statement of the relationship within the literature.

Population regression coefficients will be calculated for 75 quarters across all quarters from 1952 to the present, in spite of the fact data for 100 quarters are available. The reason for using the smaller population of data is that a distribution of the profit variables can be developed from the first 25 quarters starting with the second quarter of 1952, the coefficient of variation for any particular subsequent quarter calculated from each moving distribution of the immediately previous 25 quarters, and each coefficient of variation used as a risk surrogate in the multiple regression model.

The null and alternative hypotheses will then involve testing whether the population regression coefficients for each of the 75 quarters and all i, j, k combinations are zero or non-zero, respectively. A priori, β_1 should be greater than zero and β_2 less than zero if there indeed is a tradeoff. Further, as liquidity increases, profitability should decrease as more assets become more liquid and, by assumption, less profitable. Too, as liquidity increases, risk decreases because liquidity is more readily available to meet obligations as they come due.

Hypotheses

Multiple regressions run on each combination of measures of the three variables (liquidity, profitability, and risk) will effect the

testing of the major hypotheses with which this study is concerned. As stated above, this hypothesis posits that there is significant interaction between the profitability and composite risk measures, and that these variables separately and in combination have a functional, though not necessarily cause-and-effect, relationship with the liquidity variables. However, in this case a cause-and-effect relationship is readily explained if a significant relationship is shown to exist. The primary null and alternative hypotheses are:

H_0: For every combination of the three measures, there is a significant relationship between a liquidity measure as the dependent variable and a profitability measure and a risk measure as the independent variables in combination and without the predicted signs for every quarter, i.e., $\beta_1 < 0$, $\beta_2 > 0$.

H_1: For less than every combination of the three measures, there is a significant relationship between a liquidity measure as the dependent variable and a profitability measure and a risk measure as the independent variables in combination and with the predicted signs for every quarter, i.e., $\beta_1 > 0$, $\beta_2 < 0$.

There are two sets of corollary null and alternative hypotheses. The first set is:

H_0: For any one (or more) consistent combination of the three measures, there is a significant relationship between a liquidity measure as the dependent variable and both a profitability measure and a risk measure as the independent variables taken in combination and with the predicted signs for every quarter.

H_1: For any one (or more) consistent combinations of the three measures there is no significant relationship between a liquidity

measure as the dependent variable and both a profitability measure and a risk measure as the independent variables taken in combination and with the predicted signs for every quarter.

The second set of corollary null and alternative hypotheses is:

H_0: The estimated betas (except for the intercept beta) are significantly different from zero for every quarter and any one (or more) variable combination and signed in the predicted manner.

H_1: The estimated betas (except for the intercept beta) are significantly different from zero for less than every quarter and any one (or more) variable combination and signed in the predicted manner.

Specifically, if we let:

t = a particular quarter, where $t = 1$ is the first quarter

L_i^t = a liquidity measure, where

$$L_1^t = \frac{\text{Cash and Government Securities}}{\text{Current Liabilities}}$$

$$L_2^t = \frac{\text{Current Assets Excluding Inventories and Other Current Assets}}{\text{Current Liabilities}}$$

$$L_3^t = \frac{\text{Current Assets}}{\text{Current Liabilities}}$$

$$L_4^t = \frac{\text{Cash Flow}}{\text{Total Debt}}$$

$$L_5^t = \frac{\text{Working Capital}}{\text{Total Assets}}$$

P_j^t = a profitability measure where

$$P_1^t = \frac{\text{Net Operating Profit}}{\text{Net Sales}}$$

$$P_2^t = \frac{\text{Net Taxable Profit}}{\text{Net Sales}}$$

$$P_3^t = \frac{\text{Net Profit}}{\text{Net Sales}}$$

R_k^t = a risk measure, where each is the coefficient of variation of the moving distribution of the respective profitability measures for the preceding 25 quarters

$$R_1^t = \text{Coeff. of Var.} \left(\frac{\text{Net Operating Profit}}{\text{Net Sales}}\right)$$

$$R_2^t = \text{Coeff. of Var.} \left(\frac{\text{Net Taxable Profit}}{\text{Net Sales}}\right)$$

$$R_3^t = \text{Coeff. of Var.} \left(\frac{\text{Net Profit}}{\text{Net Sales}}\right)$$

For example, the risk measure R_1^{50} would be the coefficient of variation of the distribution consisting of the values of $\frac{\text{Net Operating Profit}}{\text{Net Sales}}$ for quarters 26 through quarter 50.

β_0^t = unknown population parameter, the intercept, for various combinations of variables for quarter t.

β_1^t = unknown population parameter associated with a profitability measure, for various combinations of variables for quarter t.

β_2^t = unknown population parameter associated with a risk measure, for various combinations of variables for quarter t.

Then, the primary null and alternative hypotheses are:

H_0: $L_i^t = f(P_j^t, R_k^t)$ for t = 26 - 100 and all L_i^t, P_j^t, and R_k^t combinations where β_1^t and β_2^t have opposite signs.

H_1: $L_i^t \neq f(P_j^t, R_k^t)$ for t = 26 - 100 and all L_i^t, P_j^t, and R_k^t combinations where β_1^t and β_2^t have opposite signs.

The two sets of corollary hypotheses are:

H_0: $L_i^t = f(P_j^t, R_k^t)$ for t = 26 - 100 and one (or more) consistent L_i^t, P_j^t, and R_k^t combinations quarterly where β_1^t and β_2^t have opposite signs.

H_1: $L_i^t \neq f(P_j^t, R_k^t)$ for t = 26 - 100 and one (or more) consistent L_i^t, P_j^t, and R_k^t combinations quarterly where β_1^t and β_2^t have opposite signs.

and, finally:

H_0: β_1^t and $\beta_2^t = 0$ for all L_i^t, P_j^t, R_k^t combinations and t = 26 - 100.

H_1: β_1^t and $\beta_2^t \neq 0$ for all L_i^t, P_j^t, R_k^t combinations and t = 26 - 100.

From these calculations and examination of the data, certain items of interest should arise. The most obvious is the existence or non-existence of a relationship between the three variables during the test period. Another is the direction of the significance, positive or negative, if significance does exist. Still another is the significance or lack of significance in an absolute sense of β_0, β_1, and β_2 for each L_i^t, P_j^t, at R_k^t combination for each quarter. Finally, the relative significance of these various combinations at various points in time and possible reasons for any differences should be other items of interest.

Sample Data

Data contained in the QFR are collected by the Federal Trade Commission and Securities and Exchange Commission. These federal commissions estimate all quarterly financial statements based upon a sampling of all enterprises classed as manufacturers which filed U. S. Corporation Income Tax Form 1120 or which filed an application for a Federal Social Security Employer's Identification Number.

The data may or may not agree with other similar compilations, whether based on a sample or complete canvass, for a number of reasons:

(1) Each corporation in the population has a known probability of being selected for the sample. In computing the population data, therefore, each selected corporation is weighted accordingly. Moreover, the composition of the sample changes quarterly to reflect all corporate formations, failures, acquisitions, spin-offs, mergers, consolidations,

and the like. Finally, one-eighth of the FTC sample segment is replaced each quarter.

(2) The data represent those of consolidated enterprises. This eliminated multiple counting of interplant and intracompany transfers, and, for the most part, multiple counting of intercorporate transfers based on unconsolidated or partially consolidated reports of conglomerates.

(3) Generally accepted accounting principles are used in arriving at the profit figures. These figures differ from the national income concepts used elsewhere.

(4) The classification of corporations by industries is based upon the Standard Enterprise classification. The Standard Enterprise classification so closely parallels the Standard Industrial classification that the grouping of companies into industries is the same for all practical purposes.

(5) Finally, the population estimates are based upon quarterly financial statements. When the estimates are aggregated for four quarters, they may differ from aggregates of annual financial statements because of differences in fiscal years, particularly among the larger corporations.

The current sample consists of approximately six percent of the total number of corporations in the entire population. In terms of total assets, the sample accounts for approximately 88 percent of the population. One subsample is drawn yearly from manufacturing corporations filing Form 1120, and another drawn from those applying for a Federal Social Security Employer's Identification Number. One-fourth

of each of the subsamples is introduced each quarter, replacing comparable portions introduced eight quarters earlier.

After a corporation is introduced into the sample, its industry classification is determined by the latest information available. Unless the corporation is deleted from the sample or has changed structure, it remains in the same industry category for eight quarters, at which time its classification is reviewed. Where a change in corporate structure does take place, its classification is reviewed to take account of the change.

Each estimated industry aggregate has an associated standard deviation which indicates the difference due to sampling that can be expected between the estimated aggregate and a comparable total based on a complete canvass. The sample design is such that one standard deviation of the estimate of net profit before income taxes for all manufacturing corporations amounts to one percent of the estimate. For most industries, one standard deviation of the estimate of this profit figure amounts to less than five percent of the estimated aggregate.

Where variations from generally accepted accounting principles occur, adjustments are made after communication with the appropriate corporate officials. Also, the surplus (retained earnings) reported on each company's balance sheet must reconcile for each quarter, and the ending surplus figure for a preceding quarter must be the same as the beginning figure for the quarter. However, because of corporate additions to and deletions from the sample every quarter, estimates of the opening surplus are usually not identical to estimates of the closing surplus for the preceding quarter.

CHAPTER IV

RESULTS AND ANALYSIS

Overview of the Experimental Results

As was noted above, the data analyzed were derived from the 100 quarters of QFR data beginning with the first quarter of 1947. The data were supplied on computer tape by the Federal Reserve Bank of San Francisco.

Analysis of the data was aided through use of the Statistical Analysis System.[1] The appendix to this study presents in abbreviated tabular form an example of the results of the analysis on a quarter-by-quarter basis for the first five quarters of the test period. For the second quarter of 1953 through the second quarter of 1954, the appendix presents significant correlations between L_i and P_j and R_k combinations quarterly at the 0.05 significance level, where both betas are significantly different from zero at the 0.05 significance level or one is significantly different at the 0.10 level. Computed F statistics for the significance of these relationships and computed T statistics for the null hypothesis test that the computed beta values that are significantly different from zero have been omitted for the sake of brevity.

In initially examining the data on the tape, it was found that the cash and marketable security balances for all industry categories were missing for a large number of quarters. The quarters for which the cash and marketable security balances did exist were insufficient to fully

account for possible cyclical and secular effects on any possible existent relationships. As a consequence, the liquidity measure L_1, cash plus marketable securities divided by current liabilities, was omitted in assessing possible liquidity, profitability, and risk relationships.

Examining the results from the broadest standpoint, Table II (page 62) lists the frequency of correlations significant at the 0.05 level for the overall relationships between L_4 and various P_j and R_k combinations. Simultaneously, either the beta values corresponding to both R_j and P_k were significantly different from zero at the 0.05 significance level, or one was significant at the 0.05 significance level while the other was significant at the 0.10 significance level. L_4, as opposed to other dependent variables, was chosen as the dependent variable in this tabular presentation, because of the four liquidity measures tested, it most frequently correlated with the various P_j and R_k combinations.

Since there are nine possible combinations of P_j and R_k, the maximum frequency for significant correlations between R_4 and the combinations is nine for any given quarter. As shown in Table II, the frequency of significant correlations varies between zero and nine for the 75 quarters given, reflecting at least the lack of consistent number of correlations among the quarters. For many quarters, the frequency of significant correlations was low and for a few, zero.

Table III (page 64) lists the frequency of correlations significant at the 0.05 level for the overall relationships between all L_i and all possible P_j and R_k combinations. As in Table II, either the beta values corresponding to both P_j and R_k were significantly different from zero

TABLE II

FREQUENCIES OF OVERALL CORRELATIONS SIGNIFICANT AT THE 0.05 LEVEL BETWEEN L_4 AND ALL POSSIBLE P_j AND R_k COMBINATIONS BY QUARTER

Quarter	Year	Frequency	Quarter	Year	Frequency	Quarter	Year	Frequency
26	1952	8	39		4	52		5
27		7	40		7	53	1959	7
28		6	41	1956	7	54		6
29	1953	6	42		6	55		6
30		4	43		6	56		4
31		3	44		6	57	1960	6
32		5	45	1957	7	58		4
33	1954	4	46		6	59		4
34		5	47		6	60		4
35		6	48		6	61	1961	4
36		4	49	1958	7	62		4
37	1955	5	50		6	63		0
38		4	51		6	64		5

TABLE II (Continued)

Quarter	Year	Frequency	Quarter	Year	Frequency	Quarter	Year	Frequency
65	1962	0	77	1965	6	89	1968	2
66		9	78		6	90		2
67		9	79		6	91		2
68		9	80		5	92		2
69	1963	9	81	1966	7	93	1969	4
70		9	82		6	94		2
71		9	83		6	95		2
72		9	84		3	96		4
73	1964	9	85	1967	3	97	1970	2
74		9	86		3	98		0
75		9	87		3	99		0
76		9	88		0	100		2

TABLE III

FREQUENCIES OF OVERALL CORRELATIONS SIGNIFICANT AT THE 0.05 LEVEL BETWEEN L_i AND ALL POSSIBLE P_j AND R_k COMBINATIONS BY QUARTER

Quarter	Year	Frequency	Quarter	Year	Frequency	Quarter	Year	Frequency
26	1952	9	39		4	52		5
27		10	40		8	53	1959	10
28		6	41	1956	7	54		6
29	1953	6	42		6	55		6
30		7	43		6	56		4
31		9	44		6	57	1960	6
32		6	45	1957	7	58		4
33	1954	7	46		6	59		4
34		7	47		6	60		4
35		8	48		6	61	1961	4
36		4	49	1958	7	62		4
37	1955	7	50		6	63		1
38		4	51		6	64		5

TABLE III (Continued)

Quarter	Year	Frequency	Quarter	Year	Frequency	Quarter	Year	Frequency
65	1962	2	77	1965	6	89	1968	2
66		15	78		6	90		2
67		15	79		6	91		2
68		12	80		5	92		2
69	1963	10	81	1966	7	93	1969	4
70		13	82		6	94		2
71		18	83		6	95		5
72		12	84		3	96		4
73	1964	9	85	1967	3	97	1970	2
74		9	86		3	98		0
75		14	87		3	99		0
76		9	88		0	100		2

at the 0.05 significance level, or one was significant at the 0.05 significance level while the other was significant at the 0.10 significance level.

Comparison of Table II with Table III reveals that adding L_2, L_3, and L_5 to the list of possible candidates for the dependent variable measure as was done in the latter table does not measurably increase the frequency of overall correlations significant at the 0.05 level except in the case of a few quarters. This lack of a measurable increase is especially true in the light of the fact that the maximum number of possible correlations per quarter increases fourfold to 36. In summarizing the results presented in Table II and Table III, L_4 was the liquidity measure which most frequently and consistently correlated with the various P_j and R_k combinations.

Contrasting L_4, which as above is defined as cash flow divided by total debt, with the other liquidity measures, L_4 is a measure of flow while all of the other liquidity measures are static in nature; i.e., they are stock concepts. This suggests that measures of flow either per se or in conjunction with stock concepts provide better overall liquidity measures in the limited sense of more frequent significant correlations between these measures on the one hand and profitability and risk measures on the other. At least within the context of the model at hand, a flow measure correlates more frequently than static measures.

Examination of the residuals of correlations for each quarter and their relationships with various economic indicators reveals a few definite and consistent relationships between these and various indicators over time. The residuals of correlation do appear to vary

somewhat directly with the Standard and Poor's 425-Stock Industrial Index and the Federal Reserve Board Index of Industrial Production for a significant part of the period of the study as shown by comparison of data in Table IV, page 68. For the most part through the fourth quarter of 1965 the residuals of correlation decrease and remain at relatively low levels immediately before, during, or after the bear markets of 1952-53, 1956-57, 1959-60, and 1961-62, and increase and remain at relatively high levels immediately before, during, or after the remaining bull periods as indicated by the Standard and Poor's Industrial Index. After that period, no relationship seems to exist.

Approximately the same relationship of residuals of correlation with the Federal Reserve Board Index of Industrial Production extends over a shorter period of time with stock market turns most often preceding production turns and production turns seeming to anticipate, coincide with, or follow changes in residuals of correlation. However, the Federal Reserve Board Index does not include a downturn corresponding to the 1961-1962 bear market and there appear to be drops in residuals of correlation (to zero in two quarters) during this period. Consequently, the continuity of the relationship at the beginning of that period ends. Except for that one particular period, the relationship does continue through the fourth quarter of 1965 as did the relationship of the Standard and Poor's Industrials to the residuals of correlation. Again, beyond that period, no relationship seems to exist.

The residuals of correlation also appear to vary somewhat directly with long-term interest rates. Moreover, long-term interest rates, as reflected by the yields on Moody's Aaa corporates and long-term U. S.

TABLE IV

STANDARD AND POOR'S 425-STOCK INDUSTRIAL INDEX, THE FEDERAL RESERVE BOARD INDEX OF INDUSTRIAL PRODUCTION, AND FREQUENCIES OF CORRELATION AS SHOWN IN TABLE II, 1952-1970

Quarter	Year	S & P's Index*	FRB Index**	Frequency	Quarter	Year	S & P's Index	FRB Index	Frequency
26	1952	26	81	8	39		45	97	4
27		27	80	7	40		46	98	7
28		26	87	6	41	1956	46	99	7
29	1953	28	90	6	42		50	99	6
30		27	91	4	43		52	95	6
31		26	92	3	44		50	101	6
32		25	89	5	45	1957	47	102	7
33	1954	26	86	4	46		52	101	6
34		28	86	5	47		46	101	6
35		30	87	6	48		43	97	6
36		34	88	4	49	1958	45	92	7
37	1955	38	89	5	50		49	87	6
38		40	92	4	51		53	94	6

TABLE IV (Continued)

Quarter	Year	S & P's Index*	FRB Index**	Frequency	Quarter	Year	S & P's Index	FRB Index	Frequency
52		59	97	5	67		61	120	9
53	1959	59	100	7	68		59	120	9
54		62	105	6	69	1963	67	120	9
55		64	108	6	70		72	124	9
56		62	103	4	71		73	128	9
57	1960	63	110	6	72		77	129	9
58		59	108	4	73	1964	79	130	9
59		59	106	4	74		83	133	9
60		57	103	4	75		86	135	9
61	1961	63	101	4	76		89	134	9
62		67	103	4	77	1965	89	141	6
63		70	108	0	78		92	143	6
64		74	113	5	79		94	145	6
65	1962	74	115	0	80		90	144	5
66		69	118	9	81	1966	100	150	7

TABLE IV (Continued)

Quarter	Year	S & P's Index*	FRB Index**	Frequency	Quarter	Year	S & P's Index	FRB Index	Frequency
82		96	94	6	92		115	106	2
83		92	97	6	93	1969	111	107	4
84		82	101	3	94		112	109	2
85	1967	88	99	3	95		103	110	2
86		95	98	3	96		102	111	4
87		100	99	3	97	1970	98	107	2
88		100	101	0	98		88	105	0
89	1968	100	103	2	99		82	104	0
90		96	104	2	100		92	102	2
91		107	105	2					

*1941-43 = 10 (approximate ratio scale).

**1957-59 = 100 through 1966 QI (approximate ratio scale).

1967 = 100 from 1966 QI through 1970 QI (approximate ratio scale).

governments, like many stock market turns, anticipate production turns and anticipate, coincide with, or follow changes in frequencies of correlations as shown by the comparison of data in Table V, page 72.

Examining three diffusion indexes of National Bureau of Economic Research indicators over the same 1952 to 1971 period, a somewhat different picture emerges of the relationships between the timing of changes in these leading, coincident, and lagging indicators and the timing of changes in the residuals of correlation.[2] These three diffusion indexes are composed of 12 leading indicators, five coincident indicators, and six lagging indicators.[3] Of the timing of changes in the three indexes, changes in the timing of the diffusion index composed of leading indicators closely approximates timing of changes in the residuals of correlation between L_i as the dependent variable and P_j and R_k as the independent variables as shown by the comparison of data in Table VI, page 75. However, on the whole, changes in the residuals of correlation occur even somewhat prior to changes in the leading indicator diffusion index. This precedent period varies considerably, but in general is from one to three quarters.

In most cases coincident with and in one case lagging changes in the residual of correlation are changes in the rate of growth of the money stock as shown by comparison of data in Table VII,[4] page 77. In the period 1952 through 1970, each of the four recessions, 1953-1954, 1957-1958, 1960-1961, and 1970, are preceded by a marked slowing or absolute decline in the rate of growth of money stock, where money is M_1, demand deposits plus currency held

TABLE V

MOODY'S AAA CORPORATE AND LONG-TERM U. S. GOVERNMENT BOND YIELDS AND FREQUENCIES OF CORRELATION AS SHOWN IN TABLE II, 1952-1970*

Quarter	Year	Corp. Yields	Gov't Yields	Frequency	Quarter	Year	Corp. Yields	Gov't Yields	Frequency
26	1952	2.9	2.7	8	39		3.1	2.9	4
27		2.9	2.6	7	40		3.2	2.9	7
28		2.9	2.7	6	41	1956	3.2	2.9	7
29	1953	3.0	2.8	6	42		3.3	3.1	6
30		3.2	2.9	4	43		3.4	3.2	6
31		3.4	3.1	3	44		3.6	3.3	6
32		3.2	2.8	5	45	1957	3.8	3.4	7
33	1954	3.1	2.7	4	46		3.7	3.3	6
34		2.8	2.6	5	47		3.9	3.5	6
35		2.9	2.5	6	48		4.1	3.7	6
36		2.9	2.6	4	49	1958	3.7	3.3	7
37	1955	2.9	2.7	5	50		3.6	3.2	6
38		3.0	2.8	4	51		3.5	3.2	6

TABLE V (Continued)

Quarter	Year	Corp. Yields	Gov't Yields	Frequency	Quarter	Year	Corp. Yields	Gov't Yields	Frequency
52		4.0	3.7	5	67		4.3	3.9	9
53	1959	4.1	3.8	7	68		4.4	3.9	9
54		4.2	4.0	6	69	1963	4.3	3.8	9
55		4.5	4.2	6	70		4.2	3.9	9
56		4.6	4.3	4	71		4.2	4.0	9
57	1960	4.6	4.4	6	72		4.3	4.1	9
58		4.5	4.2	4	73	1964	4.4	4.2	9
59		4.4	4.0	4	74		4.4	4.2	9
60		4.3	3.8	4	75		4.5	4.2	9
61	1961	4.3	3.9	4	76		4.5	4.2	9
62		4.3	3.8	4	77	1965	4.5	4.2	6
63		4.4	3.7	0	78		4.6	4.2	6
64		4.5	4.0	5	79		4.6	4.2	6
65	1962	4.5	4.1	0	80		4.7	4.3	5
66		4.4	4.0	9	81	1966	4.8	4.5	7

TABLE V (Continued)

Quarter	Year	Corp. Yields	Gov't Yields	Frequency	Quarter	Year	Corp. Yields	Gov't Yields	Frequency
82		5.1	4.8	6	92		6.4	5.8	2
83		5.5	5.1	6	93	1969	6.8	6.2	4
84		5.8	5.4	3	94		7.1	6.5	2
85	1967	5.8	5.4	3	95		7.5	6.9	2
86		5.2	5.0	3	96		8.1	7.3	4
87		5.8	5.4	3	97	1970	8.7	7.6	2
88		6.1	5.8	0	98		9.0	7.9	0
89	1968	6.4	5.8	2	99		8.7	7.7	0
90		6.3	5.8	2	100		8.3	7.4	2
91		6.4	5.8	2					

*Approximate average percentage yields.

TABLE VI

NBER DIFFUSION INDEX COMPOSED OF LEADING INDICATORS AND FREQUENCIES OF CORRELATION AS SHOWN IN TABLE II, 1952-1970*

Quarter	Year	Index	Frequency	Quarter	Year	Index	Frequency	Quarter	Year	Index	Frequency
26	1952	30	8	40		47	7	54		60	6
27		30	7	41	1956	47	7	55		58	6
28		34	6	42		48	6	56		58	4
29	1953	35	6	43		47	6	57	1960	60	6
30		34	4	44		48	6	58		59	4
31		33	3	45	1957	49	7	59		58	4
32		30	5	46		48	6	60		57	4
33	1954	29	4	47		48	6	61	1961	57	4
34		32	5	48		45	6	62		60	4
35		35	6	49	1958	43	7	63		65	0
36		37	4	50		44	6	64		68	5
37	1955	40	5	51		48	6	65	1962	70	0
38		44	4	52		53	5	66		70	9
39		46	4	53	1959	57	7	67		71	9

TABLE VI (Continued)

Quarter	Year	Index	Frequency	Quarter	Year	Index	Frequency	Quarter	Year	Index	Frequency
68		72	9	79		94	6	90		107	2
69	1963	73	9	80		96	5	91		110	2
70		75	9	81	1966	99	7	92		114	2
71		76	9	82		99	6	93	1969	115	4
72		78	9	83		97	6	94		117	2
73	1964	80	9	84		96	3	95		117	2
74		82	9	85	1967	96	3	96		117	4
75		84	9	86		97	3	97	1970	115	2
76		86	9	87		100	3	98		113	0
77	1965	90	6	88		103	0	99		115	0
78		93	6	89	1968	105	2	100		113	2

*Approximate values.

TABLE VII

GROWTH OF MONEY STOCK AND FREQUENCIES OF CORRELATION AS SHOWN IN TABLE II, 1952-1970*

Quarter	Year	Index	Frequency	Quarter	Year	Index	Frequency	Quarter	Year	Index	Frequency
26	1952	124	8	40		135	7	54		142	6
27		125	7	41	1956	135	7	55		144	6
28		126	6	42		136	6	56		143	4
29	1953	127	6	43		136	6	57	1960	142	6
30		128	4	44		137	6	58		141	4
31		129	3	45	1957	137	7	59		141	4
32		129	5	46		137	6	60		141	4
33	1954	129	4	47		138	6	61	1961	142	4
34		129	5	48		137	6	62		143	4
35		130	6	49	1958	137	7	63		145	0
36		131	4	50		138	6	64		146	5
37	1955	133	5	51		139	6	65	1962	147	0
38		134	4	52		140	5	66		147	9
39		135	4	53	1959	141	7	67		147	9

TABLE VII (Continued)

Quarter	Year	Index	Frequency	Quarter	Year	Index	Frequency	Quarter	Year	Index	Frequency
68		148	9	79		163	6	90		187	2
69	1963	149	9	80		166	5	91		190	2
70		150	9	81	1966	169	7	92		194	2
71		152	9	82		171	6	93	1969	199	4
72		153	9	83		172	6	94		201	2
73	1964	154	9	84		172	3	95		203	2
74		155	9	85	1967	172	3	96		204	4
75		157	9	86		175	3	97	1970	205	2
76		159	9	87		178	3	98		207	0
77	1965	160	6	88		181	0	99		210	0
78		161	6	89	1968	183	2	100		213	2

*Approximate ratio scale, seasonally adjusted.

by the public. During expansionary periods, the residuals of correlations are high and show the marked decrease during the recessions noted above.

Tables VIII, IX, X, and XI (pp. 80, 81, 82, and 83, respectively) show the frequencies of the accuracy of the predicted signs of the coefficients of the independent variables, profitability and risk, with L_2, L_3, L_4, and L_5, respectively, as the dependent variables. Included are only those equations where the calculated T statistics were either both significant at the 0.05 level or one was significant at the 0.05 level and the other was significant at the 0.10 level.

Examination of the data given in these tables reveals that there were a number of cases where both betas were not of the opposite signs with L_2, L_3, L_4, and L_5 as dependent variables. From a more positive standpoint, however, with L_3 as the dependent variable all of the cases were ones where the predicted signs of the coefficients were accurate.

The most frequent cases of significant equations were those where L_4 was the independent variable and both betas were not of the opposite signs. More specifically, the $L_4 = f(P_1,R_2)$, $L_4 = f(P_1,R_3)$, $L_4 = f(P_2,R_2)$, and $L_4 = f(P_2,R_3)$ equations stood out as the most frequent significant equations with both betas not of the opposite signs. However, although all significant L_3 equations were ones where the predicted signs of the coefficients were accurate, in terms of absolute numbers there were more significant L_4 equations with accurate predicted signs of the coefficients than L_3 equations.

Table XII, page 84, presents intercept and coefficient values of significant equations involving the variables L_4, P_2, and R_2 and both

TABLE VIII

FREQUENCIES OF ACCURACY OF PREDICTED SIGNS WITH L_2 AS THE DEPENDENT VARIABLE*

			A[1]	B[2]
		R_1	0	4
	P_1	R_2	4	3
		R_3	4	2
		R_1	0	1
L_2	P_2	R_2	0	1
		R_3	1	1
		R_1	1	0
	P_3	R_2	1	0
		R_3	2	0

*A and B represent categories where the calculated F statistic was significant at the 0.05 level and the calculated T statistics for the independent variables were either both significant at the 0.05 level or one was significant at the 0.05 level and the other was significant at the 0.10 level.

[1]Category A represents the frequencies of the various equations with both betas of the predicted (opposite) signs.

[2]Category B represents the frequencies of the various equations with both betas not of the opposite signs.

TABLE IX

FREQUENCIES OF ACCURACY OF PREDICTED SIGNS WITH L_3 AS THE DEPENDENT VARIABLE*

			A[1]	B[2]
		R_1	9	0
	P_1	R_2	7	0
		R_3	5	0
		R_1	3	0
L_3	P_2	R_2	5	0
		R_3	5	0
		R_1	2	0
	P_3	R_2	0	0
		R_3	0	0

*A and B represent categories where the calculated F statistic was significant at the 0.05 level and the calculated T statistics for the independent variables were either both significant at the 0.05 level or one was significant at the 0.05 level and the other was significant at the 0.10 level.

[1]Category A represents the frequencies of the various equations with both betas of the predicted (opposite) signs.

[2]Category B represents the frequencies of the various equations with both betas not of the opposite signs.

TABLE X

FREQUENCIES OF ACCURACY OF PREDICTED SIGNS WITH L_4 AS THE DEPENDENT VARIABLE*

			A[1]	B[2]
		R_1	11	28
	P_1	R_2	11	46
		R_3	11	44
		R_1	11	28
L_4	P_2	R_2	11	45
		R_3	11	40
		R_1	11	19
	P_3	R_2	11	19
		R_3	11	12

*A and B represent categories where the calculated F statistic was significant at the 0.05 level and the calculated T statistics for the independent variables were either both significant at the 0.05 level or one was significant at the 0.05 level and the other was significant at the 0.10 level.

[1]Category A represents the frequencies of the various equations with both betas of the predicted (opposite) signs.

[2]Category B represents the frequencies of the various equations with both betas not of the opposite signs.

TABLE XI

FREQUENCIES OF ACCURACY OF PREDICTED SIGNS WITH L_5 AS THE DEPENDENT VARIABLE*

			A[1]	B[2]
		R_1	0	0
	P_1	R_2	0	2
		R_3	0	2
		R_1	0	1
L_5	P_2	R_2	0	0
		R_3	0	0
		R_1	0	2
	P_3	R_2	0	1
		R_3	0	0

*A and B represent categories where the calculated F statistic was significant at the 0.05 level and the calculated T statistics for the independent variables were either both significant at the 0.05 level or one was significant at the 0.05 level and the other was significant at the 0.10 level.

[1]Category A represents the frequencies of the various equations with both betas of the predicted (opposite) signs.

[2]Category B represents the frequencies of the various equations with both betas not of the opposite signs.

TABLE XII

INTERCEPT AND COEFFICIENT VALUES OF EQUATIONS INVOLVING L_4, P_2, and R_2 AND BOTH BETAS NOT OF THE OPPOSITE SIGNS

Quarter	Intercept	β_1	β_2	Quarter	Intercept	β_1	β_2
26	-0.1901	2.1433	7.4635	41	0.0076	0.7014	0.2721
27	-0.1688	2.1239	6.8371	42	0.0132	0.6886	0.2214
28	-0.1005	2.0764	5.5517	43	0.0157	0.6580	0.2234
29	-0.1349	2.0981	5.8750	44	0.0175	0.6927	0.2328
32	-0.0863	1.5311	6.8433	45	0.0182	0.6109	2.1886
33	-0.1072	1.5422	7.4398	46	0.0176	0.6838	0.1788
34	-0.1121	1.5187	8.4766	47	0.0241	0.6178	0.1217
35	-0.1215	1.6681	6.9508	48	0.0190	0.7020	0.1232
36	-0.1168	1.6203	6.1137	49	0.0153	0.6717	0.1224
37	-0.1207	1.7113	7.0423	50	0.0164	0.6907	0.1084
38	0.0046	0.7664	0.7262	51	0.0309	0.5376	0.1062
39	0.0084	0.7214	0.3914	52	0.0202	0.6606	0.0857
40	0.0143	0.6759	0.4057	53	0.0135	0.6744	0.1079

TABLE XII (Continued)

Quarter	Intercept	β_1	β_2	Quarter	Intercept	β_1	β_2
54	0.0147	0.6901	0.0934	78	0.0170	0.6882	0.0561
55	0.0156	0.6816	0.0836	79	0.0221	0.5526	0.0454
56	0.0186	0.6689	0.0858	80	0.0215	0.5651	0.0411
57	0.0115	0.7179	0.0822	81	0.0190	0.5385	0.0567
58	0.0127	0.7195	0.0890	82	0.0134	0.6457	0.0439
59	0.0193	0.6223	0.0872	83	0.0196	0.5716	0.0463
60	0.0208	0.6240	0.1030	85	0.0498	0.1245	0.0815
61	0.0150	0.6416	0.1266	93	0.0214	0.3905	0.0324
62	0.0142	0.6802	0.1804	96	0.0247	0.3884	0.0290
77	0.0148	0.6053	0.0578				

betas not of the opposite signs. Examination of the data brings several things to light. First, for the most part, the various values seem to have sequential runs. For example, from Quarter 27 through Quarter 37, all of the intercept terms are negative ranging from -0.0863 to -0.1901, and all of the β_1 and β_2 coefficients are positive ranging from 1.5187 to 2.1433 and from 5.5517 to 8.4766, respectively. Then, from Quarter 38 to Quarter 62, all of the intercept terms turn positive ranging from 0.0046 to 0.0309, and all of the β_1 and β_2 coefficients are positive again ranging from 0.5376 to 0.7664 and from 0.0822 to 0.7262, respectively. There is a final sequential run from Quarter 77 through Quarter 84 where again all of the intercept terms are positive ranging from 0.0134 to 0.0221 and all of the β_1 and β_2 are positive again ranging from 0.5385 to 0.6882 and from 0.0411 to 0.0578, respectively.

Second, the majority of intercept values are positive. In terms of the model, this implies that there is a positive amount of liquidity (although a very small amount) when profitability is zero and risk is zero. Intuitively, it would seem when risk is zero, in other words, that the future were certain in terms of the ability of the firm to pay obligations, that the amount of liquidity should be zero. Examination of Table VIII, subsequent tables and the appendix indicates that although the tendency of the intercept term is to be positive and significantly so, the magnitude is small enough to indicate that there are likely relatively few omitted variables which would explain the positive magnitude of the intercept.

Finally, at least within each sequential run, and sometimes between runs, the values of β_0, β_1, and β_2 are relatively stable over varying ranges as indicated. In the first run from Quarter 26 through Quarter

37, the values of the intercept are negative and range from approximately -0.09 to -0.19 while the β_1 and β_2 coefficients range from approximately 1.52 to 2.14 and from 5.55 to 8.48, respectively. In the next two runs, from Quarter 38 through Quarter 62 and from Quarter 77 through Quarter 96, the values are relatively stable except for the β_2 coefficient between the runs. The intercept term changes to a positive sign and ranges in value from 0.005 to 0.03, while the β_1 and β_2 coefficients range from approximately 0.54 to 0.77 and from approximately 0.04 to 0.73. The range in values for the β_2 coefficient over the last two runs is wide.

Tables XIII and XIV (pages 88 and 89) show intercept and coefficient values involving L_4, P_1, and R_2 and L_4, P_2 and R_2 respectively, as the variable combinations where both independent variable coefficients are accurately signed as predicted, i.e., oppositely signed. As before, the values of the intercepts and coefficients exist in series or runs--in both cases from Quarter 66 through Quarter 76. Further, the values exhibit a high degree of stability. In Table IX, the intercept values range from approximately 0.02 to 0.03, while the β_1 and β_2 values range from approximately 0.52 to 0.72 and from approximately -0.69 to -1.18, respectively. In Table X, similar stability is exhibited. The intercept values range from approximately 0.02 to 0.03 while the β_1 and β_2 values range from approximately 0.51 to 0.72 and from approximately -0.89 to -1.78, respectively.

The Hypotheses

In every case with respect to the primary and corollary hypotheses, the null hypotheses are rejected. In order to accept the primary null

TABLE XIII

INTERCEPT AND COEFFICIENT VALUES OF EQUATIONS INVOLVING L_4, P_1, AND R_2 WITH BOTH INDEPENDENT VARIABLE COEFFICIENTS ACCURATELY SIGNED AS PREDICTED

Quarter	Intercept	β_1	β_2	Quarter	Intercept	β_1	β_2
66	0.0297	0.5373	-1.1840	72	0.0339	0.5540	-0.8324
67	0.0314	0.5241	-0.9551	73	0.0246	0.5786	-0.8702
68	0.0261	0.6322	-1.1465	74	0.0252	0.6004	-0.9716
69	0.0197	0.6618	-0.9823	75	0.0301	0.5298	-0.9050
70	0.0171	0.7205	-0.8940	76	0.0286	0.5694	-1.0432
71	0.0308	0.5572	-0.6947				

TABLE XIV

INTERCEPT AND COEFFICIENT VALUES OF EQUATIONS INVOLVING L_4, P_2, AND R_2 WITH BOTH INDEPENDENT VARIABLE COEFFICIENTS ACCURATELY SIGNED AS PREDICTED

Quarter	Intercept	β_1	β_2	Quarter	Intercept	β_1	β_2
66	0.0323	0.5522	-1.7824	72	0.0342	0.5500	-1.1322
67	0.0337	0.5075	-1.2744	73	0.0239	0.5978	-1.1447
68	0.0280	0.6073	-1.4493	74	0.0252	0.6091	-1.2546
69	0.0201	0.6661	-1.2823	75	0.0299	0.5386	-1.1353
70	0.0171	0.7205	-0.8940	76	0.0295	0.5660	-1.4242
71	0.0295	0.5781	-0.9450				

hypothesis, the frequencies of overall correlations significant at the 0.05 level between L_i as the dependent variable and R_j and P_k as the dependent variables as shown in Table III (page 64) should all be 36, the maximum number possible for each quarter. Examination of Table III shows that in no quarter does the frequency of overall correlation reach 36. As a matter of fact, the maximum frequency during any quarter is ten. Consequently, the primary null hypothesis is rejected. For less than every combination of the three measures, there is a significant relationship between a liquidity measure as the dependent variable and a profitability measure and a risk measure as the independent variables in combination for every quarter.

The possible implications of the rejection of the primary null hypothesis are threefold. First, it is possible that the set of various combinations of liquidity, profitability, and risk measures are not sufficiently complete so as to include those measures which would show significant relationships consistently. This seems unlikely since virtually the entire gamut of plausible measures has been considered. Second, a composite of various liquidity measures as the dependent variable may prove to correlate more frequently and consistently with the profitability and risk measure combinations than the individual liquidity measures. This implication is a distinct possibility, but investigation of this possibility is beyond the scope of this study and model. Finally, perhaps the most obvious implication of the rejection of the primary null hypothesis is simply that no such consistent relationship exists at least for the posited relationships and measures, i.e., that for less than every combination of the three measures, there is a significant relationship between a liquidity measure as the

dependent variable and a profitability measure and a risk measure as the independent variables in combination for each quarter. This suggests that the literature may be wrong in its implicit assumption that there is a simple tradeoff between liquidity and profitability and risk as seems to be so often specified. The suggestion here is that statements of assumed relationships should be more cautious in specification and generalization and restrictive in definition and assumption.

In order to accept the null hypothesis of the first set of corollary hypotheses, the frequencies of overall correlations significant at the 0.05 level between L_4 as the dependent variable and all possible P_j and R_k as the dependent variables as shown in Table II (page 62) should all be nine, the maximum number possible for each quarter. The same maximum, of course, would apply to any quarter. As noted above, L_4 was selected from the set of all possible liquidity measures as the dependent variable because it by far and away most frequently correlated with the various P_j and R_k combinations. Examination of Table II shows that during 11 quarters out of the 75 quarters listed, the frequencies of overall correlation reach the maximum possible quarterly, but during the remainder the frequencies fall below the maximum. As a matter of fact, during three quarters the frequencies of correlation are zero. In any case, the null hypothesis of the first set of corollary hypotheses is rejected. For any one (or more) consistent combinations of the three measures, there is no significant relationship between a liquidity measure as the dependent variable and both a profitability measure and a risk measure as the independent variables taken in combination for every quarter.

The possible implications of the rejection of the null hypothesis of the first set of corollary hypotheses are threefold, all of which directly parallel the implications of the rejection of the primary null hypothesis. Again, it is possible that the set of various combinations of liquidity, profitability, and risk measures are not sufficiently complete so as to include those measures which would show significant relationships consistently. This also seems improbable since virtually the entire universe of possible measures has been considered via the literature. Second, as before, a composite of various liquidity measures as the dependent variable may prove to correlate more frequently and consistently with the profitability and risk measure combinations than individual liquidity measures. This implication is certainly a strong possibility, but because composite dependent variables were not posited in this particular model, the investigation of this possibility lies beyond the scope of this study. Finally, as before, the most obvious implication of the rejection of the null hypothesis of the first set of corollary hypotheses is simply that no such consistent relationship exists at least for the posited relationships and measures. For any one (or more) consistent combination of the three measures, there is no significant relationship between a liquidity measure as the dependent variable and both a profitability measure and a risk measure as the independent variables taken in combination for every quarter. This again suggests caution with respect to making sweeping generalizations with respect to the relationship between liquidity on the one hand and profitability and risk on the other.

From the results given above, it is also apparent that the null hypothesis of the second set of corollary hypotheses is also rejected.

The estimated betas (except for the intercept beta) are significantly different from zero for less than every quarter and any one (or more) variable combination. Moreover, where the estimated betas (except for the intercept beta) are significantly different from zero for a large number of quarters relative to the 75 possible quarters and for a given combination of variables, the beta values vary significantly from quarter to quarter. There is no consistent set of beta values nor any particular one beta value for any given combination of variables during this period.

The implication of these results is clear: there is no consistent relationship between the various combinations of measures as posited by the model central to this study. It should be emphasized that this implication does not lead to the conclusion that there is no consistent relationship between liquidity, profitability, and risk. Rather, this model does not best represent the QFR data. It is quite possible that a different model may show a consistent relationship between the three variables measured in the same way as above or in different ways.

From a more positive standpoint, as noted above, it should be noted that among the various liquidity measures, cash flow (L_4) most frequently and for most of the 75 quarters correlated with some combination of the profitability and risk measures. As a remote possibility, this suggests that flow measures in general may more frequently correlate with the profitability and risk measures used in this study. From a conceptual standpoint, liquidity has two measurable aspects: a flow component dealing with the inflow and outflow of funds and a stock component dealing with the reservoir of funds or funds on hand. Even more remotely, a model involving a composite liquidity measure involving

both flow and static components may even more frequently correlate with the profitability and risk measures used in this study.

Synthesis of the Results

In the light of the results of this study, in spite of the rejection of the primary and corollary null hypotheses, there appears to be some relationship among liquidity, profitability, and risk as specified in the model, slight though it may be. However, of the three variables, liquidity and profitability seem to most strongly bear a relationship to one another, and this relationship appears to be an inverse one. This relationship was reasonably consistent over the test period for various liquidity, profitability, and risk measures combinations.

Of the statements made within the literature as summarized in Table I (pages 19 and 20), only one can be taken strongly to task in light of the study results. Cohen and Robbins' statement to the effect that a strong liquidity position may be a reflection of a current economic boom or a forerunner of financial difficulty seems totally ambigous. It reflects none of the causal factors involved in the process. Of the remaining statements, only Van Horne's and perhaps Walker's deal with the liquidity-profitability-risk relationship in any great deal within their studies, and even those two authors omit many of the factors which may be operative, especially those which may be dynamic in nature and those which are external to the firm.

The studies of coporate liquidity trends since World War II indicating lower levels do seem to indicate the existence of an optimal level of corporate liquidity and the recognition that higher short-term interest rates can mean significantly higher profits if excess cash is

invested in short-term marketable securities. In light of the lack of success of the independent variable risk to explain variation, a measure to represent either current or expected short-term interest rates might be useful in helping to explain this variation.

The results of this study neither negate nor confirm the Keynesian model. As noted above, the emphasis between the model proposed here and the Keynesian model are somewhat different but the two are, for the most part, congruent. The Keynesian model does note that profitability does generate liquidity and that the more liquidity maintained means greater opportunity costs and lesser transactions costs in passing up marketable securities, which are both reflected in lower profits for the firm. The Keynesian model does ignore risk, but also as noted above, the importance of the risk variable is not strongly borne out in the study.

Donaldson's model also is neither confirmed nor negated by the study results. Again, the emphasis is different between Donaldson's model and the model proposed here. Donaldson's liquidity and flexibility dimensions and the concept of mobility intermingle the concepts behind the variables of this model--liquidity, profitability, and risk. However, Donaldson's liquidity dimension includes the capacity to borrow over the short-term, a capacity which at best is virtually impossible to measure for the external analyst. Consequently, this capacity was omitted in the measure of the liquidity variable used in this model.

All in all, the results of this study indicate that liquidity may be related to profitability over the long-run and risk over the short-run. Conceptually, this is appealing because of the time lag between the generation of profits and the subsequent conversion of these profits

into the most liquid resources. Further, there is an immediate relationship between the ability to meet obligations and the availability of liquid resources. Otherwise, insolvency is the ultimate result.

With respect to the literature on the relationship among liquidity, profitability, and risk, it is clear that a more careful specification of the relationship is an absolute necessity. The extant literature all too often has taken a casual appraisal of a very complex and dynamic relationship among these variables.

FOOTNOTES

[1]Designed and implemented by Anthony James Barr and James Howard Goodnight, Department of Statistics, North Carolina State University, Raleigh, North Carolina. A User's Guide to the Statistical Analytical System is available through Student Supply Stores, North Carolina State University, Raleigh, North Carolina 27607.

[2]U. S. Department of Commerce, Business Conditions Digest (May, 1972), p. 37.

[3]For the specific indicators comprising each of these diffusion indexes, see: U. S. Department of Commerce, Business Conditions Digest (May, 1972).

[4]Federal Reserve Bank of St. Louis Review (January, 1972).

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study was to determine if any consistent empirical relationship among corporate liquidity, profitability, and risk, all taken as separate and distinct variables, existed for the test period. Selected measures of these variables for 24 different manufacturing industry categories were examined in a specified model on a temporal cross-section basis for the period 1952 to 1971 by quarter. The data were obtained from the Quarterly Financial Report for Manufacturing Corporations published jointly by the Federal Trade Commission and the Securities and Exchange Commission.

Based upon statements in the literature, the existence of a relationship between liquidity, profitability, and risk is taken as axiomatic. It is assumed that a relationship does exist. Further, the consensus seems to be that the relationship is one such that level of liquidity is dependent upon the levels of profitability and risk, i.e., liquidity is the dependent variable and profitability and risk are the independent variables, in spite of the fact that they really appear highly interdependent. In general form, the model is $L = f(P,R)$, where L is a liquidity measure, P is a profitability measure, and R is a risk measure. It is assumed that as profitability rises, risk decreases and liquidity increases, and vice versa. Therefore, the predicted signs for the liquidity, profitability, and risk variables were that they would

be opposite.

Conceptually, the three variables were defined in the following manner: Liquidity is the ability of the firm to meet maturing obligations. Profitability is defined according to generally accepted accounting principles. Finally, risk is composite in nature in the sense that it arises from all potential sources of risk both internal and external to the firm, e.g., the financial structure of the firm, the operating leverage of the firm, inflation, the nature of the goods or services produced by the firm, and so forth.

Because there was no general consensus with respect to the manner in which these three variables should be measured, a selected population of measures for each variable was used in the testing of the model. In addition to the conceptual definition of each of the variables, the criteria used to choose each population of measures were the accessibility of the data to the external analyst, the success of the measure in predicting the ability to meet maturing obligations based upon prior empirical studies, and the common use of the selected measures.

The liquidity measures initially selected include the ratios of cash and government securities to current liabilities, current assets excluding inventories and other current assets to current liabilities, current assets to current liabilities, cash flow to total debt, and working capital to total assets. Of these liquidity measures, the first, the ratio of cash and government securities was subsequently eliminated in testing the model because of a lack of sufficient data on cash and government securities. The profitability measures selected include the ratios of net operating profit to net sales, net taxable profit to net sales, and net profit to net sales. The risk measures

included the coefficients of variation of the distributions comprised of the preceding 25 quarters' ratios of net operating profit to net sales, net taxable profit to net sales, and net profit to net sales for any given quarter beginning with the twenty-sixth one included in the period covered by the study.

Each of these measures was used in all possible combinations with other measures in the general multiple regression model

$$L_i^t = \beta_0 + \beta_1 P_j^t + \beta_2 R_k^t + e$$

where β_0, β_1, β_2 are unknown population parameters to be estimated, e is the random error variables and L_i^t, P_j^t, and R_k^t are the ith, jth, and kth measures of liquidity, profitability, and risk at quarter five.

Population regression coefficients were calculated for 75 quarters across all quarters from the first quarter of 1952 to the first quarter of 1971. Testing then involved determining whether the population regression coefficients for each of the 75 quarters and all i, j, k combinations were significantly different from zero.

The model led to one set of primary hypotheses and two sets of corollary hypotheses. The primary null and alternative hypotheses were:

H_0: For every combination of the three measures, there is a significant relationship between a liquidity measure as the dependent variable and a profitability measure and a risk measure as the independent variables in combination and with the predicted signs for every quarter.

H_1: For less than every combination of the three measures, there is a significant relationship between a liquidity measure as the dependent variable and a profitability measure and a risk measure as

the independent variables in combination and with the predicted signs for every quarter.

The two sets of corollary null and alternative hypotheses are:

H_0: For any one (or more) consistent combination of the three measures, there is a significant relationship between a liquidity measure as the dependent variable and both a profitability measure and a risk measure as the independent variables taken in combination and with the predicted signs for every quarter.

H_1: For any one (or more) consistent combination of the three measures, there is no significant relationship between a liquidity measure as the dependent variable and both a profitability measure and a risk measure as the independent variables taken in combination and with the predicted signs for every quarter.

and secondly:

H_0: The estimated betas (except for the intercept beta) are significantly different from zero for every quarter and any one (or more) variable combination and signed in the predicted manner.

H_1: The estimated betas (except for the intercept beta) are significantly different from zero for less than every quarter and any one (or more) variable combination and signed in the predicted manner.

After performing cross-temporal multiple regressions by quarter on all possible combinations of measures through the 75-quarter test period, the following general results were obtained. The frequencies of overall correlations significant at the 0.05 level between L_4 and all possible P_j and R_k combinations by quarter varied between zero and nine, the maximum possible number. The frequencies of correlation showed a definite lack of consistency among quarters. Out of all possible

dependent variables, L_4 was the one which most frequently correlated with the P_j and R_k combinations. This was reflected in that the frequencies of overall correlation significant at the 0.05 level between all liquidity measures and all possible P_j and R_k combinations by quarter do not measurably increase in number in spite of the fact that the maximum number of possible correlations per quarter increase four-fold to 36. L_4 was unique among all of the other liquidity measures in that it is a flow measure as opposed to a static measure. Within this model used in this study, static measures apparently did less well in terms of describing the data.

Examination of the residuals of correlation and their relationships with various economic indicators revealed few definite and consistent relationships between these residuals and various indicators over the test period. The residuals of correlation did appear to vary somewhat directly with Standard and Poor's 425-stock Industrial Index, the Federal Reserve Board Index of Industrial Production, long-term interest rates as reflected by the yields on Moody's Aaa corporates and long-term U. S. governments, and three diffusion indexes of National Bureau of Economic Research indicators. The temporal relationships between turns in these various indicators and turns in the residuals of correlation were dependent upon the diffusion index in question. Turns in the leading indicator diffusion index showed the closest relationship to the residuals of correlation.

Examination of the frequencies of accuracy with the predicted signs of the betas with various independent variables for those equations where the calculated F statistic was significant at the 0.05 level and

the calculated T statistics for the independent variables were either both significant at the 0.05 level or one was significant at the 0.05 level and the other was significant showed mixed results. Of all these equations, there were a number of cases where the betas were not oppositely signed. More positively, with L_3 as the dependent variable, all equations had betas with both signs as predicted.

The most frequent significant equations were those where L_4 was the independent variable and both betas were not of the opposite signs. In particular, $L_4 = f(P_1, R_2)$, $L_4 = f(P_1, R_3)$, $L_4 = f(P_2, R_2)$, and $L_4 = f(P_2, R_3)$ equations with both betas not inversely signed were the most frequent significant equations.

With respect to the hypotheses, the null hypotheses of the primary and corollary hypotheses were all rejected. The rejection of the primary hypothesis meant that for less than every combination of the three possible measures, there is a significant relationship between a liquidity measure as the independent variable and a profitability measure and a risk measure as the independent measures in combination for every quarter.

The null hypothesis of the first set of corollary hypotheses was also rejected. This means that for any one (or more) consistent combinations of the three measures, there is no significant relationship between a liquidity measure as the dependent variable and both a profitability measure and a risk measure as the independent variables taken in combination for every quarter.

Finally, the null hypothesis of the second set of corollary hypotheses was rejected. The estimated betas (except for the intercept beta) were significantly different from zero for less than every

quarter and any one (or more) variable combination. Also, where the estimated betas (except for the intercept beta) were indeed significantly different from zero for a large number of quarters relative to all quarters in the test period and for a given number of variables, the beta values varied significantly from quarter to quarter.

Based on the findings, one may safely conclude that this model does not adequately describe the data as given. There is no consistent relationship between the various combinations of measures as posited by the model central to this study. However, this does not lead to the conclusion that there is no relationship among liquidity, profitability, and risk. As a matter of fact, the results of this study indicate that liquidity may be related to profitability over the long-run and risk over the short-run. This has conceptual appeal because of the time-lag between the generation of profit and the subsequent conversion of these profits into the most liquid resources. Also, the ability to meet obligations and the availability of liquid resources are directly related.

Nothing is made clearer from the results of the study, however, than the need for explicit statements of the relationship among liquidity, profitability, and risk with the literature of finance. Existing studies all too frequently have taken a casual approach to explaining a very complex and dynamic relationship among these variables.

Among other things, this study suggests a number of possible avenues for future research. The most obvious is the application of another model to these data or other data for that matter. Specification of other variables and measures, perhaps including dynamic ones, within the new model seems a plausible approach. Leading, current, or lagged variables may be a possibility. Finally, new data incorporating

industries other than manufacturing industries and information on firm size may provide additional insight into any possible relationship among liquidity, profitability, and risk.

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APPENDIX

SIGNIFICANT MULTIPLE REGRESSION EQUATIONS BY QUARTER (1953 QII THROUGH 1954 QIV)

Abbreviations and notations:

Q26 = quarter 26 (i.e., the second quarter of 1953)
Q27 = quarter 27 (i.e., the third quarter of 1953) . . ., etc.
1952 QII = second quarter of 1952
1952 QIII = third quarter of 1952 . . ., etc.
Dep Var = Dependent variable
Indep Vars = Independent variables
Overall Indep Var Effects = Overall independent variable effects (i.e., the significance or insignificance of the two independent variables shown with all possible dependent variables for that particular quarter)
Prob > F = Probability that the calculated F statistic (not shown) for that set of variables and quarter would have occurred by chance
Est'd Params = Estimated parameters in the multiple regression equation (the first in each group, Int, is the intercept while the last two are the respective independent variables)
Int = Intercept
B Values = Estimated beta values
Prob > T = Probability that the calculated T statistic (not shown) is significantly more or less than zero for each respective estimated parameter
Insignif = Insignificant at the 0.05 level
Signif = Significant at the 0.05 level

Included in this appendix are those multiple regression equations for which the calculated F statistic was significant at the 0.05 level and the calculated T statistics for the independent variables were either both significant at the 0.05 levels or one was significant at the 0.05 level while the other was significant at the 0.10 level. Only data from five quarters of the test period are included as a representative sample of the data.

Dep Var	Indep Vars	Overall Indep Var Effects	Prob > F[1]	Est'd Params	B Values[2]	Prob > T[3]
Q26						
				Int	0.1485	0.69
L_2	R_1	Insignif	0.03	R_1	58.8135	0.04
	P_1	Signif		P_1	6.9686	0.02
				Int	-0.1897	0.01
L_4	R_1	Insignif	0.01	R_1	7.5033	0.05
	P_2	Signif		P_2	2.1359	0.01
				Int	-0.0334	0.01
L_4	R_1	Insignif	0.01	R_1	2.6088	0.03
	P_3	Signif		P_3	2.0252	0.01
				Int	0.8138	0.01
L_4	R_2	Insignif	0.01	R_2	-43.2708	0.04
	P_1	Signif		P_1	-4.2260	0.05
				Int	-0.1901	0.01
L_4	R_2	Insignif	0.01	R_2	7.4635	0.04
	P_2	Signif		P_2	2.1433	0.01
				Int	-0.0337	0.01
L_4	R_2	Insignif	0.01	R_2	2.6462	0.03
	P_3	Signif		P_3	2.0280	0.01
				Int	1.0607	0.01
L_4	R_3	Insignif	0.01	R_3	-73.4614	0.01
	P_1	Signif		P_1	-5.81	0.01
				Int	-0.2148	0.01
L_4	R_3	Insignif	0.01	R_3	13.5802	0.01
	P_2	Signif		P_2	2.1793	0.01

Dep Var	Indep Vars	Overall Indep Var Effects	Prob > F[1]	Est'd Params	B Values[2]	Prob > T[3]
				Int	-0.0382	0.01
L_4	R_3	Insignif	0.01	R_3	4.1432	0.01
	P_3	Signif		P_3	2.0338	0.01
Q27						
				Int	0.2516	0.51
L_2	R_1	Insignif	0.04	R_3	61.4651	0.05*
	P_1	Signif		P_1	6.4885	0.03
				Int	-0.1677	0.01
L_4	R_1	Insignif	0.01	R_1	6.7327	0.09*
	P_2	Signif		P_2	2.1174	0.01
				Int	-0.0340	0.03
L_4	R_1	Insignif	0.01	R_1	2.7539	0.05*
	P_3	Signif		P_3	2.0250	0.01
				Int	0.2126	0.54
L_2	R_2	Insignif	0.01	R_2	65.9747	0.03
	P_1	Signif		P_1	6.6884	0.02
				Int	-0.1688	0.01
L_4	R_2	Insignif	0.01	R_2	6.8371	0.08*
	P_2	Signif		P_2	2.1239	0.01
				Int	-0.0345	0.01
L_4	R_2	Insignif	0.01	R_2	2.8434	0.04
	P_3	Signif		P_3	2.03	0.01
				Int	-0.0224	0.95
L_2	R_3	Insignif	0.02	R_3	98.9175	0.02
	P_1	Signif		P_1	9.4728	0.01

Dep Var	Indep Vars	Overall Indep Var Effects	Prob > F[1]	Est'd Params	B Values[2]	Prob > T[3]
				Int	0.9552	0.01
L_4	R_3	Signif	0.02	R_3	-78.9205	0.01
	P_1	Signif		P_1	-5.2243	0.03
				Int	-0.1958	0.01
L_4	R_3	Signif	0.01	R_3	13.7597	0.01
	P_2	Signif		P_2	2.1609	0.01
				Int	-0.0430	0.01
L_4	R_3	Signif	0.01	R_3	5.3207	0.01
	P_3	Signif		P_3	2.0381	0.01
Q28						
(none)	R_1	Signif				
	P_1	Signif				
				Int	-0.0993	0.01
L_4	R_1	Signif	0.01	R_1	5.3958	0.07*
	P_2	Signif		P_2	2.0713	0.01
				Int	-0.0280	0.02
L_4	R_1	Insignif	0.01	R_1	2.8078	0.10*
	P_3	Signif		P_3	2.0147	0.01
(none)	R_2	Signif				
	P_1^2	Signif				
				Int	-0.1005	0.01
L_4	R_2	Signif	0.01	R_2	5.5517	0.05*
	P_2^2	Signif		P_2^2	2.0764	0.01

Dep Var	Indep Vars	Overall Indep Var Effects	Prob > F[1]	Est'd Params	B Values[2]	Prob > T[3]
				Int	-0.0288	0.01
L_4	R_2	Signif	0.01	R_2	2.9241	0.09*
	P_3^2	Signif		P_3^2	2.0174	0.01
(none)	R_3	Signif				
	P_3	Signif				
				Int	-0.1094	0.01
L_4	R_3	Signif	0.01	R_3	8.7099	0.02
	P_2	Signif		P_2	2.0881	0.01
Q29						
(none)	R_1	Insignif				
	P_1	Signif				
				Int	-0.1325	0.01
L_4	R_1	Insignif	0.01	R_1	5.5568	0.09*
	P_2	Signif		P_2	2.0915	0.01
				Int	-0.0330	0.01
L_4	R_1	Insignif	0.01	R_1	3.0671	0.07*
	P_3	Signif		P_3	2.0217	0.01
(none)	R_2	Signif				
	P_1^2	Signif				
				Int	-0.1349	0.01
L_4	R_2	Insignif	0.01	R_2	5.8750	0.07*
	P_2^2	Signif		P_2^2	2.0981	0.01
				Int	-0.1337	0.01
L_4	R_2	Insignif	0.01	R_2	3.1590	0.03
	P_3^2	Signif		P_3^2	2.0244	0.01

Dep Var	Indep Vars	Overall Indep Var Effects	Prob > F[1]	Est'd Params	B Values[2]	Prob > T[3]
(none)	R_3	Insignif				
	P_1	Signif				
				Int	-0.1473	0.01
L_4	R_3	Insignif	0.01	R_3	10.3435	0.02
	P_2	Signif		P_2	2.1153	0.01
				Int	-0.0389	0.01
L_4	R_3	Insignif	0.01	R_3	5.3262	0.01
	P_3	Signif		P_3	2.0312	0.01
Q30						
				Int	0.3445	0.31
L_2	R_1	Insignif	0.02	R_1	65.2977	0.03
	P_1	Signif		P_1	6.7481	0.04
(none)	R_1	Insignif				
	P_2	Signif				
				Int	-0.0312	0.01
L_4	R_1	Signif	0.01	R_1	2.9023	0.01
	P_3	Signif		P_3	2.0208	0.01
				Int	0.3172	0.66
L_2	R_2	Insignif	0.02	R_2	64.7818	0.02
	P_1	Signif		P_1	7.0688	0.03
(none)	R_2	Insignif				
	P_2	Signif				
				Int	-0.0321	0.01
L_4	R_2	Signif	0.01	R_2	2.9966	0.03
	P_3	Signif		P_3	2.0237	0.01

Dep Var	Indep Vars	Overall Indep Var Effects	Prob > F[1]	Est'd Params	B Values[2]	Prob > T[3]
				Int	0.2021	0.59
L_2	R_3	Insignif	0.02	R_3	93.1978	0.03
	P_1	Signif		P_1	8.1658	0.02
				Int	-0.1425	0.01
L_4	R_3	Insignif	0.01	R_3	8.8911	0.03
	P_2	Signif		P_2	2.1081	0.01

[1]For probabilities less than or equal to 0.0500, rounded to the nearest 0.01. For probabilities less than 0.0050, rounded to 0.01.

[2]Rounded to the nearest 0.0001.

[3]Rounded to the nearest 0.01 for intercept probabilities. For independent variable probabilities less than or equal to 0.0500, rounded to the nearest 0.01. For independent variable probabilities greater than 0.0500 but less than or equal to 0.1000, rounded to the nearest 0.01 and asterisked. For intercept and independent variable probabilities less than 0.0050, rounded to 0.01.

VITA

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