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BANK MANAGEMENT, COMPETITION, AND INTEREST RATES:
A PORTFOLIO MODEL OF DISCOUNT WINDOW ACTIVITY

William Jackson

Federal Reserve Bank of Richmond

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Introduction*

The ability to borrow funds at the discount window is a potentially valuable incentive for a bank to belong to the Federal Reserve System. Member bank use of this source of credit varies markedly over time and among banking organizations. This paper examines the recent borrowing behavior of large Fifth District banking organizations to determine why they appear at, or avoid, the discount window. Do banking organizations that borrow extensively differ from those that do not? If so, how do they differ? Are both macroeconomic and microeconomic criteria important in determining individual member bank borrowing activity? The answers to these questions should enrich our knowledge of bank portfolio behavior in the stormy financial climate of recent years.

This paper develops a theoretical model of a bank as a utility-maximizing institutional investor. This model of bank risk-return management extends the well-known Capital Asset Pricing Model to encompass imperfect financial markets, varying demand for financial services, and interest rate changes. The resulting portfolio model of bank behavior is tested empirically, using borrowing at the discount window as the dependent variable.

Portfolio Choice of Competitively Traded Securities

The Capital Asset Pricing Model explains portfolio choice in competitive, unregulated markets. This starting point for the analysis of

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bank portfolios is based on several assumptions (see [18, 24,31,55] for proofs of this model).

They are:

(1) Investors choose portfolios as if they operate within a single-period time horizon, utility-maximizing framework. Their utility of holding financial assets is based on the random variables: expected return $E(\tilde{R})$, and risk--expected standard deviation $\sigma(\tilde{R})$.[1]

(2) Investors can borrow or lend a riskless asset at a low interest rate R_F. This asset can be combined with risky assets to form combinations of assets that dominate risk-asset only investment opportunity sets.

(3) Investors choose Markowitz efficient portfolios with maximum $E(\tilde{R})$ for a given $\sigma(\tilde{R})$.

(4) Investors choose a risk class within which their utility varies positively with $E(\tilde{R})$ and negatively with $\sigma(\tilde{R})$: risk aversion.

(5) Securities are divisible, marketable, salable with no transactions costs, and taxfree. Investors are price-takers with identical estimates of return and risk for any asset.

(6) Interest rates are not expected to change over the planning horizon: security returns are not state-dependent.

This basic model has found wide acceptance in the theory of equity valuation and portfolio analysis. Its implications may be

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[1]The tildes denote random variables. Differentiation with respect to random variables, which assume values according to a prescribed probability density function, is of course impossible. Investors define utility over the anticipated mean and standard deviation of such distributions.

clarified by examining the behavior of individual investors, whose behavior is aggregated to determine market relationships.

Under the conditions of competitive security markets postulated by assumptions (1) through (6), the utility function of individual investors follows the continuous, twice differentiable form:

$$U^K = f^k [E(\tilde{R}), \sigma(\tilde{R})],$$

where the utility of the k-th investor from holding a portfolio increases with expected return, but decreases with risk:

$$\frac{\partial U}{\partial E(\tilde{R})} > 0; \qquad \frac{\partial U}{\partial \sigma(\tilde{R})} < 0.$$

Rational investors thus possess risk-averse utility functions. As the representative investor bears more risk, he requires a larger expected return to compensate for the higher probability of loss. An individual investor's degree of risk aversion is defined by his locus of constant utility. This isoutility locus is convex to the risk axis in risk-return space. That is,

$$\frac{\partial E(\tilde{R})}{\partial \sigma(\tilde{R})} > 0, \qquad \frac{\partial^2 E(\tilde{R})}{\partial \sigma(\tilde{R})^2} > 0$$

where second order conditions are met by the second partial derivative term.

Conservative investors prefer low expected returns since they will accept only low risk. Aggressive investors seek high

expected returns for which they accept high risk. Following assumptions (2) and (3), however, if all risk-averse investors strive for maximum expected return for given risk, or minimum risk for maximum expected return by combining holdings of risky assets with the riskless asset, a determinate risk-return market relationship emerges. This relationship shows the equilibrium tradeoff between the return on an asset and its degree of risk. The tradeoff defines the "capital market line."

The capital market line for efficient portfolios is:

$$E(\tilde{R}) = R_F + \lambda \, \sigma(\tilde{R}),$$

where λ is a positive constant, "the market price of risk," and R_F is the riskless rate of interest. Assets whose expected return exceeds that predicted by the capital market line should be in excess demand; their prices rise until portfolios containing them again lie on the capital market line. Similarly, assets whose return is less than appropriate for their risk class will suffer falling prices. Although all investors do not have to hold identical portfolios, the slope of all investors' isoutility loci, their optimum tradeoff between expected return and risk when the rate of change of utility is zero, is thus

$$-\left[\frac{\dfrac{\partial U}{\partial \sigma(\tilde{R})}}{\dfrac{\partial U}{\partial E(\tilde{R})}}\right] = \lambda.$$

With constant absolute risk aversion and normally distributed returns, the expected utility-maximizing portfolio relationship for investors can assume an exponential form such as:[2]

$$E[U(\tilde{R})]= -\exp [-c(E(\tilde{R}) - c\sigma^2(\tilde{R})/2)],$$

where the parameter c denotes investor risk avoidance: $c > 0$. The k-th investor's position along the capital market line is determined by his own risk preference.

This theory may be clarified by Chart 1 (p. 6). The set of efficient risky asset only combinations appears as the segment AMB. The Capital Market Line CML originates at R_F. It moves down toward the risk axis until it is tangent to the highest obtainable efficient risk asset portfolio combination. Point M denotes this "market portfolio" risk-reward combination. An investor who holds this "average" risk portfolio expects to receive return R_m.

In all cases, investor utility increases when portfolio investments are made along isoutility loci that lie closer to the return axis. Conservative investors maximize their utility with low risk, low return portfolios. They hold a low proportion of risky assets and a high proportion of the riskless asset along CML at points such as (R_c, σ_c). They lend this asset to investors who prefer to assume higher than average risk. Their high expected

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[2]See [24]. The common assumption of quadratic utility functions implies unrealistic behavior. It suggests that risk taking falls when wealth increases and that very high returns generate negative marginal utility.
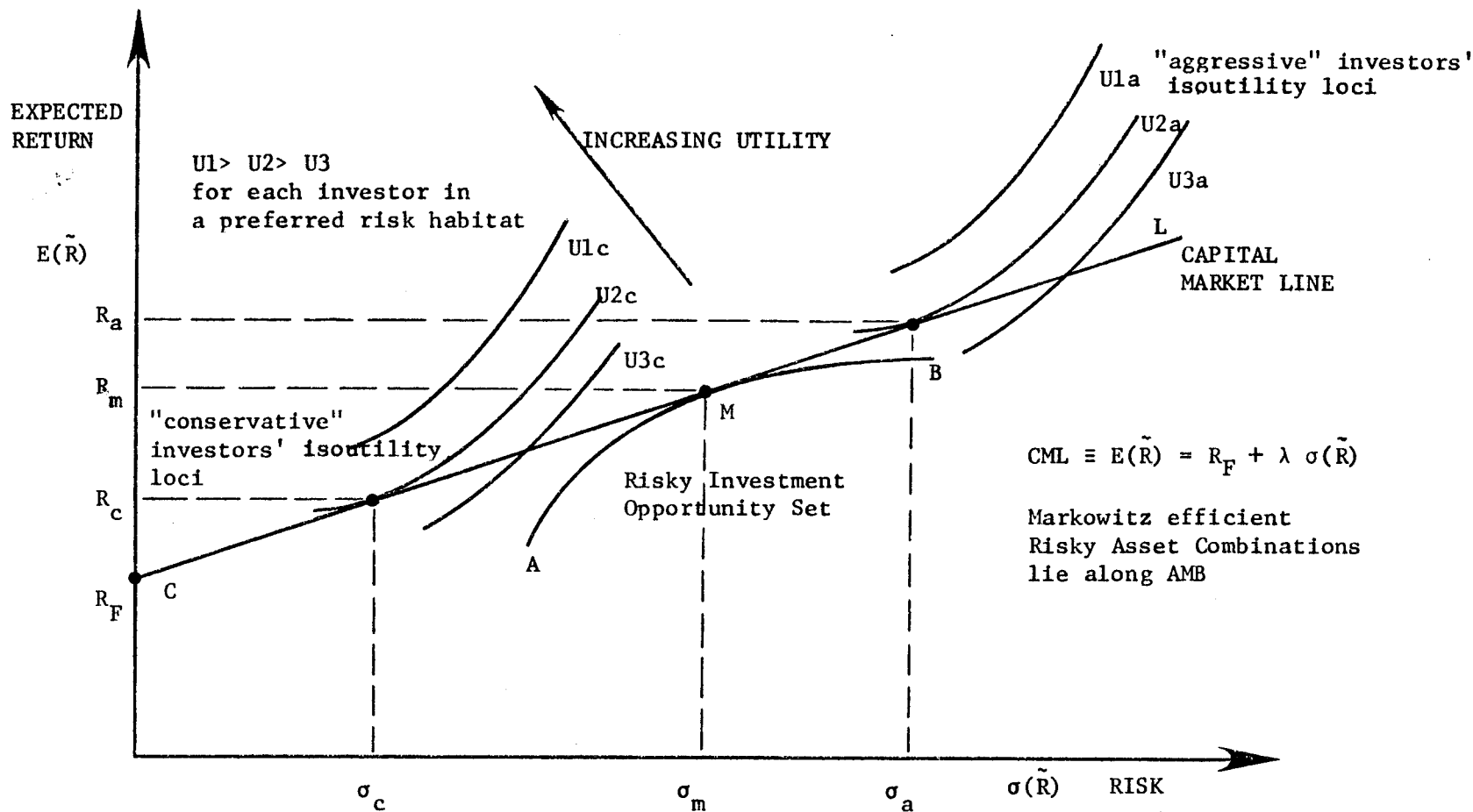
Chart 1. The Capital Asset Pricing Model

EXPECTED
RETURN

$E(\tilde{R})$

U1> U2> U3
for each investor in
a preferred risk habitat

INCREASING UTILITY

U1a "aggressive" investors'
isoutility loci

U2a

U3a

L
CAPITAL
MARKET LINE

U1c

U2c

R_a

U3c

R_m

M

B

"conservative"
investors' isoutility
loci

Risky Investment
Opportunity Set

$CML \equiv E(\tilde{R}) = R_F + \lambda\, \sigma(\tilde{R})$

Markowitz efficient
Risky Asset Combinations
lie along AMB

R_c

A

R_F C

σ_c σ_m σ_a $\sigma(\tilde{R})$ RISK

6.

return portfolios are supported by borrowing. Aggressive investors find that their utility is maximized along CML when their portfolios are expanded by high leverage to points such as (R_a, σ_a). All of these points along CML are certainty equivalents of R_F.

This theory describes the behavior of individual investors in bond and equity markets. It can also analyze business financial and operating decisions, including real sector capital budgeting and merger proposals. In particular, it can be modified to analyze the portfolio behavior of regulated financial institutions.

Banks as Institutional Investors

Unlike most individuals, banks do not invest only in marketable securities. Banks are not entirely price-takers; their basic business is supplying indivisible bank loans lying along a downsloping demand curve. Contrary to assumption (5), superior information obtained through experience in lending and "customer relationships" allows banks to invest in nonmarketable high return primary securities. Their perceived risk of extending such loans is less than that perceived by individual investors.

And contrary to assumption (2), banks issue liabilities (secondary securities) whose return is less than the lending rate. Banks issue almost riskless securities (deposits) bearing interest at rates about R_F or less. In particular, most demand deposits pay no explicit interest and traditionally represent a source of service charge income to a bank. Their time and savings deposits represent

a riskless (Federally insured in most cases) asset to conservative nonbank investors.

The resulting pooling of funds, based on divisibility, information, specialization, and transactions costs in borrowing and lending is responsible for the existence of financial inter- mediaries. Correspondingly, the opportunity locus of risky investments available to an unregulated bank dominates the securities-only Markowitz efficient investment opportunity set [35, 40, 49, 50, 55]. An unregulated bank could also invest in any of the debt and equity securities that private investors could. To the extent that it would do so, it would face the same infinitely elastic financial markets that underlie the Capital Market Line. But as it extends loans, it earns an excess risk- adjusted return. It is thus partly a rate setting and partly a quantity setting firm [50].

Chart 2 (p. 9) shows that an unregulated bank could hold an efficient portfolio that dominates the Capital Market Line [17]. This Bank Market Line reflects the higher investment opportunity set available to a financial intermediary. If an unregulated bank preferred to assume the market level of risk, it would expect to receive return R_A. Its excess return would be $(R_A - R_m)$. It would not necessarily "exploit" anyone by this intermediation, since the alternative of direct investment remains available.

In the context of this model, regulation may prevent banks from realizing their full potential return. Reserve requirements

EXPECTED RETURN

BANK MARKET LINE
NO REGULATION

An unregulated bank could
attain the Markowitz efficient
Risky Asset Combination DEF

BANK MARKET LINE
PROPORTIONAL RESERVES

CAPITAL MARKET LINE
COMPETITIVE SECURITIES

R_A

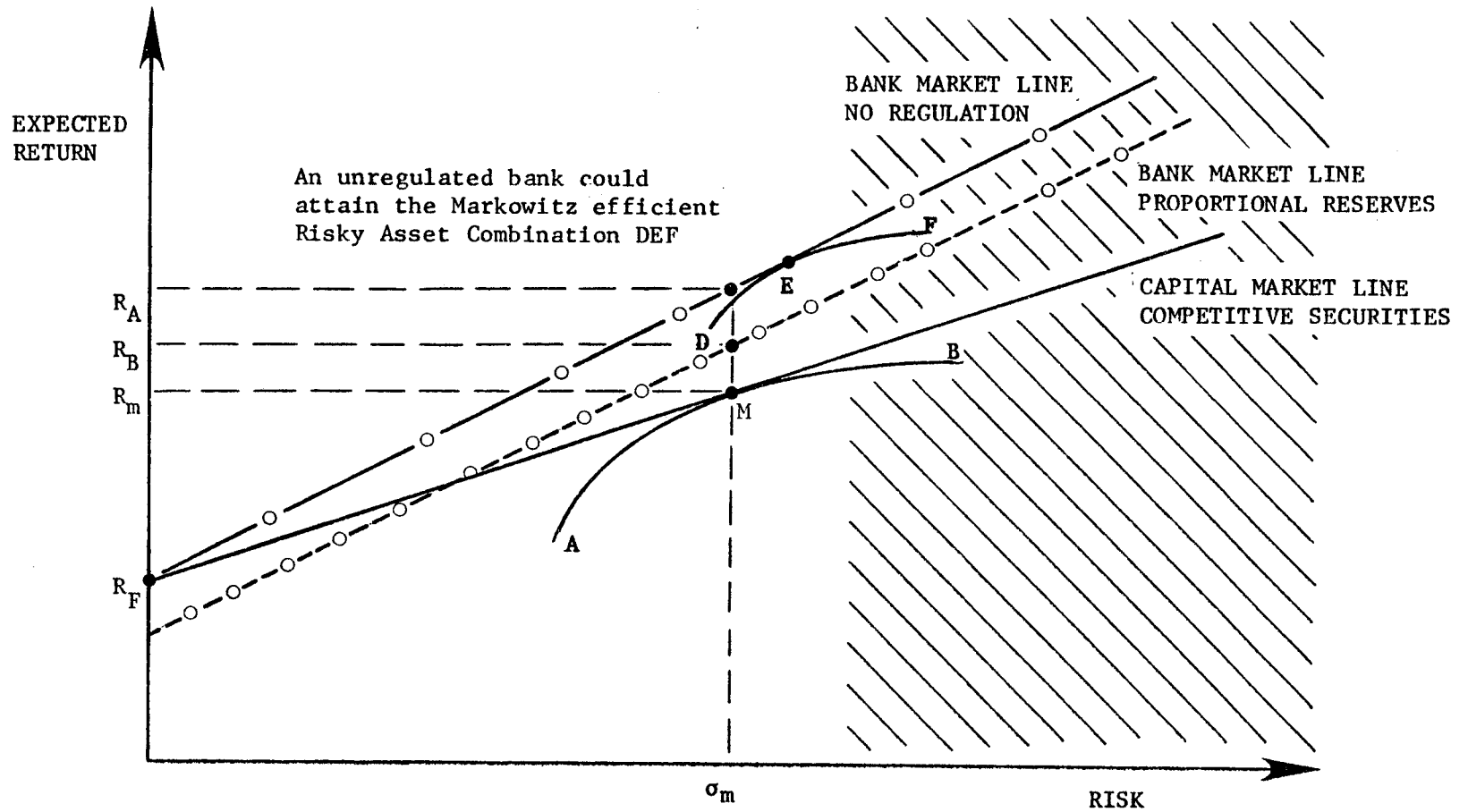R_B

R_m

F

E

D

B

M

A

R_F

σ_m

RISK

Chart 2. Potential Bank and Individual Investor Risks and Returns

Regulatory concerns for the soundness of the banking system prevent
banks from assuming risk in the shaded area. Most bankers themselves
prefer to operate where risk is less than σ_m.

clearly lower expected returns, since cash is always an inefficient asset beyond that required for transactions purposes. The weighted return on a portfolio containing n assets is:

$$E(\tilde{R}) = \sum_{i=1}^{n} w_i \cdot E(\tilde{X}_i),$$

where w_i represents the proportion of the portfolio invested in asset i and $E(\tilde{X}_i)$ denotes the expected return from asset i. The zero return on portfolio cash is clearly less than R_F. Hence, expected return falls proportionally with portfolio cash holdings. In risk-adjusted terms, holding required reserves in the form of primary reserve assets instead of secondary reserves reduces portfolio profitability to a lower certainty equivalent.

The effect of required reserves appears in the Proportional Reserves Bank Market Line in Chart 2. If reserves are held in proportion to total portfolio size, a regulated bank's reward for assuming market risk declines from R_A to R_B [49]. If the bank is very averse to risk, its return could be less than that of a conservative private investor with the same risk preference whose portfolio lies along the Capital Market Line.

Moreover, capital requirements, prohibitions against holding certain types of portfolio assets, and other regulations prevent banks from assuming risk beyond some absolute level [27]. The resulting restraint on earning speculative returns does not necessarily reduce risk-adjusted earnings further. (All points lying along a Bank Market Line represent the certainty equivalent of the zero-risk intercept rate.)

These restrictions limit accounting rates of return, while they strengthen public confidence in the banking system. Regulatory application of risk-asset and other capital ratios, in particular, tends to reinforce risk-averse behavior by banks.

Banks as Institutional Investors

Banks thus are not unconstrained profit-maximizers. They try to reconcile the conflicting goals of liquidity, profitability, and solvency according to subjectively determined utility functions. Since bank stock is not traded in "perfect" markets,[3] "bank management behaves as though stockholders have homogenous expectations and attempts to maximize utility on the basis of its judgments about stockholder preference." [17, p. 764.]

The combination of banker prudence, regulation, and stockholder preferences generates isoutility loci with the properties shown above. Bank utility functions involve positive marginal utility of return, negative marginal utility of liability cost, and negative marginal utility of asset or liability risk. Increased returns are required to offset the dollar and psychological costs of assuming increased liabilities [2, 22, 33, 36, 38, 47, 51].

Bank Portfolios and Risk Aversion

The risk preference of individual banks may be suggested by their balance sheets, holding interregional and intertemporal variations in

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[3] "Simply attempting to maximize the market value of the stock will not yield the highest utility if the market does not reflect the full value of the bank and if its stockholders are unable to obtain the true value by liquidating their holdings." [17, p. 764].

demand constant [2, 9, 10, 12, 28]. Consider the following asset and liability schedule:

	Cash: Vault Cash, Other	Borrowed Reserves	
	Federal Funds Sold	Federal Funds Purchased	
	Correspondent Balances	Government Deposits	
	Government Securities	Certificates of Deposit	
	Other Securities	IPC Demand Deposits	
	Loans	IPC Time and Savings Deposits	
	Fixed Assets	Capital: Debt, Equity	
	Total Assets	Total Liabilities=Assets	

(Left axes labeled: Asset Liquidity ↑, Risk and Return ↓. Right axes labeled: Liability Liquidity ↑, Risk (Volatility) ↑.)

Financial and operating risks are identical for a bank. This simplified balance sheet orders the risk-return characteristics of assets and liabilities under "normal" conditions. (The cost, return, and volatility of these accounts may shift if a downsloping yield curve prevails in tight money periods.)

More liquid assets generally receive lower returns, corresponding to low or zero credit risk and high predictability of capitalized value. Illiquid, somewhat risky loans earn the highest portfolio returns. Fixed assets, the largely nonmarketable plant and equipment used in operations, require even higher expected returns than loans.

Conversely, more liquid assets possess higher volatility. The risk of withdrawal or unavailability generally increases as liability

volatility increases from debt and equity capital, which is not subject to short-run withdrawal, through deposits,[4] to highly liquid short-term liabilities. While the dollar cost of liabilities (adjusted for reserve requirements) may decrease as their liquidity increases, given a positively sloped yield curve, the uncertainty attached to the total size of the available portfolio rises with increasing "liability management" [49]. "Any increase in the volatility of individual or aggregate deposit balances unambiguously worsens a bank's opportunity set. Ceteris paribus, deposit volatility increases aggregate risk exposure." [33, p. 120].

A bank that "borrows short to lend long" aggressively thus should find both its return and its overall risk rising. Such a bank accumulates or retains loans based on volatile funds, thereby running the risk of depleting its cash below required levels in the short run. Hence, increasing asset and/or liability risk acceptance raises the probability of liquidity drains severe enough to create deficiencies in legal or operational reserves. To meet these short-run cash drains, banks may sell secondary reserve assets, borrow at the discount window, or engage in other liability management activities. While banks may attempt to match the maturity or volatility of their assets and liabilities, higher risk in any category of operations raises a bank's overall risk and should be sought only by the promise of higher returns. The connection between longer term bank risk preference and shorter term reserve adjustments thus occurs through the balance sheet identity:

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[4]Kaufman's study [34] orders the variability of deposits as follows: U.S. Government deposits > demand deposits due to banks > other demand deposits $\simeq$ other time deposits $\simeq$ total demand deposits > total deposits > time and savings deposits > savings deposits.

Σ assets = Σ liabilities and equity. Higher earning asset ratios are attainable only by accepting liability risk in the short run, although longer term low risk deposits and "capital" can be attracted in the long run. Liabilities should be almost as important as assets in determining profits [2, 28, 49, 50]. (The Appendix provides new evidence on these relationships.)

Demand Variations

These portfolio preferences describe interbank differences along a given Bank Market Line: varying individual bank risk avoidance. The demand for bank earning assets should also vary both cross-sectionally and over time.

For example, Chart 3 (p. 15) depicts the previous "normal" reserve-adjusted Bank Market Line, and a reserve-adjusted High Demand Bank Market Line that shows the greater efficient returns available in a more favorable environment. This increase in demand may result from a high level of economic activity: income or population growth. It may also result from a concentrated bank structure. The resulting market environment allows each bank to achieve higher returns from the higher, less-elastic bank loan demand curve that underlies the steeper High Demand Bank Market Line in Chart 3.

The higher returns available to all banks then encourage banks to shift into somewhat riskier assets or liabilities. They can clearly attain a higher level of utility (risk-adjusted profitability) [24, 36]. Loan/deposit ratios rise [49]. This relaxation of assumption (5) encompasses the barriers to entry, customer relationships, and
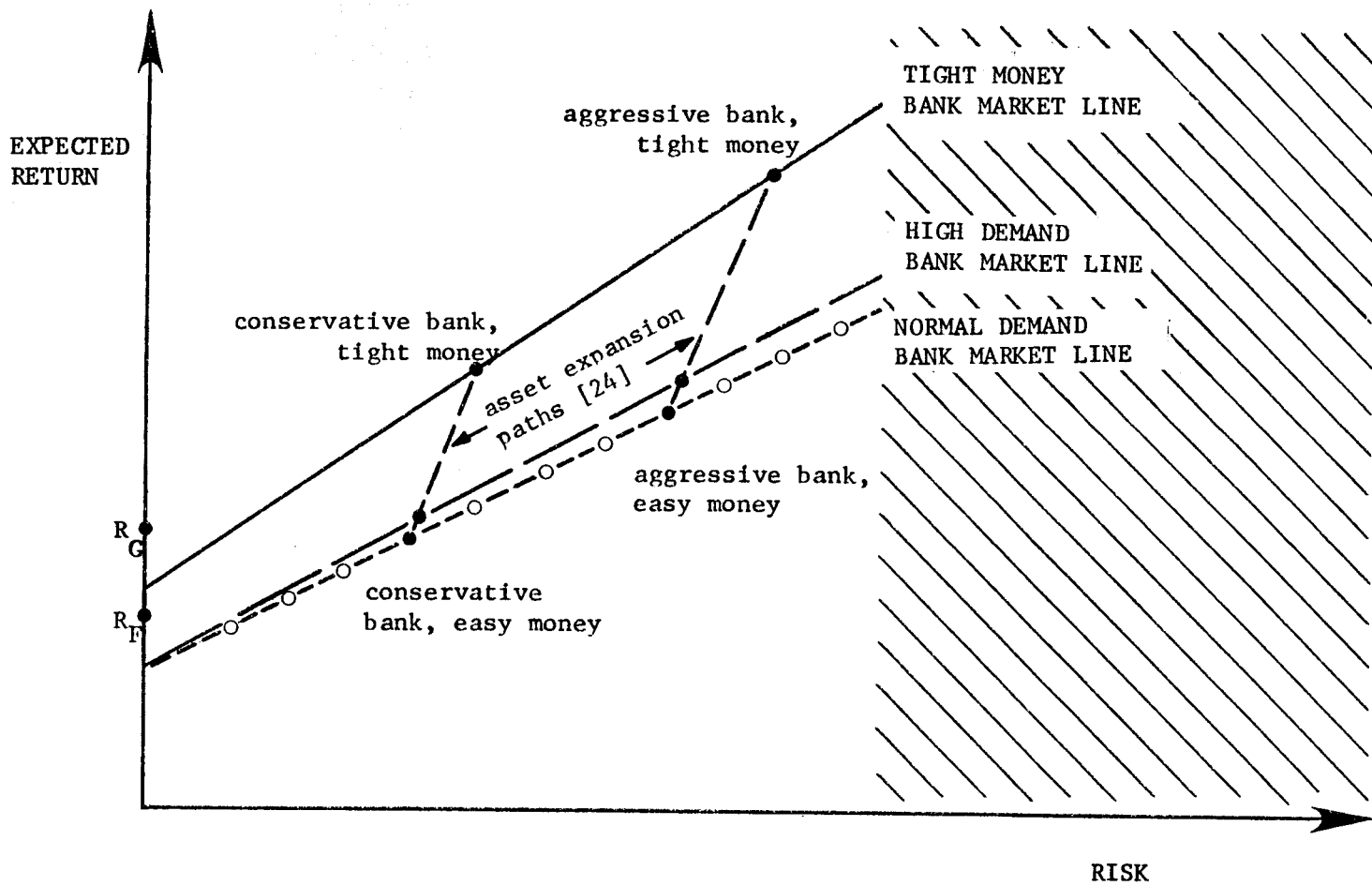
Chart 3. Interbank, Interstate, and Interest-Related Bank
Risk and Return Combinations, Proportional Required Reserves.

restrictions on branching that limit the general ability of banks to transfer resources across distances such as state lines. It conforms to the realistic observation that a bank's profitability is highly related to the economic health of its geographic territory.

Variations in the financial climate have even more dramatic effects on Bank Market Lines. When tight money raises the riskless rate of interest, it increases the height and slope of the Capital Market Line [24]. This line rises and rotates when R_F increases:

$$\frac{\partial \lambda}{\partial R_F} > 0 \; ; \qquad \frac{\partial \sigma(\tilde{R})}{\partial R_F} > 0.$$

All investors can then receive a higher return at the same risk level. The required $E(\tilde{R})$ rises:

$$\frac{\partial E(\tilde{R})}{\partial R_F} > 0 \qquad \text{at equilibrium.}$$

The Bank Market Line reacts strongly to this stimulus, contrary to assumption (6). Bank returns are highly state-dependent [51]. As rates rise, the demand for bank loans usually increases. Banks attempt to accommodate the rising demand for commercial and industrial loans, particularly that of long-term customers [33]. Their loan supply function becomes more positively sloped when rates rise, as loan returns increase relative to security returns [44]. Tight money periods are also typified by extensive liability management when banks seek to maintain or expand their portfolios despite disintermediation [38, 44]. Even conservative banks may increase their aggressive behavior. This pattern is shown in

Chart 3 when the riskless rate increases to R_G. The higher, more steeply sloped Tight Money Bank Market Line stimulates bank risk acceptance.

Bank Risk, Utility, and Borrowing

Member bank borrowing represents a source of disutility to a bank. It involves not only the explicit cost of the discount rate, but also the opportunity cost of asset management, the opportunity cost of other forms of liability management, and the implicit cost of Federal Reserve Bank "surveillance."

The incentive to borrow is the marginal pretax return on earning assets, such as loans [30] minus the pecuniary and psychological marginal cost of borrowing.

Federal Reserve pressure on extensively borrowing banks adds a strong subjective element to the true cost of borrowing. If B represents the amount of borrowing and C represents the dollar cost of borrowing:

$$\frac{\partial U}{\partial B} < 0, \quad \frac{\partial U}{\partial C} < 0, \quad \text{and} \quad \frac{\partial^2 U}{\partial B^2} > 0$$

according to [2, 21, 47]. Only the lure of high returns overcomes this reluctance to borrow. Accordingly, both individual bank risk preference and interest rates should influence borrowing.

The Financial Climate and Borrowing

When the discount rate lags behind rising money market rates, profit-conscious banks should be attracted to the discount window. One intermittent benefit of Federal Reserve System membership, a discount rate below earning asset rates, then becomes available. (See Chart 4, p. 19).

As Treasury bill rates, R_F in the Capital Asset Pricing Model, climb in tight money periods, the demand for bank loans rises. The opportunity cost of adjusting reserves by selling secondary reserve assets simultaneously increases [7, 11, 13]. In Chart 3, the position of any bank along the resulting Tight Money Bank Market Line would tend to exceed the prevailing discount rate by a greater vertical distance than its position along a "normal" Bank Market line would. Even a conservative bank could increase its total utility by borrowing in the short run. A more aggressive bank would then borrow and buy Federal funds to fund its larger extensions of loans.

Moreover, the cost of other bank reserve position instruments usually exceeds the discount rate in tight money periods. When the Federal funds rate exceeds the discount rate, reserve-deficient banks may find their disutility of borrowing overcome by the resulting profit incentive to borrow.

Empirical studies find that borrowing may vary with both the level of interest rates--financial demand [1, 2, 5, 11, 13, 15, 22, 30, 48, 53]--and with interest rate differentials--opportunity
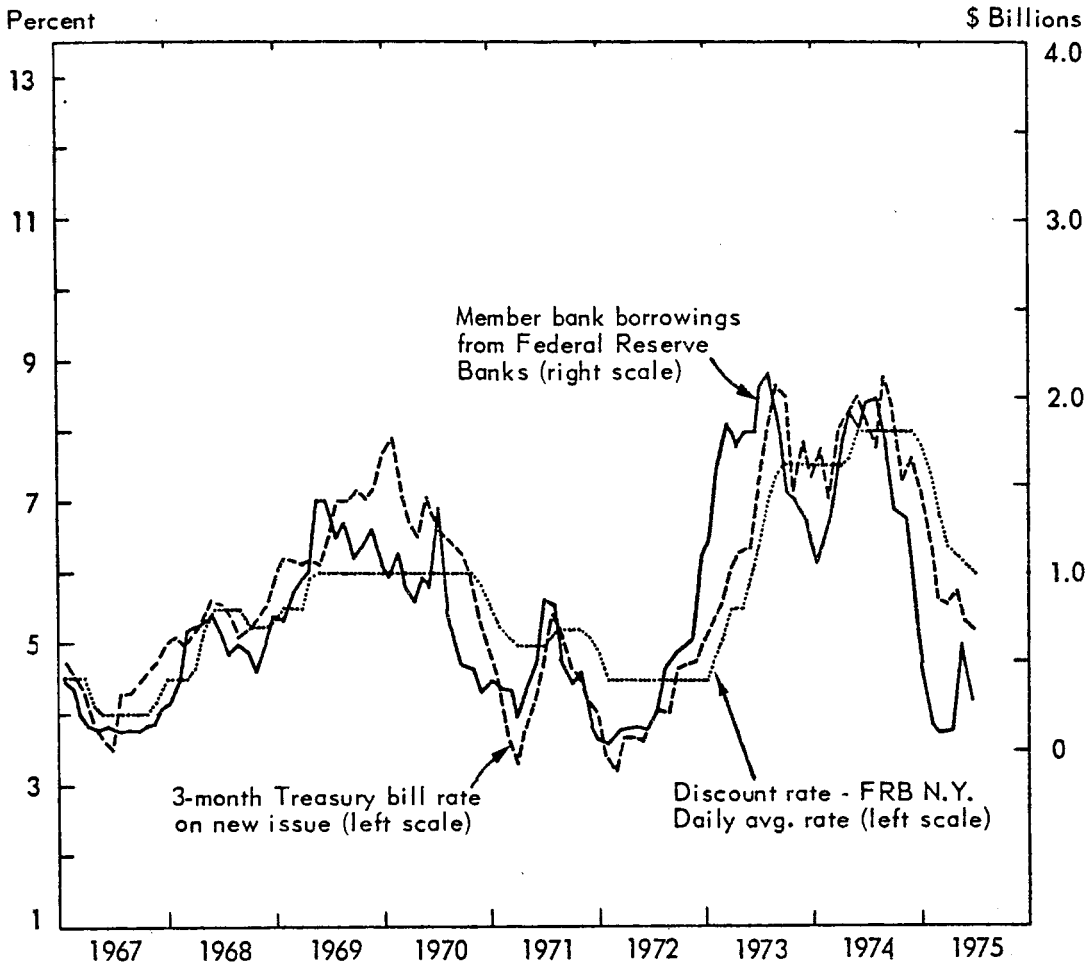
Chart 4. Adjusted aggregate borrowings, the
Discount Rate, and the Treasury bill rate, January 1967,
through June 1975. (This borrowings series removes
the emergency credit extended to the Franklin
National Bank in 1974. The amount by which borrowings
by large New York City banks from May 1974, through
October 1974, exceeded the corresponding 1973 amounts
is subtracted from the aggregate series for a non-
confidential adjustment.)

costs of asset and liability management [14, 15, 20]. This form of profit-seeking behavior is supported by the observation that "... most of the violations of Regulation A occur during periods of tight money" [19, p. 61].

It is unlikely that banks then borrow to support their Treasury security holdings, because their direction of greater utility is toward more loans. Indeed, liquidation of Treasuries is related to borrowing [3, 6, 29]. Conversely, when rates are falling, banks have a profit incentive to speculate on capital gains in Government securities. This form of low risk investment should represent the most profitable use of funds when loan demand falls; borrowings then decline.

The corresponding derived demand for borrowings relationship is contrary to price-quantity relationships in most markets [4, 42, 53]. The aggregate demand for borrowings generally varies directly, not inversely, with the discount rate in Chart 4.

The Supply of Borrowings

The accommodation of member banks when they initially approach the discount window appears to create an elastic supply schedule for borrowed funds at the existing discount rate [39, 56]. The administration of the discount window--whether it is "open" or "shut" to requests for Federal Reserve credit--is not supposed to vary with changes in business or monetary conditions. (For exceptions to this policy, see [29]). Over the longer term, "counseling" of extensively borrowing banks decreases their isoutility loci away from the return axis. This

"surveillance" is essentially endogenous, the result of prolonged individual bank borrowing [46].

The Determinants of Borrowings

Borrowings thus are primarily demand-determined in the short run. The more aggressively a bank seeks profitable loans, the lower will be its effective liquidity, and the more it is likely to utilize the discount window. The higher its outgoing cash flow into loans, relative to its incoming cash flow from deposits, the more it would be expected to borrow. These relationships characterize individual banks and the banking system [2, 3, 7, 9, 10, 14, 16, 20, 29, 32].

"Aggressive-management" fund-using or highly volatile items, such as Federal funds purchased, Government deposits, loans, and time deposits including certificates of deposit should be positively related to borrowings. Less volatile, fund-providing, and internal reserve items, such as cash, correspondent balances held, Federal funds sold, Government securities, other securities, savings deposits, and vault cash should be negatively related to borrowings, reflecting more "conservative" bank management.

This connection between "attitudes," portfolio items, and borrowing is supported by Morgan's somewhat atheoretical cross-section analysis of all member banks [41]. His study shows that the ratio of borrowed reserves to required reserves is positively related to "volatile" accounts, and is negatively related to items that comprise internal reserves or are subject to greater bank control.

Empirical Sources of Borrowing

Borrowing behavior can be shown by one measure that sum-
marizes amounts and frequency of borrowing: the averaged ratio
of borrowed reserves to required reserves. This figure is used
as the dependent variable for empirical analysis.

Twenty-eight independent variables are initially examined.
These variables largely represent the competitive, financial, and
managerial determinants of the demand for borrowings. The supply
of borrowings should be fairly elastic.[5]

The hypotheses to be tested are of the general linear form:

$$B/RR = f \ (x_1, \ x_2, \ \ldots, \ x_n \ ), e$$

where the ratio of borrowed to required reserves depends on n
explanatory variables and the inevitable error term "e". (In most
microbanking studies, "e" tends to be extremely large, on the order
of 80-95% of the observed variation.)

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[5]The possibility that inter-District differences in borrowing
behavior may reflect varying attitudes of discount administrators has
been raised [37]. Such variations would amount to regional monetary
policy. It is more likely that computed inter-District differences
in borrowing indicate differences in bank attitudes toward the discount
window, bank structure, or the demand for bank services. These
microeconomic factors should be more important determinants of bor-
rowing than the nonprice rationing that would occur if some discount
windows were open wider than others [2, 39, 52, 52]. Moreover, all of
Hinderliter's [29] attempts to quantify non-price rationing in time-
series analysis were unsuccessful.

The portfolio characteristics of these banking organizations are portrayed by the variables available from reserve position accounts:

ASSETS	The average asset size of each banking organization;
CASH	Actual reserves plus cash items in process of collection divided by total deposits;
CORR	Correspondent balances held divided by total deposits;
DEMDEP	Demand deposits divided by total deposits;
FFPUR	Federal funds purchased divided by total assets;
FFSOLD	Federal funds sold divided by total assets;
GOVDEP	U.S. Government deposits divided by total deposits;
GOVSEC	U.S. Government securities divided by total assets;
LOANS	Loans and discounts divided by total assets;
OTHERSEC	Other securities (such as "municipal bonds") divided by total assets;
SAVDEP	Savings deposits divided by total deposits;
TIMEDEP	Time deposits (including certificates of deposit) divided by total deposits;
USSEC	U.S. Government securities divided by U.S. Government deposits: a proxy for unpledged Government securities;
VCASH	Vault cash divided by total deposits.

The popular image of large banks as highly aggressive portfolio managers might suggest that they would borrow more than smaller banks. The relationship between size and borrowing is more complex. It involves relative deposit fluctuations, economies of securities transactions and availability of alternative funds, economies of cash management, risk preferences, and other factors [9, 16]. Some of these factors, such as the relatively low cash ratios of larger banks, would tend to stimulate borrowing [10]. Others, such as larger bank access to nondeposit sources of funds with lower transactions costs than smaller banks, should depress borrowing [16, 41]. The assets-borrowing relationship may be negative when other characteristics of banks are taken into account, particularly since desired reserve assets should be less than proportional to deposit size [44].

Variations in the demand for the output of these banking organizations that generate higher returns should stimulate borrowings. To test for the existence of micro-demand effects, the analysis includes binary (zero-one) variables that show the location of each banking organization: DC, MD, NC, SC, and VA. The possibility that multibank holding companies exhibit different borrowing behavior than similar large branching banks is tested by the VA variable.[6]

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[6]They dominate Virginia banking; all firms in the sample from Virginia are multibank holding companies.

Financial demand variations are represented by interest rates and interest rate differentials. They are:

DRATE	Fifth District discount rate, under sections 13 and 13a of Regulation A;
FFRATE	Federal funds rate;
FFLD	Federal funds less discount rates;
TBILL	New issue 3-month Treasury bill rate;
TLD	New issue 3-month Treasury bill less discount rates.

The higher the level of any single interest rate, the higher should be borrowing . Although an increase in the discount rate itself is usually associated with an increase in borrowing , an increase in the discount rate that lessens the FFLD and TLD interest differentials should depress borrowing .

Finally, borrowing activity may follow seasonal patterns [13, 20, 48, 53, 54]. The possible seasonal influences on borrowings are examined by binary variables that represent each quarter: Q1, Q2, Q3, and Q4.

Banks Examined

The sample consists of 23 large Fifth District banking organizations consolidated on a member-bank basis. These banks and bank holding companies are large enough to practice liability management. They hold approximately three-quarters of member bank deposits in each location: the District of Columbia, Maryland, North Carolina,

South Carolina, and Virginia.[7] They operate numerous offices that serve a diverse group of customers.

Restricting the sample to one Federal Reserve District eliminates the possibility of confusing any differences in District-by-District administration of the discount window--nonprice rationing--with the other factors that may determine borrowing activity.

The monthly influences on borrowing are examined over roughly one business cycle (recovery-boom-recession: January 1971 through July 1975). The use of monthly average variables minimizes the impact of random, transient factors that affect bank reserves from day to day. (It partly ameliorates the effect of required reserves being based on two-week lagged deposits.) It does not aggregate over periods far longer than those relevant to bank reserve positions such as quarterly or yearly intervals. Nor does the analysis aggregate individual banks into possibly nonhomogenous groups.

Variable Relationships

The 28 variables that may explain borrowings may not be independent of each other. The behavioral model of a bank's asset and liability management postulates that strong relationships exist

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[7]The smallest of these banking organizations held over one-quarter billion dollars in deposits as of December 31, 1974. West Virginia's small unit banks behave differently from those sampled [23].

among portfolio ratios themselves, as well as with the monetary
climate.

A test for the extent of the common relationships among
the independent variables--multicollinearity--is made by factor
analysis.[8] Factor analysis is a multivariate technique that
reveals the higher-order patterns of common influence present in
any large data set.[9] It reduces the dimensionality of the data
to that of a relatively compact space. Essentially, factor analysis
creates multidimensional correlation coefficients that relate large
numbers of variables to each other. It clusters highly related traits
together; while it separates unrelated traits onto patterns that are
orthogonal to each other--" at right angles" in multiple dimensions.

Factor analysis is thus a "road map" that portrays the
"distance" between variables. It shows the mutually strongest rela-
tionships between interest rates, interest rate differentials, location,
portfolio items, and seasonality. In this way, knowledge of how
mutually independent the explanatory variables are is used to reduce
multicollinearity.

Methodology

The factor analysis (not shown) suggests operational specifications

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[8]Multicollinear variables generate indeterminate estimates of
coefficients (a singular cross-product deviation matrix) in regression
equations, particularly those computed with an intercept.

[9]William Jackson, Commercial Banking Performance and Structure:
A Factor Analysis Approach, Federal Reserve Bank of Richmond, Working
Paper 74-5, 1974.

to test the initial Bank Market Line Model, which disregards interest rates and interstate demand variations, and the extended portfolio models, which utilize demand shifts across space and over time. It indicates that a smaller set of variables encompasses the independent dimensions of possible "causality". They are used as input for regression analysis. These regressions are tested against the null hypothesis that borrowing is essentially a random process, in which all coefficients are zero. This null hypothesis resembles the "need-to-borrow" theory of the 1930's, which postulated that banks borrow only when they feel the pressure of unpredictable "need" caused by random short-term reserve pressures.

Technically, the results of the regressions are presented in the form of standardized coefficients. This method of presentation gives the direct comparison of the importance of each predictor of borrowing: it avoids the serious problem of interpreting their differing units of measurement. The larger the absolute value of each variable's standardized regression coefficient, the larger is its influence on borrowing relative to the other predictors.[10] These

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[10]The computed "b" coefficients of the regression model:

$$Y = b_1 X_1 + b_2 X_2 + \ldots + b_n X_n + e$$

are converted into the standardized (β) coefficients of:

$$\frac{Y}{s_y} = \beta_1 \left(\frac{X_1}{s_1}\right) + \beta_2 \left(\frac{X_2}{s_2}\right) + \ldots + \beta_n \left(\frac{X_n}{s_n}\right) + e'$$

where "s" represents the standard deviation of a variable. For each increase of one standard deviation of an explanatory variable, the standard deviation of Y should increase by that variable's β. The standardized coefficients of absolute dollar, binary, interest rate, and ratio variables can be compared directly. Conventional regression ("b") coefficients cannot be compared directly because of their different units of measurement. Colin Clark et. al., Business and Economic Forecasting: An Econometric Approach (Homewood, Irwin: 1961), pp. 74-75. Robert Ferber and P. J. Verdoorn, Research Methods in Economics and Business (New York: Macmillan, 1962), p. 99. Arthur S. Goldberger, Econometric Theory (New York: Wiley, 1964), p. 54.

coefficients have been used in many economic studies, including [41].

Bank Portfolios, Size, and Borrowing

The test of the initial Bank Market Line model appears in Table 1 (p. 30). Table 1 shows that borrowings are positively associated with Federal funds purchased, Government deposits, and loans. They are negatively associated with Federal funds sold[11], vault cash, cash items,[12] unpledged Government securities, and banking organization size.

That is, a typical borrowing large banking organization tends to purchase other short-term reserve additions: Federal funds. It minimizes its primary reserves and unpledged Government securities, while it seeks out loans. Its liability structure involves relatively volatile deposits, typified by fluctuating Government deposits. It behaves as a risk-accepting, presumably profit-oriented enterprise that seeks high returns.

This equation suggests that large banking organizations do not tend to borrow an increasing proportion of their required reserves as they grow larger, but rather that they borrow a decreasing proportion. This finding may reflect the longer-term ability of very large banking organizations to match the supply and demand for funds better than smaller ones. The largest banking organizations were

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[11]An institutional consideration is relevant: a borrowing bank that sold Federal funds was regarded as violating the spirit of Regulation A during this period.

[12]The factor analysis reveals that vault cash and total cash items load on different factors, reflecting possibly differing bank characteristics.

TABLE 1.

Borrowed Reserves/Required Reserves
Explained by Portfolio Items Only*

Explanatory Variable	Standardized Regression Coefficient	t Statistic	Significance of t
FFPUR	0.2672	7.06	0.0001
FFSOLD	-0.2399	-8.08	0.0001
VCASH	-0.2145	-4.81	0.0001
GOVDEP	0.1703	3.51	0.0008
CASH	-0.1497	-5.65	0.0001
LOANS	0.1349	10.67	0.0001
USSEC	-0.1031	-3.33	0.0013
ASSETS	-0.0968	-2.65	0.0082
R^2		0.3242	
$F_{(8,1211)}$		72.63	

*The intercept has been suppressed to lessen multicollinearity. The
t statistic is computed under a null hypothesis of a zero relationship.
Its significance is the probability that the relationship is zero (unity
minus the confidence level). Stepwise mode estimation is used with the
significance level for variable acceptance or deletion set at 0.05.
This regression as a whole is significant at the 0.0001 level.

generally able to obtain nondeposit funds such as capital notes, commercial paper, common stock, and Eurodollars on more favorable terms than smaller ones during this period. To the extent that these liability and equity items provide funds, these banking organizations would not desire to borrow. Any positive size-borrowings relationship appears to depend on other factors typical of large banks, such as their relatively low cash holdings. (Such a finding would be a clear example of multicollinearity.)

Bank Location, Portfolios, Size, and Borrowing

The test of the second hypothesis: Bank Market Lines vary between states, appears in Table 2 (p. 32). The coefficients of the location variables identify the positive intercept associated with each state, since the conventional intercept has been suppressed. These coefficients show that Virginia, Maryland, and District of Columbia banking organizations borrow somewhat more than similar South Carolina and North Carolina banks. This finding may reflect the high demand for banking services associated with generally high economic activity in these areas.[13] The Virginia coefficient suggests that multibank holding companies tend to borrow slightly

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[13]For example, 1974 per capita incomes were:

DC	$7,479
MD	5,881
VA	5,265
NC	4,612
SC	4,258

The Virginia coefficient appears to be more related to bank holding companies than to economic activity.

TABLE 2.

Borrowed Reserves/Required Reserves
Explained by Portfolio Items and Location*

Explanatory Variable	Standardized Regression Coefficient	t Statistic	Significance of t
VA	0.6542	6.37	0.0001
MD	0.6263	7.02	0.0001
DC	0.6228	9.29	0.0001
SC	0.4484	8.27	0.0001
NC	0.4242	7.02	0.0001
FFPUR	0.2896	8.79	0.0001
FFSOLD	−0.2432	−8.43	0.0001
CASH	−0.2329	−7.95	0.0001
VCASH	−0.1503	−3.34	0.0012
SAVDEP	−0.1388	−2.98	0.0033
USSEC	−0.1232	−4.03	0.0002
GOVDEP	0.1201	2.44	0.0140
LOANS	0.0729	3.75	0.0004
R^2		0.3815	
$F_{(13,1206)}$		57.22	

*See the notes to Table 1.

more than similar large banks, since multibank holding company banks apparently seek out higher risk and returns than non-affiliated banks.[14] These coefficients do not appear to be related either to the concentration ratio or to its change, contrary to expectations.

This regression generally confirms the portfolio composition effects shown in Table 1. This equation, however, does not include asset size, which is related to location. It does include a negative relationship between savings deposits and borrowing. This finding confirms the expected positive deposit volatility-borrowings relationship, since savings deposits are a highly dependable low risk source of funds for a bank. The expected interaction between demand and portfolio allocation lowers the influence of the loan/asset ratio taken by itself.

Interest Rates, Portfolio Items, Seasonality, and Borrowings

The third regression tests the hypothesis that Bank Market Lines vary with the financial climate. In view of the importance of the seasonal borrowing privilege, it allows quarterly variables to enter the equation if they are significant. (It does not include location variables, whose effects should be swamped by the effects of interest-related variables. See Chart 3, p. 15.)

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[14]William Jackson, Multibank Holding Companies and Bank Behavior, Federal Reserve Bank of Richmond, Working Paper 75-1, 1975.

Table 3 (p. 35) indicates that interaction between the financial climate and bank decisions lessens the importance of some portfolio ratios. Its explanatory power is fairly high for a micro-banking regression.

The Federal funds less discount interest rate differential is now the strongest determinant of borrowings. Federal funds sold and purchased continue to be strongly associated with borrowings. The level of interest rates, represented by the Treasury bill rate, is a strong influence on borrowings. (It, FFLD, and USSEC are so correlated with the loan/asset ratio that LOANS could not be used in this regression, according to the factor analysis.) The size coefficient reappears, confirming the tendency for the larger banking organizations per se to appear at the discount window less than their slightly smaller competitors. Finally, unpledged Government securities again appear with a negative coefficient, despite their ability to serve as collateral against borrowed reserves.

No seasonal variables appear in Table 3, although they were considered eligible to enter the equation. Rather, loan demand pressures on reserves during periods of tight money, particularly those felt by aggressive banks that lack secondary reserves suitable for asset management (Federal funds sold, unpledged U.S. securities) describe the demand for borrowings. These banking organizations apparently face no explicit "seasonal need to borrow" that cannot be described in economic rather than temporal terms.

TABLE 3.

Borrowed Reserves/Required Reserves Explained
by Portfolio Items, Interest Rates, and Seasonality*

Explanatory Variable	Standardized Regression Coefficient	t Statistic	Significance of t
FFLD	0.3186	9.20	0.0001
FFSOLD	-0.2735	-10.30	0.0001
FFPUR	0.1874	5.48	0.0001
TBILL	0.1747	6.91	0.0001
ASSETS	-0.0771	-2.46	0.0135
USSEC	-0.0581	-2.26	0.0225
R^2		0.4499	
F(6,1213)		165.33	

*See the notes to Table 1. Time variables are eliminated by the selection algorithm since they are not significant.

Summary and Conclusions

This study develops a model of individual bank risk-return asset and liability management behavior. While this model could be extended to analyze bank reactions to regulation and other forces, it provides the framework to examine the use of the discount window. Three versions of the portfolio model are tested using borrowing by large Fifth District banking organizations as an indicator of risk acceptance.

Borrowing banks follow a risk-accepting, presumably profit-oriented approach to their portfolio management. They accept volatile liabilities, such as Federal funds purchased and Government deposits, and extend longer-term loans. They minimize their low-earning asset management accounts such as Federal funds sold, cash items, vault cash, and unpledged Government securities.

The incidence of this "aggressive" bank behavior increases when a tight money climate raises market rates faster than the lagging discount rate. Individual banking organizations typically borrow when the absolute return from lending rises, particularly when the Federal funds rate exceeds the discount rate. This procyclical behavior stimulates the supply of loans, as well as the supply of money, in a way that dampens the short run response of the financial economy to restrictive Federal Reserve policy. (For further monetary aspects of the discount window, see [32].)

Aggressive banks thus seem to use borrowings and Federal funds purchased as complementary, not as gross substitute, sources of short-

term reserve adjustments. Their relative dependence on these volatile funds apparently depends on the difference in their costs (FFLD). Conservative banks can practice asset management. They do not face large potential deposit withdrawals from volatile accounts. They do not "need" to borrow.

This study does not suggest that larger banking organizations require special surveillance. Total assets are negatively associated with borrowing. Nor does it suggest that special treatment is required for borrowing banks at different times of the year, since no seasonal shifts in borrowing appear when macro and micro-level influences on borrowing are examined simultaneously with time variables. "Seasonal borrowing" may thus represent loan and deposit induced reserve pressures that could be considered appropriate within the spirit of Regulation A without calling them "seasonal."

It does suggest that banks in areas of high economic activity are more likely to borrow than similar banks in less prosperous areas, reflecting demand inducements to assume risk. It also suggests that multibank holding company organizations borrow more than similar unaffiliated banks--one indicator of their general risk acceptance.

These systematic relationships are inconsistent with the "need" theory of borrowing. They are consistent with the profit-risk managerial utility model of a bank.

The availability of discount window funds at an elastic rate thus appears to raise the extension of credit by these banking organizations in the short run, particularly during tight money periods. An open discount window, indeed may be the decisive inducement for banks to remain

members of the Federal Reserve System. The use of this window may be predictable by observing bank portfolio ratios and money market conditions. This study finds that banking organizations' location along Bank Market Lines, as well as interstate and interest-related shifts in these lines, are important determinants of bank borrowing.

APPENDIX: Bank Portfolios and Profitability

The Bank Market Line Model indicates that a strong connection
exists between nominal profitability and the riskiness of assets and
liabilities. This connection can be tested against independent micro-
banking data, since Fifth District reserve accounts do not contain the
necessary information.

The accounting rate of return on bank equity capital is accordingly
expressed as a potential function of eighteen portfolio ratios. This
regression is computed in the same way as those in the text, except that
variables are entered into the equation only until their contribution to
R^2 is less than 0.001. The data are derived from regulatory reports by
1,644 banks in 44 states for the   (then) historically high interest
period of 1969, 1970, and 1971.* This sample includes more than 11 per-
cent of all insured banks.

Bank profitability is highly related to four broad categories of
asset and liability composition. This regression, shown in Appendix
Table I, indicates that loans earn higher returns than investments, even
after loan losses are deducted. It shows that equity capital is a more
expensive source of funds than time and savings deposits, and by impli-
cation, that demand deposits are a still lower cost source of funds.
(Strong multicollinearity, through the balance sheet identity, prevents
more variables from being included in the regression.)

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*The data were provided by the Federal Deposit Insurance Corpora-
tion. They are described in William Jackson, Commercial Bank Regulation,
Structure, and Performance (doctoral dissertation, University of North
Carolina, 1974).

Appendix Table I

Statistical Characteristics of Profitability Equation

Explanatory Variable	Standardized Regression Coefficient	t Statistic	Significance of t
Loans/Total Deposits	0.9868	28.00	0.0001
Investments/ Assets	0.7454	25.59	0.0001
Equity Capital/ Assets	-0.4409	13.87	0.0001
Time and Savings Deposits/Total Deposits	-0.3022	8.31	0.0001
R^2		0.9500	
$F_{(4,1640)}$		7787.29	

On the asset side of the balance sheet, greater loans increase profitability, while on the liability side, longer-term less risky sources of funds decrease profitability. These findings suggest that a strong positive association exists between bank asset or liability risk and accounting rates of return.**

**Ex post realized returns from highly risky loans declined later in the 1970's with a higher level of loan losses. The state of nature—a recession—generated the unfavorable portion of the distribution of returns for many banks.

REFERENCES

1. Aigner, Dennis J., and William R. Bryan, "The Determinants of Member Bank Borrowing: A Critique," _Journal of Finance_ (December, 1968).

2. _____, and _____, "A Model of Short-Run Bank Behavior," _Quarterly Journal of Economics_ (February, 1971).

3. Alperstein, Leslie M., "An Evaluation of Some Determinants of Member Bank Borrowing," in _Reappraisal of the Federal Reserve Discount Mechanism_, vol. 2. Washington: Board of Governors of the Federal Reserve System, 1971.

4. Andersen, Leonall C., and Jules M. Levine, "A Test of Money Market Conditions as a Means of Short-Run Monetary Management," _National Banking Review_ (March, 1967).

5. _____, and Albert E. Burger, "Asset Management and Commercial Bank Portfolio Behavior: Theory and Practice," _Journal of Finance_ (May, 1969).

6. Berman, Peter I., "A Theoretical and Empirical Examination of Large Bank Use of the Discount Facility in the United States." Doctoral dissertation, John Hopkins University, 1967.

7. Betz, George W., "Member Bank Borrowing from the Reserve Bank: A Micro-Analytic Analysis." Doctoral dissertation, University of Wisconsin, 1967.

8. Bryan, William R., and Willard T. Carleton, "Short-Run Adjustments of an Individual Bank," _Econometrica_ (April, 1967).

9. Cacy, J. A., "Determinants of Member Bank Borrowing," Federal Reserve Bank of Kansas City, _Monthly Review_ (February, 1971).

10. _____, "Reserve Adjustments--Some Empirical Findings," Federal Reserve Bank of Kansas City, _Monthly Review_ (June, 1971).

11. Cagan, Philip, "Interest Rates and Bank Reserves -- A Reinterpretation of the Statistical Association," in _Essays on Interest Rates_, vol. 1, eds. Jack M. Guttentag and Philip Cagan. New York: National Bureau of Economic Research, 1969.

12. Carson, Deane, and Scott, Ira O., "Commercial Bank Attributes and Aversion to Risk," _Banking and Monetary Studies_, ed. Deane Carson. Homewood: Irwin, 1963.

13. Crews, Joseph M., and Glenn C. Picou, "Alternative Reserve Concepts as Operating Targets in Monetary Policy Implementation: Specification of the Structural Model," Federal Reserve Bank of Richmond, Working Paper 74-4, 1974.

14. De Leeuw, Frank, "A Model of Financial Behavior," in James S. Duesenberry et. al., The Brookings Quarterly Econometric Model of the United States. Chicago: Rand McNally, 1965.

15. DePamphilis, Donald M., A Microeconomic Econometric Analysis of the Short-Term Commercial Bank Adjustment Process. Boston: Federal Reserve Bank of Boston, 1974.

16. Dewald, William G., and G. Richard Dreese, "Bank Behavior With Respect to Deposit Variability," Journal of Finance (September, 1970).

17. Emery, John T., "Risk, Return, and the Morphology of Commercial Banking," Journal of Financial and Quantative Analysis (March, 1971).

18. Francis, Jack C., and Archer, Stephen H., Portfolio Analysis. Englewood Cliffs: Prentice-Hall, 1971.

19. Frost, Peter A., and Thomas J. Sargent, "Money-Market Rates, the Discount Rate, and Borrowing from the Federal Reserve," Journal of Money, Credit, and Banking (February, 1970).

20. Goldfeld, Stephen M., Commercial Bank Behavior and Economic Activity. Amsterdam: North-Holland, 1966.

21. _____, and Edward J. Kane, "The Determinants of Member Bank Borrowing: An Econometric Model," Journal of Finance (June, 1966).

22. _____, and _____, "The Determinants of Member Bank Borrowing: A Reply," Journal of Finance (December, 1969).

23. Harrison, William B., and Paul A. Meyer, "Banks' Buffer Accounts, Uncertainty, and Institutional Variables," Southern Economic Journal (July, 1975).

24. Hess, Alan C., "The Riskless Rate of Interest and the Market Price of Risk," Quarterly Journal of Economics (August, 1975).

25. Hester, Donald D., "Reflections on the Discount Window," Journal of Money, Credit, and Banking (May, 1970).

26. _____, "An Empirical Analysis of Risk-Taking by Firms in the Savings and Loan Industry," in Karl Borch and Jan Mossin, eds., Risk and Uncertainty. New York: St. Martins, 1969.

27. _____, and James L. Pierce, Bank Management and Portfolio Behavior. New Haven: Yale University Press, 1975.

28. _____, and John F. Zoellner, "The Relation Between Bank Portfolios and Earnings," Review of Economics and Statistics (November, 1966).

29. Hinderliter, Roger H., "Market Access, Uncertainty, and Reserve-Position Adjustments of Large Commercial Banks in the 1960's," Journal of Finance (March, 1974).

30. Hodgman, Donald R., "Member-Bank Borrowing: A Comment," Journal of Finance (March, 1961).

31. Jensen, Michael C., "Capital Markets: Theory and Evidence," Bell Journal (Autumn, 1972).

32. Jones, David M., "A Review of Recent Academic Literature on the Discount Mechanism," in Reappraisal of the Federal Reserve Discount Mechanism, vol. 2. Washington: Board of Governors of the Federal Reserve System, 1971.

33. Kane, Edward J., and Burton G. Malkiel, "Bank Portfolio Allocation, Deposit Variability, and the Availability Doctrine," Quarterly Journal of Economics (February, 1965).

34. Kaufman, George G., "Deposit Variability and Bank Size," Journal of Financial and Quantitative Analysis (December, 1972).

35. Klein, Michael A., "The Economics of Security Divisibility and Financial Intermediation," Journal of Finance (September, 1973).

36. _____, "Imperfect Asset Elasticity and Portfolio Theory," American Economic Review (June, 1970).

37. Lapkin, David T., and Ralph W. Pfouts, "The Administration of the Discount Function," National Banking Review (December, 1965).

38. Luckett, Dudley G., "Credit Standards and Tight Money," Journal of Money, Credit, and Banking (November, 1970).

39. Monhollon, Jimmie R., and James Parthemos, "Administration of the Discount Function: A Comment," National Banking Review (September, 1966).

40. Moore, Basil J., _An Introduction to the Theory of Finance_. New York: Free Press, 1968.

41. Morgan, George E., _A Bank Portfolio Model of Discount Window Borrowings_. Washington: Board of Governors of the Federal Reserve System, 1972.

42. Parthemos, James, "The Discount Window," in _Instruments of the Money Market_, eds. Jimmie R. Monhollon and Glenn Picou, Richmond: Federal Reserve Bank of Richmond, 1974.

43. Phaup, Marvin, "Regression Estimates of Bank Earnings by Portfolio Category," Federal Reserve Bank of Cleveland, unpublished, 1974.

44. Pierce, James L., "Commercial Bank Liquidity," _Federal Reserve Bulletin_ (August, 1966).

45. _____, "The Monetary Mechanism: Some Partial Relationships," _American Economic Review_ (May, 1964).

46. Polakoff, Murray E., "Member-Bank Borrowing: A Rejoinder," _Journal of Finance_ (March, 1961).

47. _____, "Reluctance Elasticity, Least Cost, and Member Bank Borrowing," _Journal of Finance_ (June, 1960).

48. _____, and William L. Silber, "Reluctance and Member-Bank Borrowing: Additional Evidence," _Journal of Finance_ (March, 1967).

49. Pringle, John J., "The Imperfect-Markets Model of Commercial Bank Financial Management," _Journal of Financial and Quantitative Analysis_ (January, 1974).

50. Pyle, David H., "Descriptive Theories of Financial Institutions Under Uncertainty," _Journal of Financial and Quantitative Analysis_ (December, 1972).

51. Russell, William R., "Commercial Bank Portfolio Adjustments," _American Economic Review_ (May, 1964).

52. Shull, Bernard, "The Administration of the Discount Function-- Another View," _National Banking Review_ (March, 1967).

53. _____, "Report on Research Undertaken in Connection with a System Study," _Reappraisal of the Federal Reserve Discount Mechanism_, Vol.1 Washington: Board of Governors of the Federal Reserve System, 1971.

54. Silber, William L., _Portfolio Behavior of Financial Institutions_.
    New York: Holt, 1970.

55. Tobin, James, "Liquidity Preference as Behavior Towards Risk,"
    Review of Economic Studies (February, 1958).

56. Whittlesey, C. R., "Credit Policy at the Discount Window,"
    Quarterly Journal of Economics (May, 1959).