BANK PORTFOLIO ALLOCATION, DEPOSIT VARIABILITY, AND THE AVAILABILITY DOCTRINE

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I. PORTFOLIO THEORY AND THE AVAILABILITY DOCTRINE

Originally more justification than theory, the "availability doctrine" emerged in response to central bankers' instinctive need to vindicate their belief in the effectiveness of monetary policy. Over the nineteen-thirties and early forties, this faith had become a firmly disestablished one. The frustrations of the Great Depression and empirical demonstrations of the alleged interest-inelasticity of aggregate demand had convinced both theorists and practical men alike that monetary policy could be counted upon to play no more than a minor, supporting role in programs of national economic stabilization.

By underscoring lender (especially bank) reactions to credit control, proponents of availability were able to provide a rational basis for renewed trust in the efficacy of monetary policy.¹ Their central argument—that regardless of what borrowers want, if lenders as a whole simply refuse to grant accommodation, the amount of credit in circulation cannot rise—was easily grasped and absolutely undeniable. The rub, of course, lay in trying to establish theoretical conditions under which this sort of response would predominate and in showing that these same conditions characterize the real world.

Recent years have witnessed a series of attempts to clarify the doctrine's underlying behavioral postulates.² While these studies

¹ The authors wish to express their gratitude to William J. Baumol, Nevins D. Baxter, and Lester V. Chandler for helpful criticism of an earlier draft and to the Procter & Gamble Faculty Research Foundation and the American Bankers Association for their support of this project.


² See, for example, Ira O. Scott, "The Availability Doctrine: Theoretical
have uncovered elements of contradiction among various of its
tenets, they have persistently affirmed its essential plausibility.

Concentrating on bank lenders, this paper conducts a similar
examination, but one which produces far less sanguine conclusions.
By modifying a Tobin-Markowitz portfolio model to take account
of the phenomenon of deposit variability, we discover cogent reasons
for rejecting current formulations of the manner in which certain
availability effects operate. On the basis of this analysis we argue
that any tableau of the mechanics of monetary control must return
the interest-elasticity of domestic expenditure to the forestage.

In the pages that follow we focus upon three distinct aspects
of the doctrine as it purports to describe commercial bank behavior:

1. The notion that, as interest rates increase and bond prices
drop, the total value of a bank’s portfolio of government bonds
(many of which are held in a so-called secondary reserve to meet
possible deposit drains) may fall below what is considered adequate.

2. The allegation that, with the decline in market prices of
governments, bankers are reluctant to sell securities and realize book
losses even though a shift from bonds to private loans would appear
to bring the portfolio closer, in terms of considerations of profit and
risk, to an ordinary utility maximum.

3. The argument that credit restraint is not just a matter of
higher interest rates. In determining credit-worthy borrowers,
lenders may choose to apply more stringent standards. Most be-
lievers hold that in times of monetary restraint, actual increases in
loan rates are seldom of an order of magnitude sufficient to clear
the loan market, and that a considerable amount of strict credit
rationing does in fact occur.4

Most attempts to place solid analytic foundations under this
basically eclectic edifice have made use of developments in the
analysis of portfolio allocation.4 In particular, it has been assumed

H. Kareken, “Lenders’ Preferences, Credit Rationing, and the Effectiveness of
292–302, and Donald R. Hodgman, “Credit Risk and Credit Rationing,” this

3. See, for example, H. S. Ellis, “The Rediscovery of Money,” in *Money
Trade and Economic Growth*, op. cit., pp. 233–69. It may be, for instance, that
legal and institutional restraints give rise to considerable inflexibility of con-
tract rates.

4. Important pieces in the development of portfolio theory include: F.
Y. Edgeworth, “The Mathematical Theory of Banking,” *Journal of the Royal
and E. D. Domar, “Proportional Income Taxation and Risk Taking,” this
*Journal*, LVIII (May 1944), 387–422; T. Tobin, “Liquidity Preference as Be-
that commercial bank portfolio managers endeavor to maximize, subject to market and balance-sheet constraints, an objective utility function whose only arguments are indices of profitability $E(\Pi)$ and risk ($\sigma^2(\Pi)$). In more primitive formulations, it is assumed that these managers choose between but two assets, both of equal maturity. In the presentation which follows, these assets are denoted by $L$ (for loans) and $G$ (for Government securities).

The model is described by equations (I.1) to (I.3)

$$\begin{align*}
\max U &= U(E(\Pi), \sigma^2(\Pi)) \quad (I.1) \\
L + G &= D + N \quad (I.1.a) \\
L &\geq 0 \\
G &\geq 0
\end{align*}$$

where $D$ and $N$ stand for deposits and net worth which are assumed known and constant.\footnote{5}

$$E(\Pi) = L \cdot E(r) + G \cdot E(g) \quad (I.2)$$

where $r$ and $g$ represent holding-period rates of return on loans and governments respectively, and (by assumption) the holding period is less than the maturity of the securities.

$$\sigma^2(\Pi) = L^2 \sigma_r^2 + 2LG \rho_{rg} \sigma_r \sigma_g + G^2 \sigma_g^2. \quad (I.3)$$

It is customary to impose the following specific restrictions on the utility surface.

$$\frac{\partial U}{\partial E(\Pi)} > 0, \quad \frac{\partial U}{\partial \sigma^2(\Pi)} < 0.$$ 

Utility is increased by a higher expected profit, decreased by greater risk, and the marginal rate of substitution along an iso-utility locus is positive:

$$\left( \frac{d \sigma^2(\Pi)}{d E(\Pi)} \right)_{\nu=\kappa} = -\frac{\partial U}{\partial E(\Pi)} \frac{\partial U}{\partial \sigma^2(\Pi)} > 0.$$

has developed a bank portfolio management model in which deposit variability has been introduced explicitly. Porter's formulation is not, however, in the risk-aversion tradition of the authors listed above. R. C. Porter, "A Model of Bank Portfolio Selection," Yale Economic Essays, I (Fall 1961), 323–59.

5. Unless bank utility functions are quadratic or profits normally distributed, it is improper to ignore higher moments. For given mean and variance, for example, one would expect bank utility to increase with skewness. Ceteris paribus, higher skewness would imply that outcomes not contained in, say, the two-sigma interval on $E(\Pi)$ would tend to be concentrated in the upper tail of the distribution. In the Tobin–Markowitz–Scott tradition such considerations are excluded from the argument.

6. In this formulation cash and required reserves are assumed away. Their inclusion in the analysis would not materially change the results obtained from the simple model.
Since bankers are characterized as notorious risk-aversers, additional risk must be compensated by larger expected profits to keep utility constant.\(^7\)

With this apparatus we return to the three tenets of the availability doctrine which we previously identified. In effect, the availability doctrine argues that while the holding-period yield on loans is likely to be higher than that for government bonds, risk can always be reduced (in the range of efficient portfolio allocations) by substituting governments for loans. In point 1 it is argued that a central-bank-induced increase in the over-all level of interest rates disturbs the optimal portfolio allocation by reducing (through capital losses) both the size of the portfolio and the proportion of the portfolio allocated to less risky government bonds.\(^8\) To reattain portfolio balance, bankers may then be induced to substitute bonds for loans. Scott has argued that an alternative procedure which will yield the same result is the injection by the central bank of increased uncertainty into the government securities market.\(^9\) Then, even though governments have been made more risky, so long as they remain less risky than loans, the utility-maximizing banker may be forced to include more governments in his portfolio. In Scott's original presentation this follows most dramatically from his assumption that the individual banker will tolerate no more than some maximum risk \(\sigma^2 (II)\). This saturation point is portrayed diagrammatically in Figure I. Increased uncertainty regarding returns from governments is characterized by a shift in the opportunity locus from \(O_1\) to \(O_2\). Given \(\sigma^2 (II)\), the banker is constrained to shift his portfolio composition from \(C\) to \(D\). A similar result can be derived from the usual indifference-curve analysis, as the shift from \(A\) to \(B\) on Figure I reveals.

With regard to the second aspect of the doctrine, the literature distinguishes two varieties of lock-in effects which we term "optimized" and "predelicted." Assuming that interest rates on loans

\(^7\) In what follows, we shall have no occasion to make explicit recourse to second-order maximum conditions. For this reason, we content ourselves with the assumption that these are, in fact, satisfied throughout the range of feasible portfolios.

\(^8\) If we assume that yields on governments are more volatile than those for private securities of the same maturity, then capital losses on governments will be more severe when interest rates increase. Thus the percentage of the portfolio allocated to governments will be reduced. Justification for this assumption will be developed in Section III. Of course, if we assume that the maturity of the governments is longer than for private securities, this result follows with equal yield changes.

\(^9\) Ira O. Scott, op. cit.
are relatively sticky, then after credit policy has been tightened, the 
expected yield on governments including capital gains may develop 
more favorably than that on loans. Since our portfolio model uses 
holding-period yields, this optimized lock-in can be analyzed entirely 
in terms of its parameters. The portfolio manager does not 
switch from governments to loans because to do so would — on 
account of both risk and earnings considerations — move him away 
from his optimal portfolio configuration.

A predilected lock-in occurs when a banker refuses to realize

1. This is the obverse side of the argument developed in footnote 8 in/n. 
An optimized lock-in could also occur if interest rates were expected to fall in 
the future and the maturity of the governments held in the portfolio was 
longer than that of the loans. Given these expectations, the banker may not 
wish to switch to loans, because the expected holding-period yield for govern-
ments (including capital appreciation) may exceed that for the shorter-term 
loans.
capital losses even though a shift to private securities would bring the entire portfolio closer to an optimum. This argument is, of course, completely inconsistent with the maximizing model being employed. While in what follows we will not be able to treat this case specifically, we do discover considerations which, when added to expected-value, variance portfolio analysis, seem to militate strongly against the occurrence of this particular variety of non-maximizing behavior.

Nothing in the portfolio model would lead one to expect credit rationing during periods of strong loan demand and high interest rates. Even if, for one reason or another, bankers should wish to restrict the supply of business loans, it is not clear why they should ration funds on, say, the basis of credit risk. When conditions change, why should a banker deliberately move away from the portfolio optimum selected for given rates? Why should he not instead raise interest rates, thereby establishing a new optimum?\(^2\) Samuelson has criticized the availability doctrine on precisely this point.\(^8\) In his view no banker will long relish the job of saying “no” to valuable customers. To spare himself pain, he will eventually fall back on the price mechanism, i.e., raise interest rates and let the higher price help him do the rationing. Still there exist at least three possible explanations for the employment of more stringent credit standards during the boom period. In the first place, employment of more stringent credit standards for loans at unchanged contract rates stands as a surrogate for higher stated rates as the formulation of (1.4) in footnote (2) just above makes clear. Thus they do effect implicit increases in interest rates. Second, there may be legal ceilings, administrative delays, or institutional restraints which make interest rates sticky. Finally, it has been suggested that credit rationing on the basis of default risk arises because the additional burden imposed upon the borrower by virtue of the increase in interest rates causes the risk of the loan to rise so sharply that the increased contract interest rate cannot compensate the banker.\(^4\) Thus certain borrowers will be excluded from the loan

2. It should be noted that our holding-period yield on business loans is net of both expected default risk \((d)\) and costs of making and administering the loan \((c)\), all figured on a per cent basis. Thus the gross rate earned on business loans \((r')\) is related to the net yield by (1.4) \(r = r' - d - c\).


4. For example, see Ira O. Scott, “The Availability Doctrine: Develop-
market no matter what interest rate they offer. This happens because for any loan size the expected value of the return to the bank, \( E(r) \), is bounded.

Having developed the principal tenets of the doctrine as well as their theoretical foundations, we proceed now to outline our objections to them. We have seen that this theory assumes that whenever a portfolio manager increases his holdings of loans, the over-all risk exposure of his portfolio increases. In fact, Hodgman, using a different definition of risk from ours, argues that the risk of some loans becomes infinite. Implicitly, however, it holds that the act of not granting loans does not itself change the bankers' opportunity set. In opposition to this view, we insist that there exists a class of loan applications, \( L^* \) (\( L \)-Star) loans, where the very failure to grant the loan itself increases aggregate risk. These \( L^* \) loan requests are distinguished primarily by the existence of a continuing relationship between the borrower and the bank. In emphasizing the role of the bank-customer relationship, we follow the lead of Hodgman who first called attention to this important factor.\(^5\) In subsequent sections we shall develop the deposit and loan characteristics of these borrowers which bear most heavily on bank-portfolio management. While we do not deny that risk may also increase if the loan request be granted, this appears only to exacerbate the dilemma of the banker. For even if the risk involved in granting exceeds the risk in turning down the loan request, the case for refusal remains less than clear. This is so because refusal of \( L^* \) requests will also reduce the expected value of both short- and long-run profits. Incorporating these factors into the objective function works toward increasing the \( E(\Pi)/\sigma^2(\Pi) \) ratio of \( L^* \) allocations, providing strong reason for expecting \( L^* \) loan requests to be filled wherever possible.

Thus we conclude that controlling loan expansion during boom periods is a far more formidable task than proponents of availability have suggested. Moreover, we suggest that the desire to fulfill \( L^* \) requests will largely mitigate any predilection for retaining governments whose capital values have fallen below their purchase prices. Finally, we hold that to the extent credit rationing does appear, a criterion alternative to default risk seems more likely to govern the allocation.

II. PORTFOLIO OPTIMIZATION UNDER DEPOSIT VARIABILITY

We have indicated our belief that, because of the existence of continuing relationships, there exists at every bank a class of loan applicants whose very requests for credit disturb a bank’s pre-request portfolio optimum. Whatever its initial allocation, refusing accommodation to these borrowers will both increase a bank’s aggregate risk exposure and reduce its expected profits. This section and the next attempt to provide substance for these assertions. Our argument has three main branches. First, on the basis of an extended model of portfolio allocation, we attempt to establish what many readers would accept intuitively, that ceteris paribus bankers wish to minimize deposit variability both in the aggregate and in individual accounts. Next, we introduce the deposit characteristics of \( L^* \) borrowers and indicate how a bank’s disposition of an \( L^* \) credit request affects the quality of the bank-customer relationship and through this the level of aggregate profits and risk exposure. Finally, in Section III, we take note of the manner in which the cyclical pattern of an applicant’s borrowing experience plays an important role in the determination of his \( L^* \)-ness.

The introduction of deposit variability requires considerable alteration of the model developed in Section I. These modifications concern the nature of the profit and risk functions facing the individual banker and are derived from the extended portfolio model developed in the Appendix. The main result, however, may be summarized very briefly. We find that 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. Moreover, if we allow for costs of asset acquisition and sale, or if we assume that deposit flows and asset yields are inversely related, then deposit variability decreases expected profits as well.

It is in this context that the deposit characteristics of \( L^* \) borrowers (upon which this section focuses exclusively) loom as highly significant. Briefly, a bank’s \( L^* \) applicants are those depositor-borrowers whose custom is afforded an important and favorable role in calculations of its expected profits and aggregate risk exposure. They are customers whose past behavior is characterized by their tendency to maintain stable or improving relation-

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6. Contrarily, while refusal of accommodation to noncustomer applicants may involve an opportunity cost in future profits foregone, the pre-request level of profit and risk remain undisturbed.
ships. To turn down their requests for accommodation is to introduce explicit and calculable risks of customer alienation. Customer loan refusals endanger deposit relationships.

As a consequence, bankers faced with $L^*$ loan requests must proceed most cautiously. The relevant marginal calculation is not whether the additional profit from making the loan (in terms of both the additional interest income and the stronger relationship which granting may establish) justifies the greater risk inherent in a higher loan to governments ratio. A utility-maximizing bank may accede to an $L^*$ request even though, compared with its prerequisite optimum, it entails a definite sacrifice of utility. This follows from the simple fact that not granting the loan also decreases utility. Since refusal endangers the deposit relationship, even nonaccommodation must be expected to decrease expected short-run profits and to increase risk.

By drawing on the analysis in the Appendix, we can make this quite explicit. There, we have incorporated into the risk and profit functions the shift parameter, $R_{j0}$, which measures (as of time zero) the quality of the relationship the banker has been able to establish with the $j^{th}$ customer.\footnote{In his most recent work, Hodgman has extended his analysis of the impact of deposit relationships on commercial bank investment behavior. See his Commercial Bank Loan and Investment Policy (Champaign, Ill.: Bureau of Economic and Business Research, University of Illinois, 1965). In this publication, which came to our attention only after this manuscript had been completed, he reaches (by a very different analytic route) conclusions which, in some respects, are strikingly similar to our own.} We argue that action on a depositor's loan application logically requires the bank to revise its estimate of the quality of the applicant's relationship. We take it as axiomatic that granting customers' loan requests strengthens relationships while denials endanger them.

Since we want $R_{j0}$ to serve as an unambiguous indicator of the quality of bank-depositor relationships, it seems necessary to impose the following conditions:

$$\frac{\partial E_j}{\partial R_{j0}} > 0, \frac{\partial \sigma^2}{\partial R_{j0}} \leq 0,$$  \hspace{1cm} (II.1)

$(j = 1, \ldots, n)$, where, as explained in the Appendix, $n$ is the number of actual depositors and $E_j$ and $\sigma^2$ represent the expected value and variance respectively of the $j^{th}$ account's deposit flows.

With this specification, it follows that a ceteris paribus improvement in any customer relationship leaves the bank definitely "better off".
\begin{equation}
\frac{dU}{dR_{j0}} = \frac{\partial U}{\partial E_j} \cdot \frac{\partial E_j}{\partial R_{j0}} + \frac{\partial U}{\partial \sigma_j^2} \cdot \frac{\partial \sigma_j^2}{\partial R_{j0}} > 0 \quad (I.2) \tag{II.2}
\end{equation}

\( (j = 1, \ldots, n). \)

With the aid of (A.10) to (A.16) in the formal model, we now prove our thesis: Mere receipt of an \( L^* \) loan request disturbs a bank's portfolio optimum. If the application is refused, \( R_{j0} \) declines and, by (II.1) and (II.2), so does the utility of the pre-existing portfolio. Making the loan may also decrease utility, but the case for refusal is not clear-cut. While the improved relationship will tend to increase bank utility, the higher loan-government ratio will (given previous portfolio equilibrium) tend to reduce it.

To complete the argument, we must now establish that the set of \( L^* \) accounts is not an empty one. Since this is ultimately an empirical question, we can here but suggest the plausibility of their existence. The requirement we have stated is that the \( L^* \) deposit be among the bank's most highly valued accounts. We hypothesize that this value can be described by a vector whose elements are indices of the account's current size, future growth prospects, expected pattern of variability, the temporal length of its attachment to the bank, and the apparent cohesion of that attachment.\(^8\) As the extended portfolio model should make abundantly clear, each of the following statements holds \textit{ceteris paribus}:

1. large accounts are preferred to small ones;
2. growing accounts are valued more highly than declining ones;
3. stable deposits are rated over volatile ones;
4. old accounts are preferred to new ones;
5. strongly cohesive accounts are more desirable than footloose ones.

In further explication of points 4 and 5 we offer the following remarks. The confidence with which a banker can forecast the future behavior of an account is in large measure a function of the length of time over which the association has persisted. Proponents of personal probability would argue that, as a banker's experience with an account increases indefinitely, he may be expected to form better and better estimates of the parameters of the stochastic process governing its behavior.\(^9\) Moreover, we would expect that the

8. In Section III we will add important sixth and seventh dimensions to this vector: the expected value of the customer's mean indebtedness over the business cycle and the coefficient of correlation between his loans outstanding and aggregate excess demand for loans at the bank.

regularity with which the customer has been afforded past loan accommodation, especially during periods of credit restraint, would importantly increase the cohesion of deposit relationships. It seems likely, therefore, that the durability of past relationships not only leads to an increased expected value of future deposits, but also reduces the bank's estimate of the scatter of outcomes around the mean (i.e., the variance).

Concerning \( L^* \) accounts, one final point needs to be considered. Why does it happen that \( L^* \)-ness commands its premium in terms of preferential queuing treatment rather than in terms of market price? In a market possessed of facilities for disseminating perfect information, an \( L^* \) borrower would be considered especially welcome by all bankers and treated accordingly. A structure of loan rates would develop favoring applicants expected to maintain sizable, stable, and profitable deposits with whatever banks accommodate them. These customers would be charged a loan rate below the customary one by an amount consonant with the profits expected to derive from their total custom. Under these circumstances bankers would at the margin be indifferent between \( L^* \) loans at reduced rates and ordinary loans at conventional rates.

We suggest, however, that perfect information does not characterize the loan market. What is known to whichever bank an \( L^* \) applicant is now a depositor can be but loosely perceived by competing banks. The deposit characteristics of a new account are determined only with time. Furthermore, as we have already argued, the strength of depositor attachment to a bank varies directly with the length of the time period over which the customer in question has received satisfactory accommodation in the past. As a consequence, a real asymmetry exists between the potential loss as seen by the bank which currently holds the \( L^* \) account and the potential gain as perceived by a second bank which might be able to pirate it. The bank at which an \( L^* \) applicant is currently a depositor normally has more to lose by refusing the \( L^* \) request than any other bank has to gain by (perhaps only temporarily) capturing the account. Where the \( L^* \) depositor's bank risks the loss of a long-standing relationship, another bank sets forth on an association where its potential rewards are less well known and the objective probabilities of its finally capturing these rewards considerably smaller.

While we have concentrated on the short-run effects arising from probable customer alienation caused by loan refusals, we must recognize that these refusals have long-run effects as well. When-
ever the degree of customer attachment to a bank is weakened in any way, the long-run value to the bank of this association is simultaneously reduced. Taking the long run as the interval from the end of the current holding period to the end of the banker's ultimate planning horizon \((U)\) and assuming that over each holding period \(h (h = 1, \ldots , U)\), government securities earn a known rate \(g_h\), we can write the expected value of long-run profits \(E(L.R.\Pi)\) from the \(j^{th}\) deposit account as follows: Letting \(D_{jh}\) represent the average balance in the \(j^{th}\) deposit account during period \(h\), we have

\[
E(L.R.\Pi) = \int_0^U \sum_{h=1}^U \{g_h \cdot D_{jh} f(D_{jh}|R_{jh})\} dD_{jh}
\]

\[
= \sum_{h=1}^U g_h E(D_{jh}|R_{jh}). 
\]  

(II.3)

Notice that we neither discount (II.3) to present value nor compound periodic interest earnings. Assuming that the banker is certain of retaining the \(j^{th}\) deposit account, then, if the \(j^{th}\) account has neither manifested nor promises any deposit trends, (II.3) becomes simply

\[
E(L.R.\Pi) = \sum_{h=1}^U g_h E(D_{jh}) = D_{j0} \sum_{h=1}^U g_h. 
\]  

(II.4)

On the other hand, if \(D_j\) is expected to grow or to decline at a steady rate \(a_j\), (II.3) becomes:

\[
E(L.R.\Pi) = \sum_{h=1}^U g_h (1 + a_j)^h D_{j0}
\]

\[
= D_{j0} \sum_{h=1}^U g_h (1 + a_j)^h. 
\]  

(II.5)

Of course, (II.5) probably understates true profits. In the long run we might, with considerable justification, assume that the earnings rate which actually applies should turn out to be some average of prevailing loan and government yields. Whatever rate we choose, however, it appears that refusal to grant a loan currently requested by the \(j^{th}\) depositor will reduce \(R_{jh}\) for all \(h\) and therefore the expected value of long-run profits derived from this account. Clearly, the seriousness of this expected profit decline will vary directly with \(a_j\), the expected rate of growth of the \(j^{th}\) deposit balance.

1. We ignore both discounting and reinvestment of earnings to conform with the simplifying assumption in the Appendix that net worth remains equal to zero. Those who wish to account for discounting need only reinterpret \(g_h\) as a gross interest rate multiplied by an appropriate discount factor. The point is that earnings rates and discount factors are assumed to be parameters confronting the individual bank. The only variable which the bank can influence is the expected value of deposits at future dates.
Thus we find that refusals of \( L^* \) loan requests promise both to increase the variance of short-run profits and to reduce the expected value of short and long-run profits. We repeat, whichever way the bank disposes of an \( L^* \) request, its previous equilibrium is no longer a feasible one, a consideration which literature on availability seems curiously to have neglected.

III. SOME EXTENSIONS OF THE ARGUMENT

Maintaining assumptions of pure competition and relatively perfect markets, we endeavored in the preceding section to extend the model of portfolio optimization under risk aversion to take account of risks of deposit variability. In this milieu, of course, there was no room for legal and institutional restraints upon the period-to-period movement of interest rates on private loans. In this section we admit interest rate rigidities for the first time. We find that their introduction strengthens the case for distinguishing a class of \( L^* \) loan requests from all others.

It has frequently been observed that, while in securities markets bankers must act as competitors, they are able to behave as oligopolists in the granting of loans. With this in mind, we hypothesize an environment where interest rates on private loans are notoriously sticky. No longer may banks expect rates to adjust from period to period in order to equilibrate loan markets. It seems reasonable to presume, however, that those bankers responsible for leading interest-rate adjustments will endeavor to adopt a pattern of changes which will tend to clear loan markets, in the long run and on the average, without recourse to rationing. Nevertheless, loan demand is quite unstable. Because of various administrative delays and conventional disinclinations to adjust rates frequently, short-run adjustments in loan rates appear likely to follow shifts in demand only after some lag. Prima facie evidence for this presumption can be found in the National Bureau of Economic Research classification of bank rates on short-term business loans as a lagging indicator.\(^2\) On this basis it seems reasonable to argue that, at least as regards intervals between adjustments, conditions of excess demand or supply typically characterize loan markets.

Moreover, such empirical evidence as is available for the United States suggests that, especially at cyclical turning points, what adjustments in loan rates have been effected have been less

than complete. Even if rates are set to hold average excess demand for bank loans to zero over the cycle, it would appear that some excess demand must exist at the peak of the interest rate cycle. Of course, the counterpart of excess demand at the top of the boom is the existence of excess supply at trough interest rates. This would suggest that at these times bankers find themselves unable to go at rates to make as many loans as they would wish.

If this is so, and if by convention banks are unwilling to shade prevailing trough rates, then the opportunity locus, indifference curve analysis portrayed in Figure I must be modified. Because of market saturation, all points on the opportunity locus are no longer available. Since elasticities of asset supply are finite, the bank is unable to attain that segment of the opportunity locus which represents large percentage of loans. The resulting locus may very well be a discontinuous one, yielding portfolio equilibrium at the corner solution \( L = \text{L max} \).

At this point we introduce the second broad characteristic of \( L^* \) applicants. Some \( L^* \) borrowers will be those counted upon to borrow at times other than those of peak credit demands. In times of easy credit availability, it seems natural for them to favor banks and bankers who have accommodated them in the past, especially in periods of tight money. To the extent that this is true, the accommodation of \( L^* \) applications will augment the range of the opportunity locus actually attainable during periods of slack loan demand. Since these additional loans will become available at precisely the times when the spread between loan and government

3. We have compared series of monthly averages of short-term market yields with short-term business loan rates over the past ten years. We find that open-market yields not only vary over a much wider range than do rates for business loans but the coefficient of variation for open-market yields is considerably greater. Even if we try to adjust business loan rates for the simultaneous imposition of more restrictive nonprice terms (e.g., compensating-balance requirements) during periods of monetary restraint, the same broad results follow. One set of calculations appears below.

<table>
<thead>
<tr>
<th>30 Day Bill Rates</th>
<th>Business Loan Rates</th>
<th>Business Loan Rates Adjusted for Variability in Nonprice Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>( g )</td>
<td>( r )</td>
<td></td>
</tr>
<tr>
<td>Coefficient of Variation</td>
<td>36.5%</td>
<td>12.2%</td>
</tr>
<tr>
<td>Range</td>
<td>3.85%</td>
<td>1.82%</td>
</tr>
</tbody>
</table>

4. In the United States of the last ten years, the incremental relationship between loans \( (L) \) and earning assets \( (E = \text{loans plus investments}) \) of commercial banks appears to have varied inversely with the spread prevailing between \( r \) and \( g \). Fitting the linear multiple regression equation, \( \Delta L = a + b_1 \Delta E + b_2 (r - g) \), to quarterly data yielded the following results: \( b_2 = 0.994 \), \( b_2 = -1.119 .9 \), and \( R = 0.994 \). Of course, such results are suggestive only. While statistically significant by mechanical tests, they are presented simply as descriptions of experience over this decade, not as parametric estimates.
the widest, providing this financing will tend to increase the long-run profits.

Reduction of market imperfections reinforces the long-run argument of Section II, most importantly because there exists side to arguments based on interest-rate rigidities, one seems not yet to have found its way into the literature.

In times of easy money banks may have to content themselves with loans that they would prefer to hold at going rates. This knowledge may be expected to influence their allocations at the time, too. To the extent that loan opportunities in recession are to be a function of bank loan policy in previous booms, there are led to extend more loans during times of credit restraint where otherwise regard as optimal.

Of course, a prospective borrower's degree of L^*-ness is not just a function of his deposit characteristics. To these considerations must be added some measure of the average net benefit which accrues to him from his pattern of borrowing. We propose to represent this index as the customer's expected mean index over typical cycles of loan demand and the coefficient of variation between his outstanding loans and aggregate excess demand for loans at the bank.

Of this provides one more reason for asserting that (II.5) states the expected long-run value of maintaining an L^*-borrower-relationship. We should also recognize that, vis-a-vis non-borrowers, L^*-borrowers offer a distinct cost advantage. That association with a borrower-depositor has been firmly established, marginal costs of bank investigation of any new loan are minimal. The existence of a continuing relationship with only is the spread between current yields widest, but this result requires for the holding-period yields which we employ in the formal government yields are not only low relative to loan rates but as interest rates increase, government rates will increase less. Thus, given that the maturity of the two issues is equal, will be greater. In this connection, we should note that the risk spread between governments (where there is only market risk) and private issues (where both market and credit risk) will be at a minimum since capital-loss possibilities are most unfavorable for governments. Of course, it must be noted that this factor works against our argument during the latter portfolio boom. Here government rates are relative to loan rates. At the be boom the rate spread tends to favor investment in governments, mutatis mutandis, by the argument above, capital-gains possibilities favorable for governments. It is in this sense that we suggested that the effect could be considered rational (pp. 115-18). A useful framework for these effects on holding-period yields is provided by the so-called "normal" range of interest rates, and the mathematics of it as developed in B. G. Malkiel, "Expectations, Bond Prices, and Structure of Interest Rates," this Journal, LXXVI (May 1962),
presupposes that the banker regularly receives and analyzes periodic financial statements of the company. Finally, to the extent that new loans are drawn down and lost in clearing to other banks only after some delay, loan funds are temporarily available for investment in treasury bills. Again, superposition of supposed imperfections inherent in markets for bank loans only tends to reinforce the conclusions derived from the more austere model of the preceding section.

On the basis of this analysis we now turn to the question of what implications these several market imperfections have for the credit rationing hypothesis promulgated by the availability doctrine. We have suggested that both during intervals between loan rate adjustments and around cyclical turning points, loan markets will exhibit some amount of excess demand or supply. When faced with excess loan demand, the banking system must find some method for allocating credit among its too numerous applicants. To unsatisfied borrowers, this process may well appear as rationing. Several authors have argued that this “rationing” will turn on the criterion of credit or default risk. We challenge this contention on two grounds. First, because, as we have seen, default risk is but one dimension of a bank’s aggregate risk exposure. The risk of customer alienation from not granting the loan may turn out to be of far greater concern to the banker. Second, because to us considerations of long-run profits (at least some of which we have developed above), dimly perceived though they may be, appear more likely to govern actual allocation.

IV. Conclusions

In this section we summarize our findings and draw such conclusions concerning bank portfolio management and the effectiveness of monetary policy as seem appropriate. We have made two additions to the traditional bank portfolio model: deposit variability and considerations of long-run profits. We argued that one

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6. Consider, for example, the following statement by Chairman Martin of the Board of Governors of the Federal Reserve System in Monetary Policy and the Management of the Public Debt, Replies, Joint Committee on the Economic Report, 82d Congress, 3d Session, Doc. No. 123, Part I (Washington, 1952), p. 370: “Credit tightness will be reflected partly in increased rates of interest. Perhaps its principal effect on lending, however, is through more rigorous standards used by lenders for judging the basic credit worthiness of borrowers and for determining the size of credit lines which may be extended.” Theoretical arguments for this position may be found in Scott, “The Availability Doctrine: Development and Implications,” loc. cit., and Hodgman, op. cit.
class of loan requests (L* borrowers) would cause especial discomfort to any banker who had already achieved a portfolio optimum. Granting such a loan might (because of the assumption that an optimum had previously been achieved) leave the banker with an uncomfortably high risk/profit ratio; nevertheless, refusal will both increase risk and decrease expected (long-run) profit. This is the dilemma of the banker. His optimum portfolio position is disturbed in either case. Without making rather specific assumptions about the parameters of his utility function we cannot tell what choice he will actually make. Still, we must recognize the possibility that, vis-à-vis refusal, granting such loans (by increasing the strength of the relationship) may actually increase expected profit while reducing over-all risk. In these instances it must turn out that the risk of customer alienation from not granting the request actually exceeds the added risk assumed by granting the loan.

No matter what decision is finally rendered, as regards the availability model, the direction of change suggested by our analysis is clear. In booms, banks will make more loans than traditional analysis would indicate. In this way, our modifications give aid and comfort to those who question the strength of the lock-in effect. Commercial bankers seem doubly unlikely to turn down L* applications because of any mere reluctance to realize capital losses. Finally, our work suggests that to the extent credit rationing exists, it will not usually be effective solely on the basis of default risk. Instead one would expect the basis for rationing to be the degree of L*-ness: the strength of existing customer relationships; the size, stability, and prospects for future growth of deposits; and the existence of profitable future lending opportunities. As a rule of thumb, we suggest that bankers may well adopt a lexicographic decision rule: L* loan requests are always to be honored before ordinary loan requests may even be considered. Whenever more L* requests have been received than can be accommodated, they are to be rationed in accordance with the cohesion of the relationship and its expected future profitability.

As a result of these considerations, controlling bank loan expansion in boom periods takes on a far more formidable aspect than proponents of the availability doctrine seem to assume. In sharp contrast to the architects of availability, we find that on the basis of lender reactions, there exist solid reasons for expecting banks to stretch accustomed liquidity limits a long way in order to accommodate certain customers.\(^7\) Increases in L* loan demand cannot be

\(^7\) Examination of the empirical evidence in the United States seems to
represented by movements along a static supply curve because such increases in loan demand elicit concomitant shifts in aggregate loan supply. Finally, when we admit the phenomena of interest rate rigidities and credit rationing by banks, we conclude that this rationing will be both smaller in magnitude and markedly different in character than the availability literature would lead us to believe.

APPENDIX

DEPOSIT VARIABILITY AND PORTFOLIO ALLOCATION

The portfolio allocation model set forth in Section I assumes away the phenomenon of deposit variability. As equation (I.1.a) makes clear, this model allocates optimally a nonvariable amount of investible funds. To remedy matters, we rewrite (I.1.a) as follows:

\[ G_0 + L_0 = D_0 + N. \]  
(A.1)

For convenience, we append the assumption that \( N = 0 \), reducing (I.1) to

\[ G_0 + L_0 = D_0. \]  
(A.1.a)

Throughout the analysis we continue to assume that the maturities of \( G \) and \( L \) are not only equal but extend beyond the bank's short-run planning horizon \( H \), that loans are nonmarketable, and that borrowing from the central bank is not permitted. Given these conditions, it appears reasonable to assume that deposit drains during the holding period \((0,H)\) are met by sales from bank holdings of governments. Although somewhat less reasonable, for symmetry we assume further that all deposit inflows during \((0,H)\) are used to augment these holdings, never to increase loans. If we assume that no new loans are made during the holding period, then the government portfolio at the end of the holding period will equal

\[ G_H = D_0 + (D_H - D_0) - L_0 = D_0 + \dot{D}_{(0,H)} - L_0. \]  
(A.2)

So long as interest rates do not vary we can obtain portfolio profits, \( \Pi \) (which, in order to keep net worth equal to zero, must be distributed to stockholders at \( H \)), indicate that during the decade of the 1960's bankers exhibited a growing distrust of reliance upon ad hoc market liquidity ratios purporting to show the limits of loan capacity. During the period of maximum monetary restraint in the months of late 1969 and early 1970, unpublished but reliable data show that New York banks had nearly exhausted the unpledged securities held in the so-called secondary reserve. Thus we suspect that throughout the very period when availability effects were widely heralded as the savior of monetary policy, they were of relatively little importance. By portfolio adjustments in directions opposite to those suggested by the availability doctrine, banks were able significantly to mitigate the restrictive effects of monetary policy.

To enable a definitive test of this hypothesis, we should like to see sudden random collection of future call-report data. So long as published figures remain subject to deliberate window dressing, even the most sophisticated statistical analysis may uncover and perpetuate no more than carefully constructed myths and images.
\[ \Pi = g_0 (D_0 - L_0) + \Pi [\dot{D}_{(0,H)}] + (r_o' - d - c) L_0, \]  
(A.3)

where \( \Pi [\dot{D}_{(0,H)}] \) represents net earnings (positive or negative) brought about by the exact pattern of deposit change. Next we define \( \gamma \) as the logarithmic equivalent (with continuous compounding) of \( g_0; \gamma_0 = e^{r_H} - 1 \). By making the following additional assumptions, we are able to derive and manipulate an explicit expression for \( \Pi [\dot{D}_{(0,H)}] \) in a particularly easy way:

(a) \( c = 0 \), there are no costs of making and administering loans.
(b) \( \gamma_t \) and \( r_t' \) are not random, \( \gamma_t = \gamma_0 = \gamma; r_t' = r_0' \) for \( 0 \leq t \leq H \).
(c) \( \dot{D}_t \) and \( d \) (holding-period default experience expressed as a percentage of total loans) are random variables:

(i) \( \dot{D}_t = D_t - D_{t-1} \),
\[ E(\dot{D}_t) = 0 \quad \text{and} \quad E(\dot{D}_t^2) = \sigma^2 < \infty; \]
(ii) \( E(d) = \bar{d}, \quad E(d - \bar{d})^2 = \sigma_d^2 < \infty. \)
(d) \( H = 1 \).

Under these conditions,
\[ \Pi [\dot{D}_{(0,H)}] = \frac{1}{\sigma_0^2} \int_0^1 \dot{D}_t \left[ e^{\gamma(t-n)} - 1 \right] dt = \gamma \int_0^1 \dot{D}_t e^{-\gamma t} dt \]
\[ - \frac{1}{\sigma_0^2} \int_0^1 \dot{D}_t dt. \]  
(A.3.a)

We can readily supply this equation with a commonsense interpretation. The term \( \int_0^1 \dot{D}_t e^{-\gamma t} dt \) measures the present value as of time zero of the deposit flow occurring during the period \((0,1)\). To record the net accumulation of deposit inflows and earnings thereon over the same period, this term must be multiplied by \( e^{r_H} \). Finally, subtracting off \( \int_0^1 \dot{D}_t dt \) [the observed change in deposits over \((0,1)\)], yields interest earnings net of new deposit liabilities.

Equation (A.3) may now be specialised to read:
\[ \Pi = g_0 D_0 + [(r_o' - d - g_0) L_0 + \gamma \int_0^1 e^{-\gamma t} \dot{D}_t dt - \int_0^1 \dot{D}_t dt. \]  
(A.3.b)

Taking the expected value of this expression, we obtain
\[ E(\Pi) = g_0 D_0 + [(r_o' - E(d)) - g_0] L_0 \]
\[ + \gamma \int_0^1 e^{-\gamma t} E(\dot{D}_t) dt - \int_0^1 E(\dot{D}_t) dt. \]  
(A.4)

Since \( E(\dot{D}_t) = 0 \), this becomes
\[ E(\Pi) = g_0 D_0 + [(r_o' - \bar{d}) - g_0] L_0. \]  
(A.5)

Just as (A.2.a), (A.5) has immediate physical significance. \( g_0 D_0 \) may be interpreted as the expected value of a portfolio con-
sisting entirely of governments. If \( \{r' - d\} - g_0 > 0 \) (which we may deem the ordinary case), it also represents the greatest lower bound of the bank’s expected-profit opportunity set. If the spread is \( \leq 0 \), it represents the least upper bound of the same set. In the first case, any shift of bank funds into loans brings about an expected earnings increase; in the latter, any such shift would decrease expected profits. While portfolio shifts also affect the variance of bank profits, since our assumptions leave governments utterly riskless, it should be intuitively clear that, unless the net interest spread be positive, the efficient \( E(\Pi), \sigma^2(\Pi) \) opportunity set may well consist of the single point \( \{G_0 = D_0, L_0 = 0\} \).

From (A.3) and (A.5), we have that the variance of profits,
\[
\sigma^2(\Pi) = E[(\Pi - E(\Pi))^2] = \sigma^2 L_0^2 - 2L_0 \int_0^1 E(\hat{d} \cdot \hat{D}) e^{-\gamma t} dt - \int_0^1 E(\hat{d} \cdot \hat{D}) dt^2.
\]
Assuming \( E(\hat{d} \cdot \hat{D}) = E(\hat{d} \cdot \hat{D}) \) for all \( t \geq 0 \), (A.6) becomes:
\[
\sigma^2(\Pi) = \sigma^2 L_0^2 - 2\omega_0 L_0 \sigma_d \sigma_D^2 + \omega_1 \sigma_D^2.
\]
(A.7)

where \( \omega_0 = -\gamma^{-1}(-e^{-\gamma} - 1) + \frac{1}{e^{\gamma} - 1} \geq 0 \), since \( e^{\gamma} > 1 + \gamma \).

It will be useful to compare (A.7) with (I.3). The first terms are very much the same, the single difference being that in (A.7) we have allowed variability in \( \hat{r} \) to arise from default experience only. Since we have assumed away market risk on governments, in (A.7) the second and third terms of (I.3) have disappeared. In their place are terms representing those elements of risk associated with deposit variability. Since \( \sigma_D^2 = 0 \) seems the natural assumption (conditions which leave consumers and firms unable to repay their loans would probably be those when deposit outflows are most expected), each of these terms appears to add to the variance of profits.

Differentiating (A.7) partially establishes that profit variance (aggregate risk exposure) is increased by \( \text{ceteris paribus} \) increases in both the variability of defaults and the volatility of deposits:
\[
\frac{\partial \sigma^2(\Pi)}{\partial \sigma_d} = 2L_0^2 \sigma_d + 2L_0 \omega_0 \rho_{dD} | \sigma_D | \sigma_D > 0,
\]
(A.8)
and
\[
\frac{\partial \sigma^2(\Pi)}{\partial \sigma_D} = 2\omega_0 \sigma_d^2 + 2L_0 \omega_0 | \rho_{dD} | \sigma_D > 0.
\]
(A.9)

1. We would expect that the absolute magnitude of this negative \( \rho_{dD} \) will vary directly with the extent to which a bank lends to its own depositors. Customer firms unable to repay their loans would presumably also run down their deposit balances.

2. While we do not provide formal proof, our conclusions concerning the influence of deposit variability on aggregate risk exposure appear to hold a fortiori when various simplifying assumptions are removed. In particular,
We now disaggregate the profit and risk functions (A.5) and (A.7). At any moment $t$, we distinguish $n$ actual and $m$ potential depositors. Letting $D_{jt}$ represent the deposit balance in the $j^{th}$ account at time $t$, we have

$$D_0 = \sum_{j=1}^{n+m} D_{jt}, \quad (A.10)$$

$$E(\hat{D}_t) = \sum_{j=1}^{n+m} E(\hat{D}_{jt}). \quad (A.11)$$

We hold that the probability distribution $[f_{jt}(\hat{D}_{jt})]$ of each $D_{jt}$ not only depends upon the characteristics of the $j^{th}$ depositor's deposit activity, but also varies directly with the bank's estimate (as of time 0) of the quality of the relationship ($R_{jt}$). It has been established that this customer. To emphasize this, we write the expected value of $j^{th}$ account deposit flows as follows:

$$E(\hat{D}_{jt}) = \int_{-\hat{D}_{jt}}^{\hat{D}_{jt}} f_{jt}(\hat{D}_{jt}; R_{jt}) \, d\hat{D}_{jt}$$

$$= E(\hat{D}_{jt} | R_{jt}), \quad (0 \leq t \leq 1). \quad (A.12)$$

By assuming stationarity for the duration of the holding period in the first two moments of each such distribution, we can dispense with the time subscript:

$$E(\hat{D}_{jt} | R_{jt}) = E(\hat{D}_t | R_{jt}) = E_{jt}, \quad j = 1, \ldots, n + m; \quad 0 \leq t \leq 1. \quad (A.13)$$

On this same assumption, the variance of these flows becomes

Equation (A.9) continues to hold when we introduce the phenomenon of switching costs and allow for variation in market yields on government securities. In fact, under these circumstances, increases in the volatility of deposits worsen not only the variance of short-run (or holding-period) profits, but even their expected value. It is intuitively clear that, to the extent switches into and out of governments are not costless, total switching cost increases pari passu with deposit volatility. When government yields are also allowed to vary expected profits fall even more, since it seems necessary to assume that deposit outflows are inversely correlated with interest rate movements. By the theory of liquidity preference, deposit outflows are likely to occur when interest rates move above $\rho$ and inflows when rates fall below $\rho$.

Of course, once deposit variability is introduced, it becomes possible for banks to fail. In a model which allows no borrowing we must insist that each banker hold enough governments to meet the maximum drain which could occur. Thus we should include a liquidity constraint to insure:

$$G_0 e^{\gamma t} + \int_0^z \hat{D}_t e^{\gamma(z-t)} \, dt \leq -\int_0^z \hat{D}_t \, dt \text{ for all } z, 0 \leq z \leq 1.$$

Perhaps the simplest device would be to require banks to hold governments greater than or equal to a specified number of standard deviations of deposit change: $G_0 \equiv k \sigma^D$, then to relax the prohibition on bank borrowing from the central bank so as to enable them to meet bona fide deposit drains in excess of that amount. Whether such borrowing be at $\gamma_1$ or at a penalty rate, so long as proof of good faith is required, a bank's interest in minimizing deposit volatility seems in no way diminished.
\( \sigma_D^2 = E(\hat{\sigma}^2_{R_p}) - (E\hat{\sigma})^2 = \sigma^2 \)  \hspace{1cm} (A.14)

\( (j = 1, \ldots, n + m; \quad 0 \leq t \leq 1). \)

As a matter of definition, (A.14) is related to aggregate deposit variance by

\[ \sigma^2_D = \sum_{j=1}^{n+m} \sum_{j=1}^{n+m} \rho_{ij} \sigma_i \sigma_j. \]  \hspace{1cm} (A.15)

Differentiating this expression with respect to \( \sigma_j \), we obtain

\[ \frac{\partial \sigma^2_D}{\partial \sigma_j} = 2 \sigma_j + 2 \sum_{i=j}^{n+m} \rho_{ij} \sigma_i \]  \hspace{1cm} (A.16)

\( (j = 1, \ldots, n + m). \)

We take it that (A.16) will be positive in sign; a ceteris paribus increase in the volatility of any one deposit account increases total deposit variance.³

In Section II of the text, we employ these results to establish a case for a bank's weighing the effects of alternative allocational decisions upon its various \( R_p \). In particular, we argue that refusal of a customer loan request impairs his relationship. This, in turn, alters unfavorably the arguments of the bank's utility function. As a consequence of these considerations, banks will necessarily grant more loans in times of monetary restraint than a fixed-deposits model would suggest.

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3. Although individual \( \rho_{ij} \) may well be negative in value (e.g., balances in payroll accounts will correlate inversely with employee balances), \( \sum_{i \neq j} \rho_{ij} > 0 \), or if negative \( > - \sigma_j \), seems the natural assumption. In most cases, we may expect effects of negative \( \rho_{ij} \) to be overcome by the weight of positive ones.