THE IMPACT OF DEPOSIT VARIABILITY

ON AVERAGE LABOR COST IN

COMMERCIAL BANKING

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PREFACE

The banking literature of recent years contains a plethora of studies on bank cost. These studies establish that unit costs in commercial banking are significantly influenced by bank size.

The purpose of this study is to ascertain whether other variables significantly influence unit costs in commercial banking. Specifically, the study is concerned with the impact of deposit variability on average labor cost in commercial banking. The general conclusion reached is that average labor cost in commercial banking is significantly influenced by deposit variability.

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CHAPTER I

INTRODUCTION

Statement of the Problem

In the banking literature of recent years one area of research receiving a great deal of attention is the question of whether economies of scale exist in commercial banking. Over the past decade more than a dozen empirical studies have been undertaken in order to test for economies of scale in commercial banking.[1] These studies use different samples of banks drawn from different geographical areas of the country as well as different measures for bank output and different econometric techniques, and yet in each study the same conclusion is reached, namely that a larger scale of banking enterprise is conducive to lower per unit operating costs. Moreover, in explaining the source of observed economies of scale in commercial banking, most of the authors conclude that such economies are due primarily to reduced labor cost per unit of output, which in turn is explained by the greater specialization and division of labor permitted by a larger scale of enterprise.

For example, David Alhadeff in describing the operations of commercial banks states:

> By virtue of the volume of business done in the different aspects of banking, large banks can afford to hire expert

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[1]A survey of the literature pertaining to economies of scale in commercial banking is presented in Chapter III.

> talent and to give its personnel in various fields an opportunity to specialize in their limited areas. Specialization breeds expertise, and expertise enhances efficiency. In the banking functions of business lending and security investment, the bankers in large institutions are probably more knowledgeable in their respective fields than their small bank counterparts. In short, specialization in large banks is conducive to greater efficiency of labor, and _cet. paribus_, to lower unit costs for reasons analogous to those long ago identified by Adam Smith in his _Wealth of Nations_.[2]

In addition, Lyle Gramley points out that:

> Specialized personnel with the experience and knowledge necessary to perform such tasks with optimum efficiency in many cases cannot be employed economically at small banks. Their specific skill cannot be used to advantage unless it is employed at full capacity, and below some scale of operations in banking this is clearly impossible.[3]

All of which to say that it has been reasonably well established that one avenue open to the commercial bank manager who is seeking ways to reduce his average labor cost is to expand his scale of enterprise. Consequently, one can reasonably move on to the question of whether there are other avenues open to a commercial bank manager by which he can reduce his average labor cost in addition to the avenue of expanding his scale of enterprise.

The present study examines one possible route by which a commercial bank manager might reduce his unit labor cost, namely through a reduction in the amount of deposit level variability to which the bank is subject from one reporting period to the next. Specifically, the hypothesis with which this dissertation is concerned is that increased variation in the level of deposits of a commercial bank results in

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[2]David A. Alhadeff, _Monopoly and Competition in Banking_, (Berkeley, 1954), p. 86.

[3]Lyle Gramley, _A Study of Scale Economies in Banking_, Federal Reserve Bank of Kansas City Publication, (Kansas City, 1965), pp. 25-26.

higher average labor cost, providing bank size is held constant. Once again, existing studies on bank costs clearly indicate that average labor cost is a function of bank size, consequently holding bank size constant enables one to distinguish the impact of observed differences in deposit variability on average labor cost from the impact of changes in bank size.

An example may help clarify the point. Assume that in a given year two banks operate with the same average dollar value of assets, but that one bank experiences more variation in the level of its deposits. The present hypothesis is that the bank with the greater deposit variability also experiences higher average labor cost for the year. To express it differently, then, the present hypothesis is that increased deposit variability causes the average labor cost curve of a commercial bank to shift upward.

If the present hypothesis is accepted, then one of the possible conclusions of earlier studies on bank costs needs to be modified. That is, since existing empirical studies have ascertained that economies of scale are characteristic of commercial banking, one could infer on the basis of these findings that the profit oriented bank manager should always seek to expand his scale of operations through attracting new deposits, presumably without regard to the stability of the newly acquired deposits. If the present hypothesis is not rejected, one would have to modify the conclusion that increased bank size *per se* is desirable. The present hypothesis adds a new dimension to the problem of bank expansion, namely the necessity to take into account the variability of the new deposits which are obtained. Hence, the profit oriented bank manager should not be concerned exclusively with attracting new deposits, but rather with attracting new deposits which are as stable as possible. In other words, if newly acquired deposits are highly unstable and thereby raise the overall level of deposit variability for the bank, the economies of a larger scale operation are partially or wholly offset.

Relationship to Earlier Studies

In hypothesizing that average labor cost is a function of deposit variability, the present study represents a marked departure from existing discussion found on deposit variability. Although a large number of studies on deposit variability are found in the literature, virtually all of the existing studies are concerned with determining whether deposit variability is a function of bank size. In fact, there is only one existing study on deposit variability in which it is explicitly noted that unit costs in commercial banking may be a function of deposit variability:

> In summary, the major conclusion of this study is that as the size of banks increased, variability in the level of deposits decreased. This suggests that one of the economies of large scale banking operations lies in reduced deposit variability.[4]

However, Rangarajan neither analyzes nor tests this conjecture. Consequently, the present study explores an aspect of the impact of deposit variability on the individual commercial bank which is not examined in the existing literature.

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[4]C. Rangarajan, "Deposit Variability in Individual Banks," National Banking Review, IV (1966), p. 71.

Before testing the hypothesis, it is necessary to construct a model so as to clarify the nature of the relationship between average labor cost and deposit variability. This is presented in Chapter II. In addition, the assumptions on which the model rests are discussed.

Chapters III and IV investigate the literature on economies of scale in commercial banking and deposit variability. The purpose in perusing the literature on economies of scale is to establish that average labor cost is a function of bank size and that it is therefore necessary to hold bank size constant if one is to clearly estimate the impact of deposit variability on average labor cost. The survey of the literature on deposit variability is not critical to the present hypothesis; however it is presented in order to establish that deposit variability is an area of current research interest.

In Chapter V, the hypothesis is tested. Data collected for the present study are discussed and examined in terms of their relationship to existing studies on economies of scale and deposit variability. In Chapter VI a summary of the findings is presented, along with a discussion of the implications of these findings.

CHAPTER II

A MODEL OF DEPOSIT VARIABILITY AND AVERAGE LABOR COST IN COMMERCIAL BANKING

The Model

In order to clarify the nature of the relationship between deposit variability and average labor cost it is necessary to construct a model. Basically the model consists of reducing average labor cost to a function of deposit variability and bank size.

In order to facilitate the development of the model, an initial change in deposit level resulting from a bank's clearing house operations or its cash flows is treated as an independent event. That is, until all the implications of a given change in deposit level have been fully worked out it is assumed that there are no further changes in deposit levels except for those changes which are directly attributable to the initial change in deposits.

In addition, it is assumed that bank managers pursue a policy of trying to stay fully "loaned up".[1] Given this assumption, when a bank manager is in equilibrium with reference to his portfolio, he has zero excess reserves. Consequently, starting from such an equilibrium

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[1]With regard to this assumption Orr and Mellon state, "The individual bank in practice probably stays nearly 'loaned up'." Daniel Orr and W. B. Mellon, "Stochastic Reserve Losses and Expansion of Bank Credit," The American Economic Review, (September, 1961), p. 615.

position, any change in deposit level due to cash flows or clearing house operations creates either excess or deficit reserves which are equal to the change in deposit level minus the legal reserve requirement multiplied by the change in deposit level. That is:

$$R = (1-r)\ |\Delta 0_D|$$

where:

R = excess or deficient reserves

r = the weighted average legal reserve requirement

$\Delta 0_D$ = a change in deposit level due to cash flows or clearing house operations.

Again, by assuming that a bank manager follows a policy of becoming fully loaned up, it follows that he will either acquire or dispose of earning assets in an amount equal to the bank's excess or deficient reserves. However, in acquiring or disposing of earning assets, the bank manager may simultaneously create or destroy deposit liabilities. Consequently, the bank continues to have excess or deficient reserves equal to (1-r) times the created or destroyed deposit. The process repeats itself until the last created or destroyed deposit of the bank approaches zero. That is, the bank alters its earning assets by creating or destroying deposits of the following magnitude:

$$0_{c1} = (1-r)\ \Delta 0_D$$

$$0_{c2} = (1-r)\ 0_{c1}$$

$$0_{c3} = (1-r)\ 0_{c2}$$

$$\vdots$$

$$0_{c\infty} = (1-r)\ 0_{cx-1} = 0$$

where:

0_c = created or destroyed deposits.

The sum of the created or destroyed deposits equals the total change in earning assets, that is:

$$\Delta A = 0_{c1} + 0_{c2} + \ldots 0_{cx-1} = \sum_{j=1}^{\infty} 0_{cj}$$

or

$$\Delta A = (1-r)\ \Delta 0_D + (1-r)\sum_{n=1}^{\infty} 0_{cn} \qquad (1)$$

where:

ΔA = change in earning assets.

Of course if the above process is one of expansion some of the created deposits may be subsequently withdrawn. In addition, there may be further losses or gains of primary deposits. Consequently, the process needs to be repeated each time the bank experiences additional deposit level changes. For each such additional deposit level change, the change in earning assets is equal to (1-r) times the initial change in deposits plus (1-r) times the sum of either newly created deposits or deposits which are destroyed as a result of the initial change in deposits.

Consequently, the total change in earning assets associated with deposit level changes in period one is equal to the sum of the changes in earning assets associated with each individual deposit level change resulting from clearing house operations or cash flows. That is:

$$\Delta A_1 = \left((1-r)\Delta 0_{DA} + (1-r)\ \sum_{n=1}^{\infty}{}_{cn}\right) + \left((1-r)\Delta 0_{DB} + \sum_{n=1}^{\infty} 0_{cn}\right)$$
$$+ \ldots \left((1-r)\Delta 0_{DZ} + (1-r)\sum_{n=1}^{\infty} 0_{cn}\right) \qquad (2)$$

where:

ΔA_1 = the total change in earning assets in period one due to deposit variation

ΔO_{DA} through ΔO_{DZ} represent all changes in deposit level which are due to clearing house operations or cash flows

O_c = deposits which are created or destroyed as a result of an initial change in deposit level.

From equation (2) it is clear that the total change in earning assets in period one (ΔA_1) is equal to (1-r) times the sum of all deposit level changes which are due to clearing house operations or cash flows plus (1-r) times the sum of all deposits created or destroyed. That is:

$$\Delta A_1 = (1-r)|\Delta O_{D1}| + (1-r)|O_{c1}|$$

$$= (1-r)\{|\Delta O_{D1}| + |O_{c1}|\} \qquad (3)$$

where:

ΔO_{D1} = total change in deposits in period one resulting from clearing house operations or cash flows

O_{c1} = total deposits created or destroyed in period one.

Next, the total change in deposit level occurring in period one can be expressed as the difference between the deposit level at the end of the period (O_1) and the deposit level at the beginning of the period (O_0):

$$\Delta O_1 = |(O_1 - O_0)| \qquad (4)$$

where:

ΔO_1 = the total change in deposit level over period one

O_1 = deposit level at the end of period one

O_0 = deposit level at the beginning of period one.

It is also possible to express the deposit level change over period one as the sum of deposit level changes due to clearing house operations and cash flows plus the sum of all deposits created or destroyed, which is:

$$\Delta O_1 = |\Delta O_{D1}| + |O_{C1}|. \tag{5}$$

From equations (4) and (5) it follows that:

$$\Delta O_1 = |O_1 - O_0| = |\Delta O_{D1}| + |O_{C1}|$$

and therefore:

$$(1-r)\ |O_1 - O_0| = (1-r)\ \{|\Delta O_{D1}| + |O_{C1}|\}. \tag{6}$$

From equations (3) and (6) it follows that:

$$\Delta A_1 = (1-r)|O_1 - O_0| \tag{7}$$

where:

ΔA_1 = total change in earning assets due to deposit level changes in period one.

The same process is repeated for period two, yielding:

$$\Delta A_2 = (1-r)|\ O_2 - O_1|$$

where:

ΔA_2 = total change in earning assets due to deposit level changes in period two

O_2 = deposit level at the end of period two

O_1 = deposit level at the end of period one.

Consequently, the total dollar value of earning assets acquired or disposed of as a result of changes in deposit level over the entire year is:

$$\Delta A = \sum_{t=1}^{K} \Delta A_t = (1-r) \sum_{t=1}^{26} |O_t - O_{t-1}|,^2 \tag{8}$$

where:

ΔA = total dollar change in earning assets which was in response to changes in deposit level for the entire year

ΔA_t = total dollar value of changes in earning assets in period t in response to deposit level changes in period t

O = deposit level in each of 26 bi-weekly reporting periods

K = number of reporting periods in a year.

Next, since the model is limited to a case in which bank size is held constant, it is assumed that the increased level of asset acquisition-sale associated with deposit level changes in a given year requires additional labor activity but does not substantially alter the capital and materials requirements of the bank. In other words, it is assumed that capital and materials requirements are a function of bank size.[3] Using a Cobb-Douglas function to express this assumption yields:

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[2]If one were to assume banks do not seek to reduce excess reserves to zero, then the expression for the acquisition of earning assets would be:

$$\Delta A = (1-r) \sum_{t=1}^{26} |O_t - O_{t-1}| \frac{dA}{dER_D}$$

where:

ER_D = excess reserves associated with changes in deposit level. Provided that $dA/dER_D > 0$, the present hypothesis can be established. Orr and Mellon found dA/dER_D to be greater than zero, even in a case where it is assumed that banks do not seek to reduce excess reserves to zero. Daniel Orr and W. G. Mellon, "Stochastic Reserve Losses and Expansion of Bank Credit," The American Economic Review, (September, 1961), p. 619.

[3]Some support for this assumption is provided by the fact that existing studies have found average capital and average materials cost are approximately constant, regardless of bank size. For example, see

$$\Delta A = \P(\overline{K})^{\alpha} \; (\overline{M})^{\beta} \; L_D^{\;\delta} \tag{9}$$

where:

ΔA = asset acquisition-sale associated with deposit level changes

K = capital stock

M = materials

L_D = hours of labor resulting from deposit level changes and the associated asset acquisition-sale.

Next, the total labor activity of the bank can be defined as:

$$L = L_D + L_2$$

where:

L = total labor activity

L_D = labor activity resulting from deposit level changes asn the associated asset acquisition-sale

L_2 = the remaining labor activity of the bank.

The residual labor activity of the bank (L_2) is assumed to be a function of bank size:

$$L_2 = f(N)$$

therefore, if

$N = \overline{N}$, then $L_2 = \overline{L}_2$.

Next, taking the average labor cost identity,

$$ALC = \frac{W_L}{N},$$

where:

ALC = average labor cost

Frederick W. Bell and Neil B. Murphy, "Economies of Scale in Commercial Banking: Specialization and Technology," New England Business Review, (April, 1967), p. 4.

W = wage rate

N = bank output

L = labor activity

and breaking down total labor activity into its two components yields:

$$ALC = \frac{W}{N}L_D + \frac{W}{N}L_2. \tag{10}$$

Solving equation (9) for L_D, and substituting the results into equation (10) yields:

$$ALC = \frac{W}{N}\left(\frac{\Delta A}{\P(K)^{\alpha}(M)^{\beta}}\right)^{\frac{1}{\delta}} + \frac{W}{N}L_2 \tag{11}$$

$$= \frac{W}{N\left(\P(K)^{\alpha}(M)^{\beta}\right)^{\frac{1}{\delta}}}\Delta A^{\frac{1}{\delta}} + \frac{W}{N}L_2.$$

For a given bank size:

$$\frac{W}{N\left(\P(K)^{\alpha}(M)^{\beta}\right)^{\frac{1}{\delta}}} = \overline{Z}, \text{ a constant}$$

and

$$\frac{W}{N}L_2 = B, \text{ a constant.}$$

Therefore:

$$ALC = \overline{Z}\Delta A^{\frac{1}{\delta}} + \overline{B}. \tag{12}$$

Next, equation (8) is substituted into equation (12), which yields:

$$ALC = \overline{Z}\left((1-r)\sum_{t=1}^{26}\left|(0_t-0_{t-1})\right|\right)^{\frac{1}{\delta}} + \overline{B} \tag{13}$$

$$= \overline{Z}(1-r)^{\frac{1}{\delta}}\left(\sum_{t=1}^{26}\left|(0_t-0_{t-1})\right|\right)^{\frac{1}{\delta}} + \overline{B}.$$

The next step in the model is to introduce deposit variability. This is done by using Gramley's expression of deposit variability.[4]

$$V = \frac{\sum_{t=1}^{K} \left(\frac{|O_t - O_{t-1}|}{X} \right)}{K} \tag{14}$$

where:

V = deposit variability

O = the observed deposit level in each of the 26 bi-weekly reporting periods

X = mean level of deposits for the 26 bi-weekly reporting periods

K = the number of annual deposit level observations in the present study K = 26.

Solving equation (14) for $\sum_{t=1}^{26} |O_t - O_{t-1}|$, yields:

$$\sum_{t=1}^{26} |O_t - O_{t-1}| = 26XV. \tag{15}$$

Substituting equation (15) into equation (13) yields:

$$ALC = \overline{B} + \overline{Z}\ (1-r)^{\frac{1}{\delta}} (26XV)^{\frac{1}{\delta}} \tag{16}$$

Next, it can be shown that holding bank size constant (i.e., holding the mean level of bank assets constant) results in the mean level of deposits (X) also being constant.

Assume the average level of assets is equal to the mean level of deposits plus a constant so that:

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[4]Lyle Gramley, "Deposit Instability at Individual Banks," Essays on Commercial Banking (Federal Reserve Bank of Kansas City, 1962), p. 41.

$$N = X + C.$$

Then if

$$N = \overline{N}$$

$$\overline{X} = \overline{N} - C.$$

Consequently, in equation (16) $X = \overline{X}$, so that:

$$ALC = \overline{B} + \overline{Z}\left(26\overline{X}(1-r)\right)^{\frac{1}{\delta}}V^{\frac{1}{\delta}}.$$

Therefore,

$$\frac{dALC}{dV} = \frac{1}{\delta}\{\overline{Z}\left(26\overline{X}(1-r)\right)^{\frac{1}{\delta}}\}V^{\frac{1-\delta}{\delta}} > 0.$$

Critical Assumptions

In the above model, two assumptions stand out as being especially critical: (1) changes in excess reserves result in asset acquisition and sale (equation 2), and (2) asset acquisition and sale entails labor activity and therefore labor cost (equations 3 through 7). The importance of these assumptions to establishing the present hypothesis is illustrated in a statement by Kane and Malkiel: "Moreover, if we allow for costs of asset acquisition and sale, . . . then deposit variability decreases expected profits as well."[5]

Thus, according to Kane and Malkiel, deposit variability results in asset acquisition and sale which in turn raises cost and therefore lowers profit. Again, this statement succinctly emphasizes that the present hypothesis rests primarily on two assumptions. Because each of

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[5]Edward J. Kane and Burton G. Malkiel, "Bank Portfolio Allocation, Deposit Variability, and the Availability Doctrine," Quarterly Journal of Economics, (February, 1965), p. 120.

these assumptions is critical, a more detailed discussion of each is presented below.

Asset Acquisition and Sale as a Function of Variation in Deposit Level

As developed in the preceding model, asset acquisition and sale becomes a function of bi-weekly variation in deposit levels by assuming that in equilibrium banks hold excess reserves equal to zero (equation 2). While such an assumption does simplify the analysis, it is not necessary for obtaining the desired positive relationship between changes in deposit level and changes in the asset holdings of the bank.

Even if one concedes that bank managers want to hold some excess reserves in order to meet adverse clearing balances or cash withdrawals, it is still possible to construct a model which establishes a positive relationship between changes in a bank's excess reserves and changes in its asset holdings. Such a model has been developed by Orr and Mellon.[6] It rests on two assumptions: (1) bank managers are constrained profit maximizers, and (2) deposit losses are randomly distributed. Thus, the Orr and Mellon model assumes that a profit maximizing bank manager, when faced with an increase in his desired reserve position, engages in asset acquisition subject to the constraint imposed by uncertainty of future random losses in reserves occurring from adverse clearing balances or deposit withdrawals. If such random losses in reserves do occur, the bank may incur a dollar cost. The possibility of a dollar cost

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[6]Daniel Orr and W. G. Mellon, "Stochastic Reserve Losses and Expansion of Bank Credit," The American Economic Review, (September, 1961), p. 615.

resulting from these reserve losses is explained by the fact that commercial banks are members of the Federal Reserve System and therefore subject to legal reserve requirements. Consequently, losses of reserves may result in the bank's having to incur costs in order to correct a deficiency in its required reserves.[7] Hence the bank manager faced with an increase in his reserves above the desired level has to weigh the interest that he could earn by acquiring additional assets against the financial penalty which could result if subsequent losses of reserves were to cause the bank to become deficient in its required reserves. Or, to put it in the terms of the authors, "the problem facing the profit-maximizing bank is: how far should credit be expanded, given the random nature of its cash flows and the reserve requirement it must meet."[8]

The Orr and Mellon model, then, can be explained in terms of a situation in which the initial equilibrium position of a bank is disturbed by the introduction of an increase in reserves above the desired level (which in turn would have resulted from variation in its deposit levels). The model then shows how a bank manager could be expected to react to this increase in reserves. The relevant variables are:

R: the increase in reserves above the desired level which occurred at the beginning of the decision period.

A: the dollar volume of additional earning assets acquired during the period. Since Orr and Mellon assume banks acquire assets by creating deposit liabilities against themselves, A also represents an increase in deposit liabilities.

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[7]Ibid., pp. 615-616.

[8]Ibid., p. 616.

L: random losses of reserves which result from deposit withdrawals or adverse clearing balances during the decision period.

δ: the legal reserve requirement ratio.

$$(0 < \delta < 1)$$

In order for the bank's reserves to be legally sufficient at the end of the decision period, it is necessary that the following condition hold:

$$R - L \leq \delta(A - L). \tag{17}$$

Once again, since the bank manager is concerned with profits, when confronted with reserve increases over the desired level his objective is to acquire additional earning assets in a volume that maximizes the anticipated addition to profits. Thus, the bank must consider not only the positive return from acquiring additional earning assets, iA (where i = the interest rate earned on earning assets), but also any dollar costs it might incur if acquiring additional earning assets resulted in its required reserves becoming deficient. Such a deficiency in required reserves involves a dollar cost which, according to Orr and Mellon, has two components: M, which is a lump sum cost resulting from the paper work involved in taking care of a reserve deficiency; and r which is a penalty rate per dollar of insufficient reserves (such as the discount rate or the federal funds rate).[9] Consequently, the total possible dollar cost of using the initial increase in reserves to acquire additional earning assets is given by the probability expressions:

$$M\int_S^{\infty}\big(\phi(L)\big)\ dL + rL\int_S^{\infty}\big(\phi(L)\big)\ dL \tag{18}$$

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[9]Ibid., p. 617.

where $\phi(L)$ is the probability density function of random losses in reserves occurring, and S is the value of L solved by making the reserve sufficiently condition in equation (17) an equality; i.e., S is the value of L that results from assuming the bank is just meeting its reserve requirements so that

$$S = (R - A) / (1 - \delta). \tag{19}$$

By subtracting the probable losses in equation (18) from the expected return (iA), the constrained profit equation can be written

$$P = iA - M \int_S^{\infty} \{\phi(L)\} \, dL - rL \int_S^{\infty} \{\phi(L)\} \, dL \tag{20}$$

where P is the expected addition to profit from acquiring additional earning assets in response to an increase in reserves.

Consequently, assuming that the second order conditions are met, the profit maximizing asset decision to make in response to a change in excess reserves is indicated where:

$$\frac{\partial P}{\partial A} = 0.$$

Since Orr and Mellon express random losses in deposits (L) as a fraction (K) of deposit liabilities, where:

$$0 \leq K \leq 1$$

then

$$\frac{\partial P}{\partial A} = i + (M + rS)\phi(S) \frac{dS}{dA} - (MK - rS)\phi(S) - r\{1 - \phi(S)\}. \tag{21}$$

Using equation (19) to solve for S and $\frac{dS}{dA}$ and substituting these results into (21) yields:

$$\frac{\partial P}{\partial A} = i - \{r(R-\delta A)/(1-\delta)^2 + M\{k + \delta/(1-\delta)\}\}$$

$$\phi\{(R-\delta A)/(1-\delta)\} - r\{1 - \phi\{(R-\delta A)/(1-\delta)\}\}. \tag{22}$$

By setting $\frac{\partial P}{\partial A}$ equal to zero and assigning numerical values to the parameters M, R, i, δ, and k, equation (22) becomes a two variable model in which A = f(R). Consequently, by assigning different values to the independent variable R, it is possible to obtain the corresponding optimal values of A associated with each of these values of R through successive approximation using tables of normal density and distribution functions. The results obtained by Orr and Mellon when they solved their equation in this manner show that an increase in bank reserves (R) over the desired level resulted in an increase in earning assets (A).[10]

Thus, when a portfolio model incorporating uncertainty is used, there is a positive relationship between increases in the acquisition of earning assets by the bank (A)--provided one assumes bank managers are constrained profit maximizers. Of course, one of the important implications of the model, which is emphasized by Orr and Mellon, is that while increases in reserves over the desired level do result in the acquisition of additional earning assets in their model, such asset acquisition as does occur is less than the amount of asset acquisition that would be predicted using the conventional, deterministic model which incorporates the assumption that banks keep excess reserves equal to zero.[11] However, in terms of the present study, the significance of the Orr and Mellon model is that it establishes that there is a positive relationship between increases in reserves over the desired level and changes in the volume of earning assets acquired even in the presence of uncertainty.

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[10] Ibid., p. 619.

[11] Ibid., p. 619.

It is true that Orr and Mellon present their model strictly in terms of a situation in which reserves are initially greater than optimal, and deposit variability can mean less than optimal reserves as well as greater than optimal reserves. However, the same model can be used equally well to explain the impact that a drop in reserves below the optimal level has on a bank's portfolio holdings. Starting from an initial equilibrium position in which the level of reserves is considered optimal, and then disturbing this equilibrium by introducing a reduction in reserves, the profit oriented manager could be expected to respond to this loss of reserves by reducing his portfolio of earning assets _if_ the possible dollar cost-savings to be gained from reducing asset holdings outweighs the loss of interest. The possible cost savings would be in the form of avoiding a deficiency of required reserves resulting from further random losses of reserves, i.e., the possible cost saving, is given by the probability expressions:

$$M \int_{S}^{\infty} \left(\phi(L)\right) dL + rL \int_{S}^{\infty} \left(\phi(L)\right) dL.$$

Since the loss in interest is equal to iA, the decision equation is:

$$P = \int_{S}^{\infty} \left(\phi(L)\right) dL + rL \int_{S}^{\infty} \left(\phi(L)\right) dL - iA. \qquad (23)$$

Using equation (23) to take the partial of P with respect to A and setting it equal to zero yields the same results obtained by Orr and Mellon. Consequently, their model can be used to explain the impact of decreases in reserves as well as increases.

Labor Cost as a Function of Asset Acquisition

The second critical assumption, that labor activity is entailed in acquiring and disposing of earning assets, is a fundamental part of Hicks' theory of interest. Hicks states that on bills so short as to rule out rediscount, the rate of interest is equal to the cost of acquiring the bill and he states that a part of this cost is the "trouble" of acquiring assets:

> For a bill so short that the possibility of having to rediscount is ruled out, the only inferiority of the bill (to money) is the cost of investment, so the rate of interest on the bill corresponds to the cost of investment to the marginal lender . . .
>
> To convert money into bills requires a separate transaction, and the trouble of making that transaction may offset the gain in interest. It is only if this obstacle were removed, if safe bills could be acquired without any trouble at all, that people would become willing to convert all their money into bills, so long as any interest whatsoever was offered. Under the conditions of our model, it must be the trouble of making transactions which explains the short rate of interest.[12]

The repeated use of the word "trouble" clearly implies that Hicks believes labor activity is involved in acquiring assets.

In addition, George Bentson has argued that bank labor costs are the result of the time that is involved in servicing accounts and acquiring assets. Moreover, Bentson has stated that the amount of labor time associated with portfolio management is directly related to the volume of asset acquisition.[13]

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[12] J. R. Hicks, Value and Capital, (London, 1950), pp. 164-165, p. 167. Italics added.

[13] George Bentson, "Economies of Scale and Marginal Cost in Banking Operations," National Banking Review, IV, No. 2 (June, 1965), p. 509.

CHAPTER III

ECONOMIES OF SCALE IN COMMERCIAL BANKING

Organization of the Chapter

This chapter is concerned with the influence of bank size on per unit costs in commercial banking. The chapter first presents a theoretical model which establishes a basis for assuming that per unit costs are influenced by bank size. Next the findings of existing studies on economies of scale in commercial banking are summarized.

Economies of Scale in Commercial Banking: A Theoretical Model

Based largely on empirical evidence, recent studies have concluded that:

$$ATC = f_1(N),\ f_1^{\prime}<0$$

and

$$ALC = f_2(N),\ f_2^{\prime}<0.$$

The authors of one such study estimate their empirical results in terms of a model based on the following Cobb-Douglas production function:[1]

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[1]Frederick W. Bell and Neil B. Murphy, Costs in Commercial Banking, (Boston, 1968).

$$N = K^{\alpha}L^{\beta}M^{\delta} \tag{1}$$

where:

N = output

K = capital

L = labor

M = materials.

Associated with this production function is the total cost identity:

$$C = wL + rK + nM \tag{2}$$

where:

C = total cost

w = wage rate

r = rent on capital

n = price of materials.

Working with the production function in (1) and assuming increasing returns to scale (i.e. $\alpha + \beta + \delta = S > 1$) it can be shown, subject to the constraint that for any given output total costs are minimized, that

$$\frac{d\left(\frac{C}{N}\right)}{d\ N} < 0.$$

That is:

$$F = (wL + rK + nM) + \lambda \left(N - \pi K^{\alpha}\ L^{\beta}\ M^{\delta}\right). \tag{3}$$

Where λ is a non zero Lagrange multiplier so that:

$$\frac{\partial F}{\partial L} = W - \lambda\ MP_K = 0 \text{ where } MP_L = \text{the marginal product of labor} \tag{4}$$

$$\frac{\partial F}{\partial K} = r - \lambda\ MP_K = 0 \quad MP_K = \text{the marginal product of capital} \tag{5}$$

$$\frac{\partial F}{\partial M} = n - \lambda\ MP_M = 0 \quad MP_M = \text{the marginal product of materials} \tag{6}$$

$$\frac{\partial F}{\partial} = N - \pi\ K^{\alpha}\ L^{\beta}\ M^{\delta} = 0. \tag{7}$$

Equation (4) divided by equation (5) yields:

$$\frac{MP_L}{MP_K} = \frac{w}{r} \text{ so that } \frac{MP_L}{w} = \frac{MP_K}{r} \; . \tag{8}$$

Equation (5) divided by (6) yields:

$$\frac{MP_K}{MP_M} = \frac{r}{n} \text{ so that } \frac{MP_K}{r} = \frac{MP_M}{n} \; . \tag{9}$$

Equation (4) divided by (6) yields:

$$\frac{MP_L}{MP_M} = \frac{w}{n} \; . \tag{10}$$

Therefore:

$$\frac{MP_L}{w} = \frac{MP_K}{r} = \frac{MP_M}{n} \; .$$

Thus the marginal product per dollar spent is equal for all factors of production, thereby ensuring that cost is minimized for any given level of output, assuming the second order conditions are met. Equations (8), (9), and (10) may be rewritten

$$\frac{w}{r} = \frac{\pi \; \beta \; K^{\alpha} \; L^{\beta-1} \; M^{\delta}}{\pi \; \alpha \; K^{\alpha-1} \; L^{\beta} \; M^{\delta}} = \frac{\beta K}{\alpha L} \; . \tag{11}$$

so that

$$\frac{rK}{\alpha} = \frac{LW}{\beta} \tag{11a}$$

and

$$K = \frac{\alpha LW}{r\beta} \tag{11b}$$

$$\frac{r}{n} = \frac{\pi \; \alpha \; K^{\alpha-1} \; L^{\beta} \; M^{\delta}}{\pi \; SK^{\alpha} \; L^{\beta} \; M^{\delta-1}} = \frac{\alpha M}{\delta K} \tag{12}$$

so that

$$\frac{nM}{\delta} = \frac{rK}{\alpha} \tag{12a}$$

and

$$M = \frac{r\delta K}{\alpha n} \tag{12b}$$

$$\frac{w}{n} = \frac{\pi\ \beta K^{\alpha}\ L^{\beta-1}\ M^{\delta}}{\pi\ \delta K\ \ L^{\beta}\ M^{\delta-1}} = \frac{\beta M}{\delta L} \tag{13}$$

so that

$$\frac{wL}{\beta} = \frac{Mn}{\delta} \tag{13a}$$

and

$$L = \frac{\beta Mn}{w\delta}. \tag{13b}$$

Substituting equations (11b), (12b), and (13b) into the cost identity [equation (3)] yields

$$C = w\,\frac{\beta Mn}{\delta w} + r\,\frac{\alpha Lw}{\beta r} + n\,\frac{r\delta K}{n}$$

or

$$C = \frac{\beta nM}{\delta} + \frac{\alpha Lw}{\beta} + \frac{r\delta K}{\alpha}$$

or

$$C = \beta\,\frac{nM}{\delta} + \alpha\,\frac{Lw}{\beta} + \delta\,\frac{rK}{\alpha}\ .$$

From equations (11a), (12a), and (13a) it follows that

$$\frac{rK}{\alpha} = \frac{wL}{\beta} = \frac{nM}{\delta}. \tag{14}$$

Therefore it follows that

$$C = \frac{nM}{\delta}\,(\beta + \alpha + \delta) \tag{15}$$

so that

$$M = \frac{\delta C}{nS} \tag{15a}$$

and

$$C = \frac{wL}{\beta}(\beta + \alpha + \delta) \tag{16}$$

so that

$$L = \frac{\beta C}{wS} \tag{16a}$$

and

$$C = \frac{rK}{\alpha}(\beta + \alpha + \delta) \tag{17}$$

so that

$$K = \frac{\alpha C}{rS}. \tag{17a}$$

Substituting equations (15a), (16a), and (17a) into the production function [equation (1)] yields:

$$N = \pi\left(\frac{\alpha C}{rs}\right)^{\alpha}\left(\frac{\beta C}{ws}\right)^{\beta}\left(\frac{\delta C}{ns}\right)^{\delta}$$

so that

$$N = \pi\left(\frac{1}{r}\right)^{\alpha}\left(\frac{\alpha C}{s}\right)^{\alpha}\left(\frac{1}{w}\right)^{\beta}\left(\frac{\beta C}{s}\right)^{\beta}\left(\frac{1}{n}\right)^{\delta}\left(\frac{\delta C}{s}\right)^{\delta}$$

and

$$N^{\frac{1}{s}} = \pi^{\frac{1}{s}}\left(\frac{1}{r}\right)^{\frac{\alpha}{s}}\left(\frac{\alpha c}{s}\right)^{\frac{\alpha}{s}}\left(\frac{1}{w}\right)^{\frac{\beta}{s}}\left(\frac{\beta c}{s}\right)^{\frac{\beta}{s}}\left(\frac{1}{n}\right)^{\frac{\delta}{s}}\left(\frac{\delta c}{s}\right)^{\frac{\delta}{s}}$$

and

$$\frac{N^{\frac{1}{s}}}{\left(\frac{1}{r}\right)^{\frac{\alpha}{s}}\left(\frac{1}{w}\right)^{\frac{\beta}{s}}\left(\frac{1}{n}\right)^{\frac{\delta}{s}}} = \pi^{\frac{1}{s}}\left(\frac{\alpha c}{s}\right)^{\frac{\alpha}{s}}\left(\frac{\beta c}{s}\right)^{\frac{\beta}{s}}\left(\frac{\delta c}{s}\right)^{\frac{\delta}{s}}$$

and

$$N^{\frac{1}{s}}\, r^{\frac{\alpha}{s}}\, w^{\frac{\beta}{s}}\, n^{\frac{\delta}{s}} = {}^{\frac{1}{s}}\left(\frac{\alpha}{s}\right)^{\frac{\alpha}{s}}\left(\frac{\beta}{s}\right)^{\frac{\beta}{s}}\left(\frac{\delta}{s}\right)^{\frac{\delta}{s}}(C)\,\frac{\alpha + \beta + \delta}{s}$$

and

$$N^{\frac{1}{s}} r^{\frac{\alpha}{s}} w^{\frac{\beta}{s}} n^{\frac{\delta}{s}} = C \left[\frac{\pi^{\frac{1}{s}} \alpha^{\frac{\alpha}{s}} \beta^{\frac{\beta}{s}} \delta^{\frac{\delta}{s}}}{s}\right]$$

Let

$$\left[\frac{s}{\pi^{\frac{1}{s}} \alpha^{\frac{\alpha}{s}} \beta^{\frac{\beta}{s}} \delta^{\frac{\delta}{s}}}\right] = G, \text{ a constant.}$$

Therefore,

$$C = G\, N^{\frac{1}{s}} r^{\frac{\alpha}{s}} w^{\frac{\beta}{s}} n^{\frac{\delta}{s}} \tag{18}$$

and

$$\frac{C}{N} = G\, N^{\frac{1-s}{s}} r^{\frac{\alpha}{s}} w^{\frac{\beta}{s}} n^{\frac{\delta}{s}}$$

Assuming the banker does not possess monopsony power in the purchase of his resources, r, w, n are constants, and

$$\frac{d(\frac{C}{N})}{dN} < 0, \text{ if } s > 1.$$

Thus, by using a Cobb-Douglas production function, and by assuming increasing returns to scale, it is possible to prove mathematically that the partial derivative of average total cost with respect to bank size is less than zero. That is to say, it is possible to show mathematically that the long run average total cost curve of a commercial bank is downward sloping.

Economies of Scale in Commercial Banking: Summary of the Literature

In the summary of the literature presented below, one point consistently emerging is that larger bank size tends to be associated with lower unit operating costs in commercial banking. Since the present study is concerned with the impact of deposit variability on unit costs in commercial banking, the summary of the literature presented below makes it clear that it is necessary to control for bank size if one is distinguished clearly the impact of deposit variability on unit cost in commercial banking.

Schweiger and McGee

Using banks in the Chicago area, Irving Schweiger and John McGee conducted a study in which they found evidence of economies of scale in commercial banking. In testing their hypothesis the authors did a multiple regression analysis using cost per 100,000 dollar valuation of assets as the dependent variable, and bank output (defined as the total dollar value of bank assets) as one of the independent variables. Their results were significant at the .01 level with an R^2 value of .495. The sign of the regression coefficient of bank output was negative, indicating that as bank output increased, unit cost decreased. Specifically, their regression coefficient of 1383 indicated that unit costs fell $13.83 per million dollar increase in bank assets.[2] This lead them to conclude that, "Banks of less than 50 million in deposits can realize marked cost savings by growing."[3]

Federal Reserve Bank of Kansas City

The Federal Reserve Bank of Kansas City in its Monthly Review for

[2]Irving Schweiger and John McGee, "Chicago Banking," The Journal of Business, XXXIV (July, 1961), pp. 208-228.

[3]Ibid., p. 215.

February, 1961,[4] presented the first of a series of articles on economies of scale in commercial banking. The principal contribution of the first article was to establish, on the basis of empirical evidence, that economies of scale are characteristic of the commercial banking industry, particularly with regard to labor cost savings.

The second article[5] explored further a point brought out in the earlier article, namely that it was primarily reduced average labor costs that resulted from a larger scale of operations in commercial banking. The principal contribution of this article was the finding that average wages and salaries (defined as total wage and salary cost divided by total assets) declined by 3/10 of one percent for every ten percent increase in bank output.[6] The article went on to recognize that it is possible for that saving to have occurred because the larger banks payed lower wages and salaries per employee. However, just the opposite proved to be the case. It was found that a rise in wages and salaries per employee occurred when bank output increased. Thus, the lower average labor cost which was associated with larger bank output could not be explained by a lower wage per employee.

Lyle Gramley

Lyle Gramley, in his study on economies of scale in commercial banking, defines average cost as total current operating expenses

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[4]"Relationship of Bank Size and Bank Costs," Monthly Review of the Federal Reserve Bank of Kansas City (February, 1961), p. 3.

[5]"Interpretation of Size-Cost Relationships in Banking," Monthly Review of the Federal Reserve Bank of Kansas City (March, 1961), p. 3.

[6]Ibid., p. 3.

divided by total assets.[7] Total output thus is equal to the total dollar value of assets. According to Gramley this amounts to establishing a criterion for bank output which is based on the firm's concept of output:

> This study is concerned with efficiency at individual banks, and does not attempt to determine whether, from the standpoint of achieving maximum social welfare, the banking system should be composed of small or large units.[8]

Given the above definition of output (and therefore of average cost), Gramley found that economies of scale do, in fact, exist in commercial banking. Using multiple regression analysis, in which average total cost was the dependent variable and bank output was one of five independent variables, the estimates indicated that reduced average total cost was associated with larger bank output at the .05 level of significance with an R^2 fo .608.[9] Plotting the relationship between average total cost and bank size yielded the result depicted in Figure 1.[10]

Gramley also plotted the results of his regression analysis with the output axis converted into a log scale so as to depict changes in output of an equal proportion. This resulted in the linear average

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[7] Lyle E. Gramley, A Study of Scale Economies in Banking, Federal Reserve Bank of Kansas City Publication (Kansas City, June, 1965), p. 10.

[8] Ibid., p. 4.

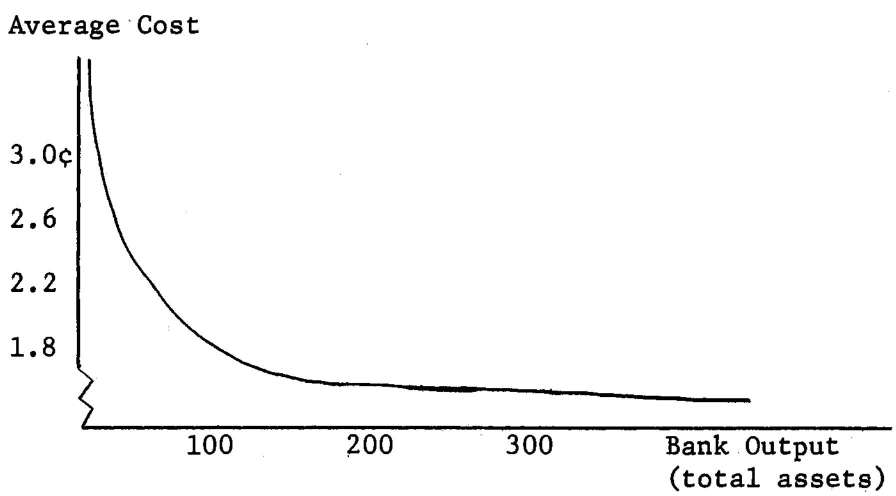
[9] Ibid., p. 18.

[10] The estimating equation for Figure 1 is:

$$ATC = 3.0 - .394 \log N$$

where ATC = average total cost
N = bank output.

total cost curve depicted below, with the same estimating equation used in Figure 1.



Source: Lyle E. Gramley, Scale Economies in Banking, Federal Reserve Bank of Kansas City Publication (Kansas City, June, 1965), p. 18.

Figure 1. Relationship of Average Cost to Bank Output

The slope of the average total cost line in Figure 2 means that a 100 percent increase in bank output leads to a 3.9 cents decline in average total cost.[11]

In a second regression analysis (see Figure 3), which used average labor cost as the dependent variable and the same independent variables as above, Gramley found average labor cost to be associated with bank

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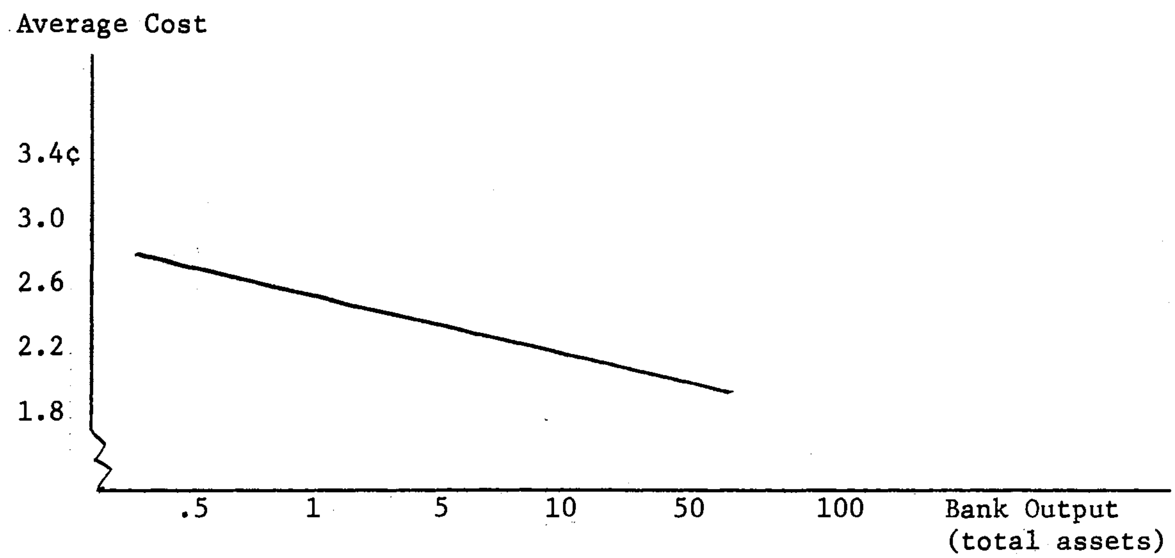
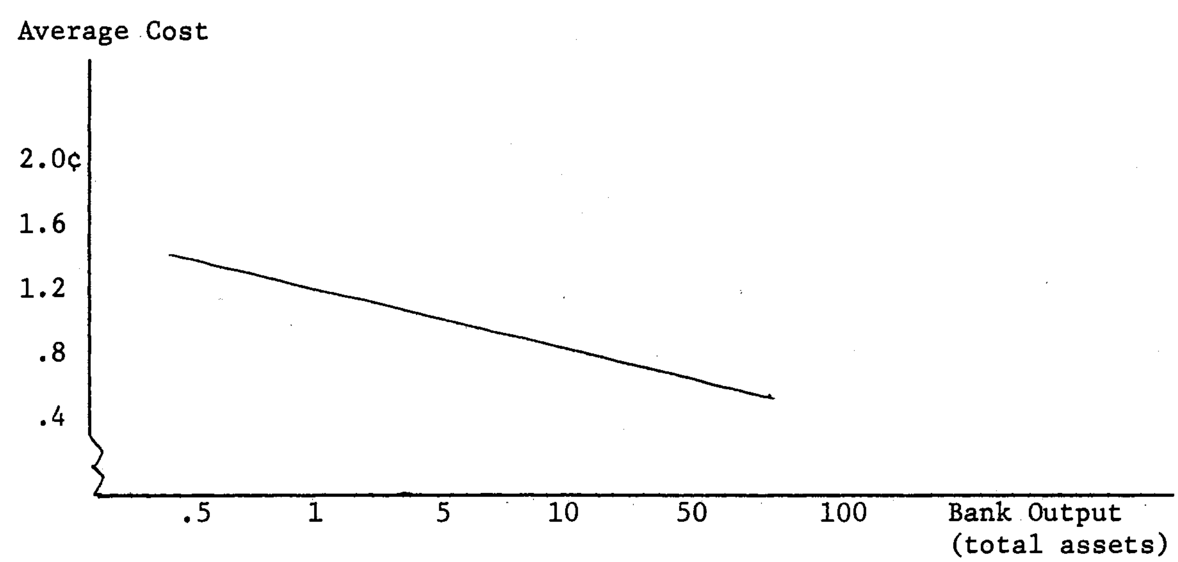
[11] Ibid., p. 20.



Source: Lyle Gramley, Scale Economies in Banking, Federal Reserve Bank of Kansas City Publication (Kansas City, 1965), p. 20.

Figure 2. Relationship of Average Cost to Bank Output (Log Scale)



Source: Lyle Gramley, Scale Economies in Banking, Federal Reserve Bank of Kansas City Publication (Kansas City, 1965), p. 21.

Figure 3. Relationship of Average Wage and Salary Cost to Bank Output (Log Scale)

output at the .05 level of significance with an R^2 value of .49.[12] The nature of the relationship between average labor cost and bank output is plotted below.[13]

Bell and Murphy

Frederick W. Bell and Neil B. Murphy published in the New England Business Review a series of four articles on economies of scale in commercial banking. In their initial article, the authors touched first on the significance of whether or not economies of scale exist in banking. Their conclusion was that ascertaining the presence of economies of scale is of particular significance because a great deal of the controversy over bank regulation can be reduced to differences of opinion as to whether or not small banks are able to compete with large ones in terms of unit operating costs.[14]

Bell and Murphy conclude that small banks are not competitive in terms of unit costs: in other words by increasing their scale of operation smaller banks can reduce their average total costs.[15] In addition, these per unit or average cost reductions are significantly

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[12]Ibid., p. 21.

[13]The estimating equation for Figure 3 is:

$$ALC = 1.8 - .327 \log O$$

where ALC = average labor cost
O = output.

[14]Frederick W. Bell and Neil B. Murphy, "Economies of Scale in Commercial Banking: The Measurement and Impact," New England Business Review (March, 1967), p. 2.

[15]Ibid., p. 2.

greater if the growth in scale of operation occurred under conditions of unit banking as opposed to conditions of branch banking.[16]

The authors define bank output (and therefore average cost) in terms of a variety of different banking functions. That is, they have used several different measures of output. However, they center most of their analysis around two of these measures: total number of demand deposits and total number of business loans. The reason for this emphasis is that demand deposits are the most significant factor determining bank costs (accounting for 34 percent of the total) and that business loans are the most significant single source of revenue for a bank (accounting for more than 20 percent of total revenue for the banks in their sample).[17]

Using the number of demand deposits as a measure of output, the authors found that economies of scale existed: a ten percent increase in the number of demand deposit accounts resulted in a 9.1 percent increase in total cost.[18] Their findings are depicted in Figure 4.[19]

With regard to their second key measure of bank output, Bell and Murphy found that an increase in the physical number of business loans

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[16]Ibid., p. 2.

[17]Ibid., pp. 4-5.

[18]Ibid., p. 3.

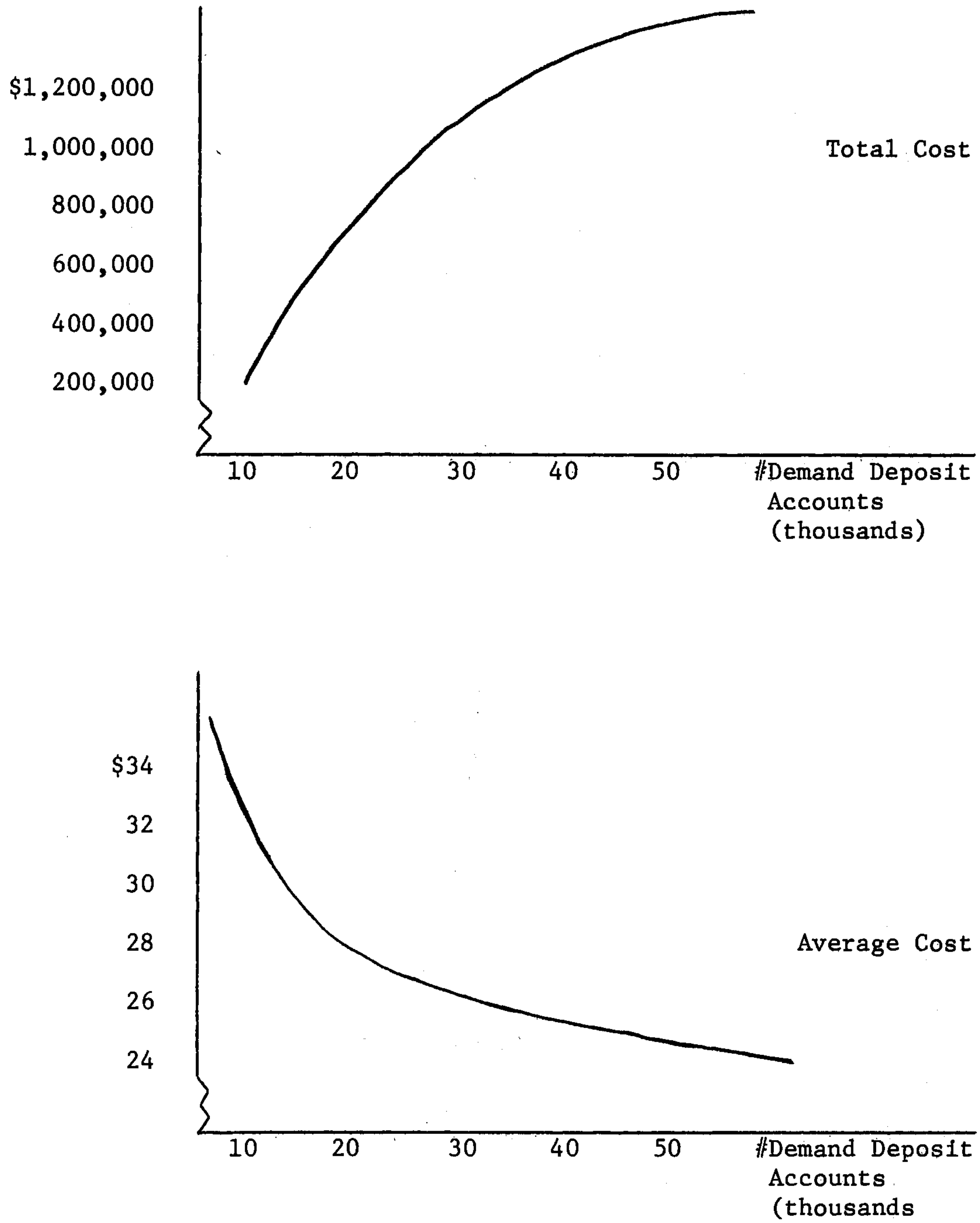
[19]Figure 4 is based on the following estimating equation:

$$\log TC = -2.2706 + .9059 \log N_D$$

where TC = total cost

N_D = number of demand deposit accounts.

F. W. Bell and N. B. Murphy, Costs in Commercial Banking, Federal Reserve Bank of Boston Publication #41 (Boston, 1968), p. 49.



Source: Frederick W. Bell and Neil B. Murphy, "Economies of Scale in Commercial Banking: The Measurement and Impact," New England Business Review (March, 1967), p. 5.

Figure 4. Total and Average Costs as Related to the Number of Demand Deposit Accounts

was associated with a less than proportional increase in cost.[20] Thus, growth in the principal earning asset of a commercial bank was associated with lower per unit costs; the association was significant at the .01 level.[21] These findings are depicted in Figure 5.[22]

In their second article they attempted to identify the origin of the economies of scale which they found to exist in commercial banking. The two primary sources they examined were specialization of labor and technology. For most bank operations the authors found that the decline in per unit costs resulted almost entirely from greater labor specialization.[23] For example, economies of scale associated with the number of demand deposits and the number of business loans (the two measures of bank output stressed in the earlier study) were almost entirely the result of labor cost savings.[24] Figure 6 summarizes their findings as to the source of reduced average total cost when the number of demand deposits is used as a measure of bank output. As the figure reveals, average materials costs rose slightly as the number of demand deposits

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[20]Ibid., p. 7.

[21]Ibid., p. 8.

[22]Figure 5 is based on the following estimating equation:

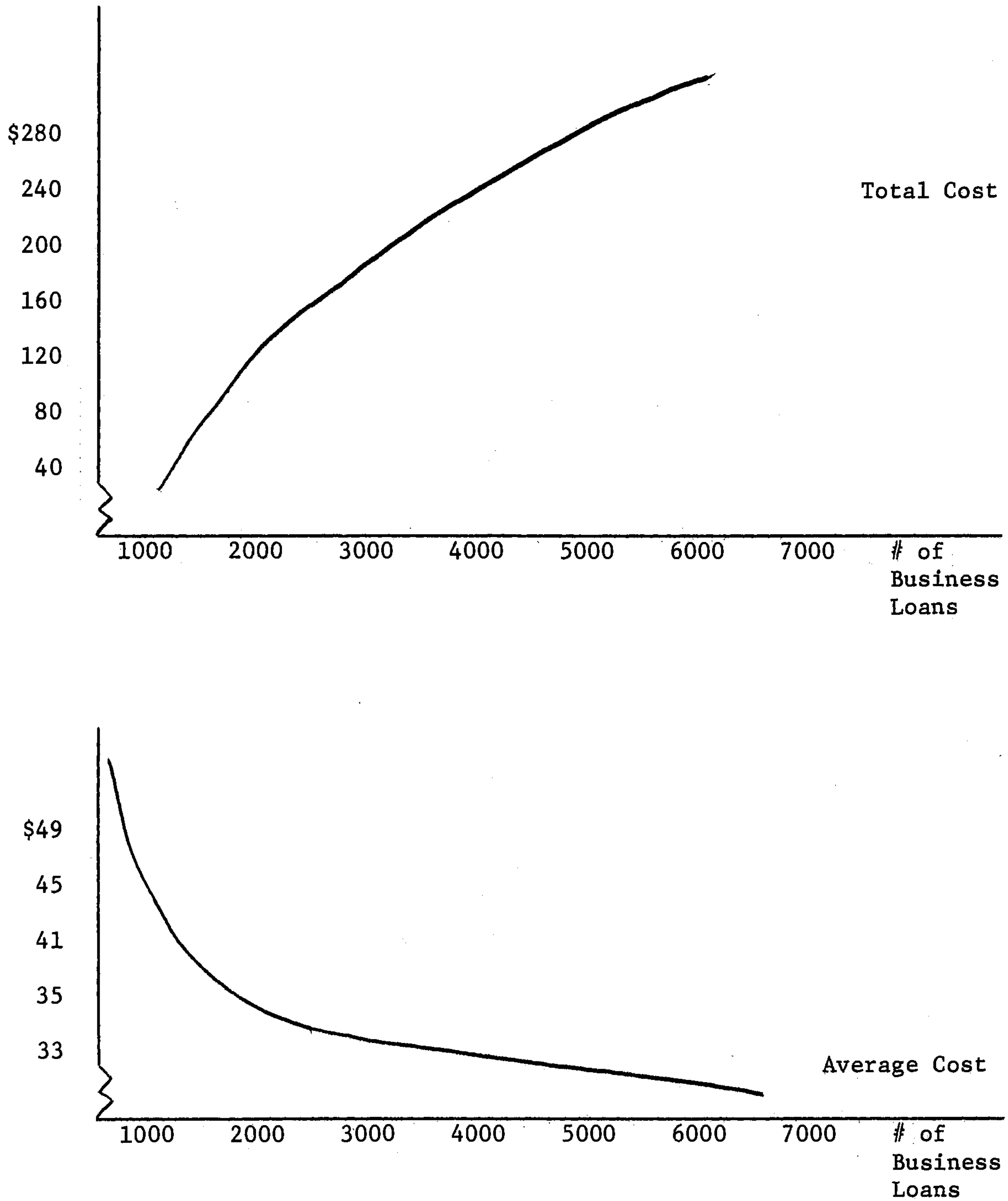
$$\log TC = -2.468 + .9172 \log N_B$$

where N_B = number of business loans.

F. W. Bell and N. B. Murphy, Costs in Commercial Banking, Federal Reserve Bank of Boston Publication #41 (Boston, 1968), p. 49.

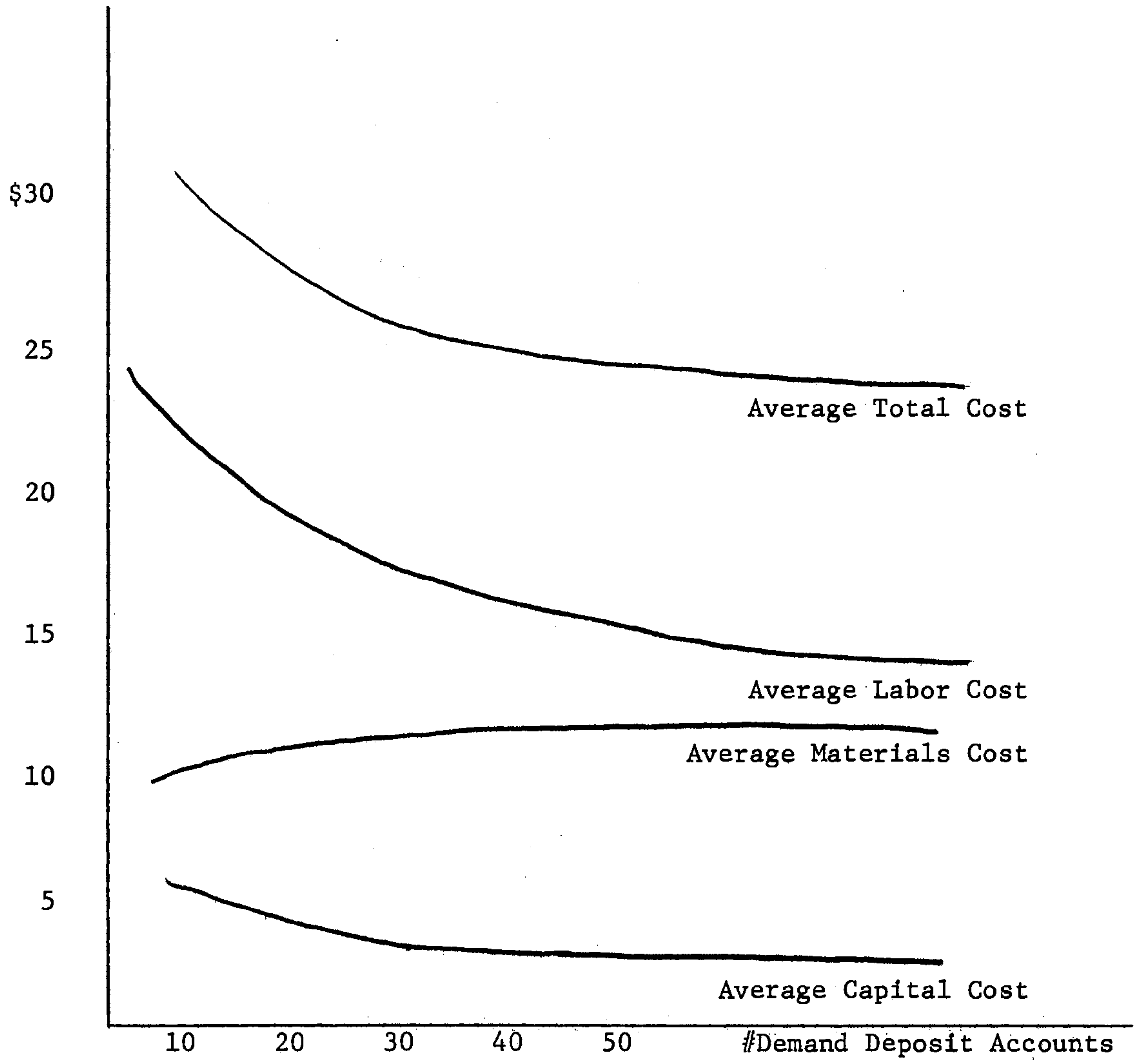
[23]Frederick W. Bell and Neil B. Murphy, "Economies of Scale in Commercial Banking: Specialization and Technology," New England Business Review (April, 1967), p. 2.

[24]Ibid., pp. 4 and 7.



Source: Frederick W. Bell and Neil B. Murphy, "Economies of Scale in Commercial Banking: The Measurement and Impact," New England Business Review (March, 1967), p. 7.

Figure 5. Total and Average Costs as Related to the Number of Business Loans



Source: Frederick W. Bell and Neil B. Murphy, "Economies of Scale in Commercial Banking: Sepcialization and Technology," New England Business Review (April, 1967), p. 4.

Figure 6. Average Costs as Related to the Number of Demand Deposit Accounts

increased, and average capital costs remained virtually constant with growth in the number of demand deposits.[25]

Figure 7 summarizes Bell and Murphy's findings on the source of economies of scale when the number of business loans are used as the measure of bank output.

In the third article, Bell and Murphy were concerned with the relationship between economies of scale and branch banking. Their conclusion was that bank expansion which was the result of additional branches did not result in economies of scale.[26] That is, moving from a small branch banking operation to a large one resulted in cost per account rising by nine-tenths of one percent at every level of output.[27] In the case of business loans, larger branch banking operations had costs per loan which were five-tenths of one percent greater than the cost per loan of smaller branch banking operations.[28]

The final article in this series is concerned with policy recommendations. Their conclusion with regard to the relative

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[25]The estimating equations for labor, materials, and capital costs in Figure 6 are as follows:

$$\log TLC = -2.3288 + .8739 \log N_D$$
$$\log TMC = -2.883 + 1.0174 \log N_D$$
$$\log TKC = -3.7227 + .9548 \log N_D$$

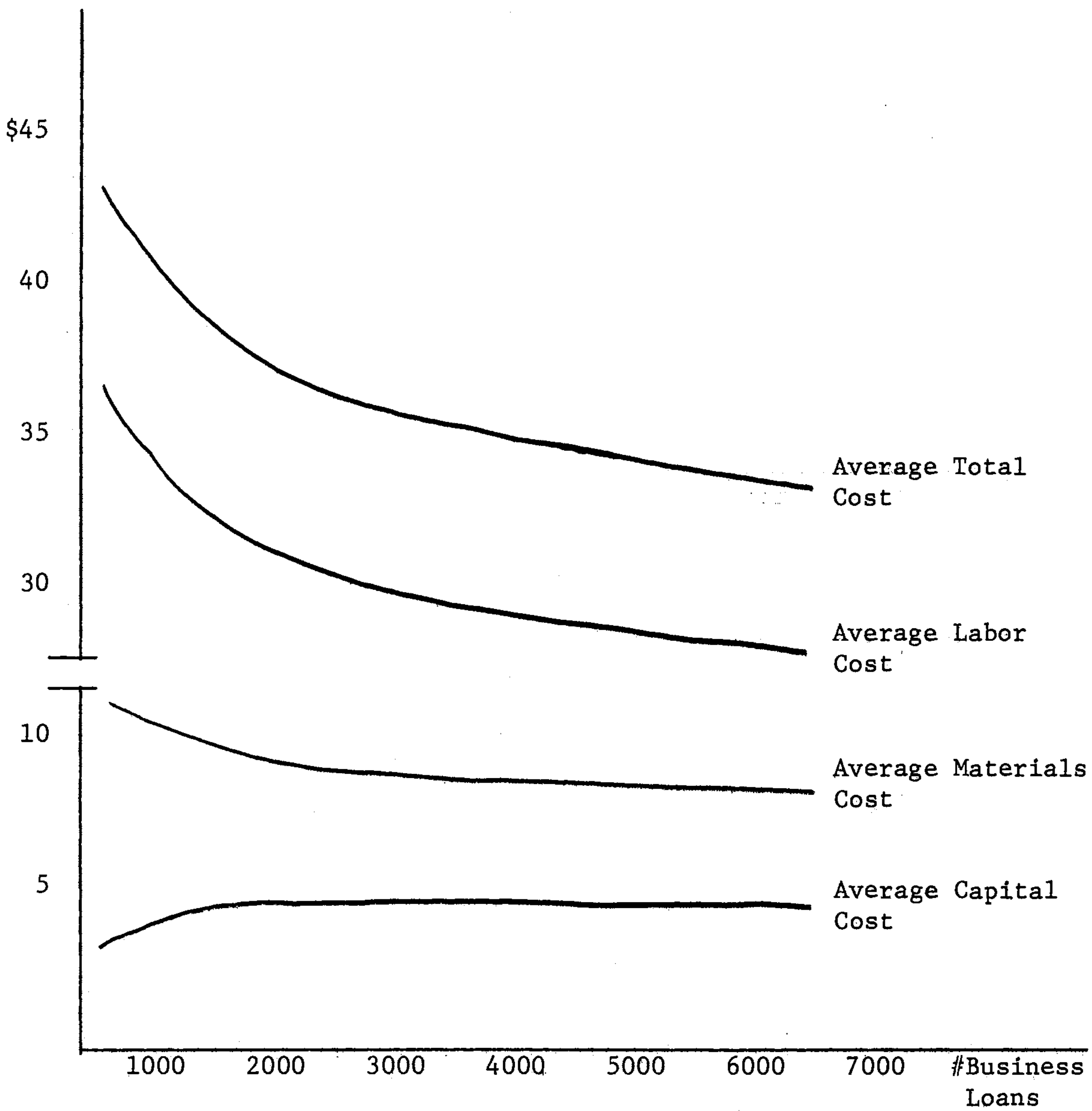
where TLC = total labor cost
TMC = total materials cost
TKC = total capital cost

F. W. Bell and N. B. Murphy, Costs in Commercial Banking, (Boston, 1968), p. 149.

[26]Frederick W. Bell and Neil B. Murphy, "Economies of Scale in Commercial Banking: The Overall Impact of All Cost Factors," New England Business Review (June, 1967), p. 13.

[27]Ibid., p. 14.

[28]Ibid., p. 15.



Source: Frederick W. Bell and Neil B. Murphy, "Economies of Scale in Commercial Banking: Specialization and Technology," New England Business Review (April, 1967), p. 7.

Figure 7. Average Costs as Related to the Number of Business Loans

desirability of establishing either a new unit bank or permitting an additional branch is that it depends on the scale of operation involved and on the objectives of the regulating board. If cost is the principal consideration and the potential size is large enough, then a new bank is preferable to an additional branch.[29]

George Benston

George Benston completed a study which also supports the existence of economies of scale.[30] As discussed above,[31] Benston argued that bank output should be defined in terms of physical units (such as number of accounts) rather than in dollar terms. Using physical units as a measure of output, Benston found that commercial banks were subject to economies of scale.[32] Benston used multiple regression analysis to estimate the relationship between bank output and average total cost.

Benston's regression analysis indicated that total direct expenses of banks in his sample was a function of bank output. Specifically his estimates indicated that a given increase in bank output was associated with a less than proportionate increase in total direct cost -- indicating that average total cost declined as bank output increased.[33]

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[29] Frederick W. Bell and Neil B. Murphy, "Economies of Scale in Commercial Banking: The Role of Costs in Banking Regulation," New England Business Review (July, 1967), p. 19.

[30] George Benston, "Economies of Scale and Marginal Cost in Banking," National Banking Review, IV, No. 2 (June, 1965).

[31] See page 22, Chapter II.

[32] Ibid., p. 541.

[33] Ibid., p. 514.

Stuart Greenbaum

Further support for the hypothesis of economies of scale in commercial banking appears in a National Banking Review article by Stuart Greenbaum.[34] Greembaum found that U-shaped average cost curves were characteristic of banks in the fifth and tenth Federal Reserve districts, and that the optimum size output (measured in terms of a weighted aggregation of the various types of earning assets) existed at an output level equal to 62 percent of the output of the largest bank in his sample.[35] However, only two percent of the banks in his sample operated in the rising portion of the average total cost curve, whereas a movement from the lowest output level to the optimum level resulted in a 33 percent reduction in average cost.[36]

John Powers

John A. Powers' study offers additional evidence that economies of scale exist in commercial banking; however, most of his study is concerned with economies of structure, or with whether or not branch banking offers cost advantages over unit banking.[37] In addition, Powers approaches his study from the standpoint of social welfare; that is, he is not concerned with bank management and therefore his study is not

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[34] Stuart I. Greenbaum, "A Study of Bank Cost," National Banking Review, VI, No. 2 (June, 1967), p. 426.

[35] Ibid., pp. 426-427.

[36] Ibid., p. 427.

[37] John A. Powers, "The Existence of Economies of Structure and of Economies of Scale in Commercial Banking" (unpub. Ph.D. dissertation, Perdue University, 1966).

intended to be used "in intrabank decision making. Its value lies in its conforming rather closely to what is meant by the social value of what a bank produces."[38] Since Powers uses a social welfare approach to commercial bank management, he devises an extremely complex method of determining and weighting bank output; all of which, as he notes, is not particularly relevant to a study using a micro ("intrabank") approach to bank management. But even using a social welfare approach Powers finds evidence to support the hypothesis that economies of scale exist in commercial banking. Specifically, Powers states,

> In previous studies concerned with economies of scale in banking, the evidence supported the hypothesis that economies of scale do exist . . . the results of this study tend to lend support to this hypothesis.[39]

His results are as follows: of the 24 banks in his sample, 14 exhibit a decline in long run average cost from the lowest observed output to the highest,[40] and of the 10 banks exhibiting an increase in long run average cost from the lowest observed output to the highest, only 5 display uniformly increasing average costs.[41]

Summary of the Chapter

From the above summary of the literature; it is apparent that a bank manager concerned with the minimization of his unit costs must consider the advantages inherent in a larger scale of enterprise.

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[38] Ibid., p. 50.

[39] Ibid., pp. 44-45.

[40] Ibid., p. 48.

[41] Ibid., p. 49.

However, it should be noted that most studies show that scale economies are particularly significant for smaller size banks. Once again, from the point of view of the present study, the significance of these findings is that one must control for bank size in attempting to ascertain the impact of deposit variability on unit costs in commercial banking.

CHAPTER IV

DEPOSIT VARIABILITY AS A FUNCTION OF BANK OUTPUT

Introduction

In the present study deposit variability is treated as a variable influencing unit cost in commercial banking. Treating deposit variability as a determinant of unit cost represents a marked departure from the existing literature on deposit variability. Consequently, the summary of the literature presented below does not provide any direct support for the present hypothesis, but is presented in order to establish that deposit variability is a current topic of research interest.

Deposit Variability in Commercial Banking: Summary of the Literature

In the survey of the literature presented below, most of the studies conclude that deposit variability is inversely related to bank size. However, it should be noted that the statistical evidence presented in several of the studies in support of this conclusion is not particularly compelling, and, in fact, one of the authors rejects this conclusion altogether.

Lyle Gramley

One of the earliest studies dealing with deposit variability is that of Lyle Gramley.[1] Gramley emphasizes the need to look at the deposit variability from the standpoint of individual banks since aggregate deposit figures tend to mask the existence of individual bank deposit variability.[2] As Gramley expresses it:

> The behavior of total deposits at large groups of banks has been characterized in recent years by an impressive degree of stability which individual banks typically do not enjoy. At all member banks in the Federal Reserve System for example, total deposits have been remarkably stable in the postwar period.[3]

The principal contribution of the Gramley article, however, is his conclusion that short-term deposit losses are inversely related to bank size.[4] Gramley's findings are summarized in Table I. In order to measure the short term deposit loss, Gramley first measures the average daily deposit level for each bank in his sample over a three and one-half month period. Next, he expresses each change in average daily deposit level figures as a percent of the mean level of deposit. Finally, he calculates the mean value of these percent figures.

As Table VI reveals for the banks in Gramley's sample, short run deposit changes range from a low of 16 percent to a high of 37 percent. Moreover, the deposit change levels in the table mean that, on the average, his largest size banks ($25 million and over) have deposit changes which are approximately 20 percent smaller than those for his smaller size banks. These results are statistically significant at the

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[1]Lyle E. Gramley, "Deposit Instability at Individual Banks," <u>Essays on Commercial Banking</u> (Kansas City, 1962).

[2]Ibid., p. 42.

[3]Ibid., p. 45.

[4]Ibid., p. 45.

.05 level.[5] In conclusion Gramley asserts,

> The smaller short run deposit losses for larger banks cannot reasonably be attributed to the presence of a high long run growth factor at these banks, for the influence of long run deposit growth is of minor importance in periods of six months or less.[6]

TABLE I

SHORT RUN DEPOSIT LOSSES IN THE TENTH FEDERAL RESERVE DISTRICT[a]

Bank Size (total deposits) million dollars	Average Percent Change in Deposit Level	Range of Deposit Level Changes	
		Low Percent	High Percent
Below 2	26.8	20.4	37.1
2-5	25.5	17.8	33.8
5-10	25.6	20.8	33.2
10-25	25.2	20.2	30.5
Over 25	20.6	15.9	29.8

[a]Source: Lyle E. Gramley, "Deposit Instability at Individual Banks," contained in Essays on Commercial Banking published by the Federal Reserve Bank of Kansas City, 1962.

Gramley's conclusions are, then, that evidence points to greater deposit variability at small banks in the tenth Federal Reserve district and that the most satisfactory explanation of this lies in the lack of

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[5]Ibid., p. 45.

[6]Ibid., pp. 44-45.

diversification of deposit ownership which is a characteristic of small banks.[7] Furthermore, Gramley believes that his findings can probably be generalized to the banking industry as a whole, although he stresses that further study is needed before this extension is conclusively accepted.[8]

C. Rangarajan

In the initial portion of his article, C. Rangarajan discusses the significance of deposit variability to portfolio management in terms of its increasing the need for liquidity in the bank's portfolio of earning assets.[9] According to Rangarajan, some evidence that deposit variability has a direct impact on the need for liquidity is provided by the fact that time deposits (which are presumed to be more stable than demand deposits) are subject to a lower reserve requirement than are demand deposits.[10]

The main thrust of the Rangarajan article, however, is not that one particular type of liability is subject to greater variability than another, but that the same liability is subject to greater or lesser degrees of variability depending on the size of the bank holding that variability.[11] Specifically, Rangarajan finds that, "As the size of a

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[7] Ibid., p. 50.

[8] Ibid., p. 51.

[9] C. Rangarajan, "Deposit Variability in Individual Banks," National Bank Review (September, 1966), p. 61.

[10] Ibid., p. 61.

[11] Ibid., p. 61.

bank increases, variability in its level of demand deposits decreases."[12]

In support of his hypothesis, Rangarajan did a regression analysis which used a double log relationship in order to ascertain the nature of the relationship between deposit variability and bank size.[13] The measure of deposit variability used by Rangarajan was the standard deviation over the mean, and total output was measured by the dollar level of deposits. Although he did not present the results of any tests of significance, Rangarajan stated that the results of his regression analysis substantiated that an inverse relationship existed between bank size and deposit variability.[14] Specifically, he stated that his regression estimates indicated that a 100 percent increase in bank size was associated with a five percent decrease in deposit variability.[15]

Rangarajan maintains that one of the explanations of the greater stability of the deposits of larger banks lies in the flow of funds from one account to another:

> The larger the bank, the greater the probability that a check drawn on a given account will be credited to another account in the same bank. For this reason, even if individual accounts are volatile, the aggregate may not be.[16]

In addition to the article discussed above, Rangarajan's doctoral dissertation deals, in part, with the significance of deposit

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[12]Ibid., p. 62.

[13]Ibid., p. 68.

[14]Ibid., p. 68.

[15]Ibid., p. 68.

[16]Ibid., p. 65.

variability for an individual bank.[17] Since the National Banking Review article is based on this part of his dissertation, most of his findings have already been summarized.

Of particular interest in this second work, however, is the fact that Rangarajan presents the results of his regression analysis along with tests of significance. One of these results is as follows:[18]

$$\log V = -.2572 - .053 \log N$$

where V = deposit variability
N = bank output.

The above relationship was statistically significant at .05 percent, but Rangarajan obtained an R^2 of only .04. Thus, it would appear that while deposit variability was related to bank size there were other variables (besides bank size) which were also of considerable significance in explaining differences in the degree of deposit variability experienced by individual banks.

Donald Fraser

As did Rangarajan, Donald Fraser first emphasizes that deposit variability is a major determinant of the need for asset liquidity, and that it is therefore of "crucial significance" to an individual bank.[19] Next Fraser summarizes some of the results of earlier studies which show that a positive relationship exists between deposit stability and bank

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[17] C. Rangarajan, "Variability of Demand Deposits," (Unpub. doctoral dissertation, University of Pennsylvania, 1964), pp. 127-163.

[18] Ibid., p. 148.

[19] Donald Fraser, "A Note on Deposit Stability," Business Review, Federal Reserve Bank of Dallas (March, 1967), p. 3.

size. Fraser offers two explanations for accepting these results:

> (1) Larger banks have more diversity in the ownership of their deposits. As a result, there is a greater probability that the fluctuations in demand deposits of one group will be offset by the variations (in the opposite direction) in the deposit holdings of another group.
>
> (2) Related to this diversity of ownership, the probability is also greater that a check drawn upon the larger bank will be paid to someone who has an account with the (same) bank.[20]

The empirical portion of Fraser's study is concerned with testing to determine if: (1) the inverse relationship between bank size and deposit variability found in earlier studies is characteristic of banks in the eleventh district, and (2) time deposits are less variable than demand deposits.[21]

Using data on individual banks in the eleventh district, Fraser calculated the coefficient of variation as a measure of deposit variability (for both time deposits and demand deposits), and he used total deposits as his measure of bank output.[22] Using these measures for deposit variability and bank size, Fraser ran a series of regressions, the results of which indicated "that there was little or no relation between bank size and deposit variability for either demand or time deposits."[23] This was especially evident in the case of time deposits. Consequently, Fraser concluded that the substantial amount of interbank

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[20]Ibid., p. 5.

[21]Ibid., p. 4.

[22]Ibid., p. 3.

[23]Ibid., p. 4.

differences in time deposit variability was "apparently the result of some other factor or factors than bank size."[24]

Thus Fraser found that, while banks in the eleventh district were characterized by considerable interbank differences in stability of deposits, these differences--especially in the case of time deposits--were not particularly related to bank size.

Struble and Wilkerson

Frederick M. Struble and Carroll H. Wilkerson have two articles dealing with deposit variability. Their first article is primarily concerned with the impact of time deposits on the overall level of deposit variability in the banking system.[25] The authors point out that the liquidity position of commercial banks in general has declined since 1962.[26] Since deposit variability is a principal determinant of the need for bank liquidity, the authors suggest that the observed decline in the level of bank liquidity may be due to a simultaneous change in the composition of bank deposits which results in less overall deposit variability.[27]

Specifically, the authors found that since 1962 the growth of time and saving deposits, "far surpassed that of demand deposits . . . . resulting in a marked increase in the ratio of time and saving deposits

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[24]Ibid., p. 7.

[25]Frederick M. Struble and Carroll H. Wilkerson, "Deposit Variability at Commercial Banks," Monthly Review of the Federal Reserve Bank of Kansas City (July-August, 1967).

[26]Ibid., p. 27.

[27]Ibid., p. 27.

to total deposits."[28] It was the growth of time deposits rather than savings deposits which the authors believe contributes to the reduction in the overall level of deposit variability.[29] Their conclusion is that such a shift in the composition of deposits is expected to reduce deposit variability, since time deposits are generally believed to be more stable than demand deposits.[30] Their results tend to support this assumption (see Table II). As the data below reveal, for each of the six years analyzed, time deposits are more stable than demand deposits.

TABLE II

DEPOSIT VARIABILITY IN THE TENTH FEDERAL RESERVE DISTRICT[a]

	1961	1962	1963	1964	1965	1966
Ratio of time deposits to total deposits	.26	.30	.32	.34	.36	.40
Total deposit variability	3.3	3.0	3.0	3.0	3.0	2.9
Demand deposit variability	4.3	4.2	4.3	4.3	4.3	4.4
Time deposit variability	2.5	2.5	2.1	1.9	1.9	2.2

[a]Source: Frederick M. Struble and Carroll H. Wilkerson, "Deposit Variability at Commercial Banks," Monthly Review of the Federal Reserve Bank of Kansas City (July-August, 1967), p. 31.

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[28]Ibid., p. 27.

[29]Ibid., p. 29.

[30]Ibid., p. 27.

Notice also that demand deposits grew as a percent of total deposits, and, finally, that overall deposit variability declined in the six-year period analyzed.

Struble and Wilkerson summarize their findings as follows: "The evidence suggests that if all other conditions are held constant, an increase in the proportion of total time and saving deposits will reduce the variability of total deposits."[31]

In their second article, the same authors introduce bank size as a variable.[32] In this article the authors ascertain two things: first, that larger banks are characterized by less overall deposit variability, and, second, that larger banks have less variability in each of several subcategories of deposits analyzed. Before presenting their own findings, the authors provide a tentative basis for testing the hypothesis that greater deposit stability is associated with larger banks:

> First larger banks have a greater number of deposit customers and in most cases these customers receive their incomes from a wide number of different industries and occupations. As a result, there would appear to be a greater tendency for withdrawals by some depositors to be offset by the additions of other depositors . . . Moreover, it is likely that the deposit customers of large banks are located in a wider geographic area and this should reduce the chance for natural catastrophes . . . to affect coincidently the economic fortunes of a large proportion of these depositors. Finally, it has been contended that the larger the size of a bank's total deposits the greater is the probability that funds will flow among its deposit accounts. That is, a check drawn on one account in the bank is more likely to be deposited in another account in the same bank.[33]

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[31] Ibid., p. 34.

[32] Ibid.

[33] Ibid., p. 5.

Table III summarizes the actual findings of the authors with regard to the relationship between bank size and overall deposit variability. As the table reveals, the larger banks do, in fact, tend to have greater overall deposit stability.

TABLE III

DEPOSIT VARIABILITY AS RELATED TO BANK SIZE IN THE TENTH FEDERAL RESERVE DISTRICT[a]

Bank Size (total assets) million dollars	Total Deposit Variability	Time and Savings Deposit Variability	Demand Deposit Variability
Less than 2	3.6	3.2	4.6
2-4.9	3.1	2.2	4.5
5-9.9	2.9	1.8	4.4
10-24.9	2.5	1.6	3.5
25-99.9	2.1	2.5	4.0
100 and over	2.7	2.5	3.8

[a]Source: Frederick M. Struble and Carroll H. Wilkerson, "Bank Size and Deposit Variability," Monthly Review of the Federal Reserve Bank of Kansas City (November-December, 1967), p. 90.

Table III also contains the relationship between bank size and the level of variation of time and saving deposits and of demand deposits. While the table does indicate that, on the whole, larger bank size is associated with reduced deposit variability, it should also be noted that the total deposit variability of the largest category of bank size exceeds the deposit variability of the next two smaller categories. Moreover, time deposits variability is less for the second, third, and fourth categories of bank size than it is for the largest category of bank size. Finally, the largest size category has greater demand deposit variability than does the fourth largest category.

These findings led Struble and Wilkerson to conclude, "The evidence presented in this study tends to support the hypothesis that demand deposits and total deposits are more stable at larger banks."[34]

Summary of the Chapter

The above summary of the literature suggests that it is difficult to draw any clear or consistent conclusion regarding deposit variability. That is to say, a perusal of this literature leaves one with no clear understanding of the policy implications of deposit variability for the management of a commercial bank. It is true that several of the studies conclude that deposit variability is inversely related to bank size. However, there are some authors who dispute this conclusion. Moreover, to conclude that larger banks have less deposit variability does not seem to be a particularly useful conclusion unless one can clearly demonstrate that reduced deposit variability carries with it an advantage in the form of increased profitability stemming from cost savings or increased revenues, and none of the existing studies satisfactorily relates deposit variability to bank profit. In short, the existing literature suggests the need for more elaboration on the significance of deposit variability to a commercial bank.

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[34]Frederick M. Struble and Carroll H. Wilkerson, "Bank Size and Deposit Variability," <u>Monthly Review of the Federal Reserve Bank of Kansas City</u> (November-December, 1967), p. 9.

CHAPTER V

ANALYSIS OF DATA

Introduction

In this chapter, the analysis of data on bank cost and deposit variability is presented. Cost and deposit variability data are for individual banks in a sample drawn from the Tenth and Eleventh Federal Reserve Districts. The data are taken from Federal Reserve work sheets compiled from the bi-weekly reports submitted by all member banks to the two District Banks. The banks in the sample represent a cross section of small to large banks. In order to obtain such a cross section, banks in each of the two districts are first classified in five size categories: (1) total assets of less than two million, (2) assets of five to ten million, (3) assets of twenty-five to thirty-five million, (4) assets of fifty-five to seventy million, and (5) assets greater than one hundred million. Next, four banks are selected at random out of the total number of banks in each of the five classes of bank size for each of the two districts, yielding a total of eight banks in each size category.

As the above discussion suggests, the dollar value of bank assets is used as the measure of bank output. This measure of bank output is used in most existing studies on economies of scale in banking. However, it should be noted that some writers argue that a physical measure of output such as the total number of accounts is the appropriate measure.[1] Benston arrives at this conclusion because he believes the conventional measure of bank size gives rise to unit cost differences which do not reflect differences in managerial efficiency.

For example, if one bank has 100 separate accounts each with an average daily deposit level of $50, and a second bank also has 100 accounts, but each account has an average daily deposit level of $100, then both banks incur the same total cost in servicing their accounts -- provided they are being operated at the same level of efficiency. At the same time, however, the second bank has twice the dollar value of assets as the first bank. Thus, if the total number of accounts is used as a measure of output, the two banks in this example would have the same average cost of servicing accounts; whereas if total dollar value of assets were used as a measure of output, then the bank with the greater dollar value of assets would have a lower average cost of servicing accounts. Thus, if one were to use the dollar value of assets, and thereby obtain a lower average cost of servicing accounts for the second bank in the example, it would be interpreted to mean the second bank is managed more efficiently than the first which, according to Benston, is not the case.

The present study rejects the Benston measure of bank output because in the present study, bank size is defined from the point of

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[1] George Benston, "Economies of Scale and Marginal Cost in Banking," National Banking Review, IV (June, 1965).

view of the individual firm, and the individual firm regards output as that which produces revenue. Since in commercial banking revenue is derived almost exclusively from bank earning assets, the measure of bank output employed in the present study is the total dollar value of the bank's earning assets.

Greenbaum also objects to the use of the mean dollar value of assets as a measure of output. Greenbaum is concerned with the "socially" desirable size for a bank, which is to be determined on the basis of the lowest average cost of providing the bank's most socially desirable service.[2] This necessitates that the various services offered by a bank be weighted on the basis of their social desirability.

Aside from the difficulty of determining what constitutes the most socially desirable service, it would seem to be equally valid to define average cost from the point of view of the banker or individual firm. Once again, since bank earning assets are what produce revenue for a bank, they fit the firm's concept of output and should be used in determining the average cost if one is using a micro approach. Greenbaum himself admits that 90 percent of all bank earning are from interests on assets.[3] Consequently, a lower average cost determined by using earning assets as a measure of output represents an optimum situation from the firm's point of view.

Once a measure for bank output was decided upon and the sample drawn, data were collected on a total annual direct wage and salary

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[2]Stuart L. Greenbaum, "Competition and Efficiency in the Banking System," Journal of Political Economy (August, 1967).

[3]Ibid., p. 466.

expenses, total annual operating costs, and bi-weekly deposit levels. These individual bank data were collected for three years (1964-1966) for banks in the Eleventh District and for four years (1963-1966) for banks in the Tenth district. The difference in the number of years of data collected in the two districts resulted from differences in data storage techniques which permitted retrieval of only three years of data in the Eleventh District.

The data are analyzed to determine three things: (1) whether economies of scale exist, (2) whether deposit variability is inversely related to bank size, and (3) whether average labor cost is directly related to deposit variability. In the first two cases, the analysis represents an attempt to corroborate the extent to which the present data support the conclusions of earlier studies on bank size and deposit variability; in the third case, the data are analyzed in order to test the present hypothesis. The remainder of the chapter is divided into three sections containing separate discussions of the three issues.

Economies of Scale

Bivariate regression analysis is employed to test for economies of scale. The results of this regression analysis support the conclusions of earlier studies. That is to say, the analysis of cost data indicates that economies of scale are characteristic of banks in the sample.

In order to use bivariate regression analysis to test the hypothesis of economies of scale, the estimating equations are of the following form:

$$ATC = a_o + b_oN$$

where ATC = average total cost

N = bank size.

The sample size for all years except 1963 was 40 banks. In 1963 the sample size was 20 banks and was comprised entirely of banks from the Tenth District. Table IV summarizes the principal results of the regression analysis. As the table reveals, the signs of the regression coefficients are consistently negative indicating that the regression analysis yields estimating equations which support the hypothesis of economies of scale. In addition, the F ratios in the table indicate that average total cost is significantly related to bank size for every year of data analyzed, and that the level of significance is consistently at the .01 level. Finally, the r^2 values range from .41 to .59 and the standard errors of the estimates range from .38 to .54, indicating variation around the regression line of .38 to .54 dollars per hundred dollars of total assets.

As discussed in Chapter III, most studies on economies of scale in commercial banking conclude that technological considerations are negligible in explaining the per unit cost reduction associated with expanded bank output. The general conclusion is that reduced average total cost is due primarily to reduced average labor cost resulting from greater specialization and division of labor. In support of this conclusion, bivariate regression analysis is run in which average labor cost is made a function of bank size. The data indicates that average labor cost is a function of bank size when the estimating equations are of the following form:

$$ALC = A_1 + b_1N$$

where ALC = average labor cost

N = bank size.

Table V contains a summary of the results of the regression analysis. As the table reveals, the signs of the regression

TABLE IV

REGRESSION ANALYSIS OF THE INFLUENCE OF BANK SIZE
ON AVERAGE TOTAL COST IN COMMERCIAL BANKING

(Average Total Cost in Dollars per Hundred Dollars of Bank Assets)

Year	a_o	b_o	F Ratio	Level of Significance	Standard Error of Estimate	r^2
1963	3.2553	-.0066 (.0019)	12.0873	.01	.4288	.41
1964	3.7572	-.0133 (.0036)	11.5778	.01	.5419	.44
1965	4.0514	-.0093 (.0020)	23.6515	.01	.4085	.56
1966	4.4755	-.0112 (.0023)	19.6166	.01	.3834	.59

TABLE V

REGRESSION ANALYSIS OF THE INFLUENCE OF BANK SIZE ON AVERAGE LABOR COST IN COMMERCIAL BANKING

(Average Labor Cost in Dollars per Hundred Dollars of Bank Assets)

Year	a_1	b_1	F Ratio	Level of Significance	Standard Error of Estimate	r^2
1963	1.5472	-.0053 (.0015)	12.6284	.01	.3320	.49
1964	1.5714	-.0060 (.0017)	22.3361	.01	.3360	.54
1965	1.5056	-.0059 (.0013)	28.8302	.01	.2699	.62
1966	1.6332	-.0065 (.0017)	23.8956	.01	.3414	.67

coefficients are consistently negative indicating estimating equations in which expanded bank output is associated with reduced average labor cost as is hypothesized. In addition, the F ratios contained in the table indicate that average labor cost is consistently related to bank bank size at the .01 level of significance for each year of data analyzed. Finally, the r^2 values range from .49 to .67 and the standard errors of the estimates range from .27 to .34, indicating .27 to .34 dollar variation in average labor cost per hundred dollar of total assets.

In summary, the results discussed above indicate that average total cost and average labor cost are significantly influenced by bank size. Once again, these findings are consistent with the conclusions reached in earlier studies concerned with economies of scale in commercial banking.

Deposit Variability

In the following discussion, the data on deposit variability are analyzed in order to ascertain the extent to which these data support the conclusions reached in earlier studies. That is to say, the data are analyzed solely to ascertain whether an inverse relationship exists between deposit variability and bank size.

The measure of deposit variability used is one employed by Lyle Gramley.[4] Gramley's index of variability is obtained by calculating the percent deviation of each bi-weekly deposit level from the mean

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[4]Lyle Gramley, "Deposit Instability at Individual Banks," Essays on Commercial Banking (Federal Reserve Bank of Kansas City, 1962), p. 41.

level of deposits for the entire year and then computing the mean value of these percent deviations.

Table VI summarizes the results of bivariate regression analysis of the influence of bank size on deposit variability for the sample of banks for which data are collected. In order to test the hypothesis that reduced deposit variability is associated with expanded bank output, the estimating equations resulting from the bivariate regression are of the following form:

$$DV = a_2 + b_2 N$$

where: DV = deposit variability
N = bank size.

Table VI summarizes the results of the regression analysis. As the table reveals, the signs of the regression coefficients are negative, indicating that the estimating equations are consistent with the hypothesized relationship between deposit variability and bank size. However, the table also contains F ratios which indicate that the level of significance in two out of four years is less than .10 and in the remaining two years the level of significance is at the .05 level. Finally, the r^2 terms range from .08 to .22, and the standard errors of the estimates range from .49 to .87 indicating variation around the regression line of .49 to .87 dollars per hundred dollars of assets.

In summary, regression analysis of the data tends to indicate that deposit variability is influenced by bank size. However, the relationship is apparently a fairly weak one, as indicated by a very low level of significance in two out of the four years analyzed, and by the fact that in the remaining two years, the level of significance is no greater than .05. Moreover, the r^2 values tend to be low and the standard errors of the estimates tend to be high. Consequently, the

TABLE VI

REGRESSION ANALYSIS OF THE INFLUENCE OF BANK SIZE ON DEPOSIT VARIABILITY OF COMMERCIAL BANKS

Year	Constant a_2	b_2	F Ratio	Level of Significance	Standard Error of Estimate	r^2
1963	2.2764	-.0073 (.0034)	4.477	.05	.7739	.16
1964	3.1534	-.0098 (.0039)	2.617	.25	.7963	.14
1965	2.6746	-.0095 (.0035)	5.925	.05	.4899	.22
1966	2.8528	-.0055 (.0043)	2.784	.25	.8699	.08

findings tend to support Fraser's conclusion that a substantial amount of inter-bank differences in deposit variability is attributable to factors other than bank size.[5] Thus, the results raise a question as to the validity of Rangarajan's conclusion that bank size is a major determinant of deposit variability.

The Impact of Deposit Variability on Average Labor Cost in Commercial Banking

In the following section, a discussion of the multiple regression analysis undertaken to test the hypothesis is presented. The theoretical foundation for the hypothesis that average labor cost is influenced by deposit variability is presented in Chapter II, and that analysis is not repeated in any detail in the present chapter.

As discussed in the preceding chapters, a substantial number of studies have established bank output as an independent variable influencing unit costs in commercial banking. These earlier studies ascertained that as the level of bank output expanded, unit costs declined. The general conclusion reached in these studies was that observed cost savings in commercial banks were primarily the result of the greater specialization and division of labor permitted by a larger scale of enterprise.

The present study is related to these earlier studies in that it too is concerned with variables which influence per unit labor cost in commercial banking. Moreover, the present study accepts the conclusion reached in earlier studies that the relationship between average labor

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[5]Donald Fraser, "A Note on Deposit Stability," Business Review, Federal Reserve Bank of Dallas (March, 1967), p. 7.

cost and bank output is such that a bank's average labor cost curve is negatively sloped; however, the present study advances an additional hypothesis, namely that the degree of deposit variability associated with any given level of bank output determines the height of the average labor cost curve. Specifically, it is assumed that the greater the deposit variability, the higher is the average labor cost curve. In other words, it is hypothesized, that, if bank size is held constant, an increased amount of deposit variability results in higher average labor cost.

The technique employed in order to control for bank size, and thereby determine the influence of deposit variability on average labor cost, is the dummy variable approach suggested by Daniel B. Suits.[6] This technique is employed because linear regression yields biased estimates in the event that a nonlinear relationship exists between average labor cost and bank size; by partitioning the scale of bank size into discrete intervals, unbiased estimates are obtained because the regression coefficients of the dummy variables conform to any curvature that is present.[7]

In using the dummy variable technique to estimate a regression equation, it is necessary to set the regression coefficient of one category of bank size equal to zero; in other words, it is necessary to drop one of the five categories of bank size as an independent variable

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[6]Daniel B. Suits, "Use of Dummy Variables in Regression Equations," Journal of the American Statistical Association (1957), p. 548.

[7]Ibid., p. 551.

in the multiple regression equation. The regression coefficient and the test of significance for the missing category of bank size can be obtained by estimating a second regression equation in which the dropped category of bank size is included and one other category of bank size is deleted.

In the present case, the regression matrix associated with the use of the dummy variable technique contains entries of either zero or one in each of the columns representing the categories of bank size. For a given row in the matrix, if the bank represented by that row falls into a particular size category, a one is entered in the column representing that size category and zeros are entered for all other categories of bank size. The remaining two columns in the matrix contain continuous observations for deposit variability and average labor cost.

The computer program employed is the University of California at Los Angeles Biomedical Data (UCLA-BMD) step-wise regression program which computes a sequence of multiple linear regression equations in a step-wise manner. At each step one variable is added to the regression equation. The order in which the variables are added is determined on the basis of which variable has the highest partial correlation with the dependent variable. The F level for inclusion is .01 and for deletion, .005.

To serve as a test of the hypothesis, the estimating equation resulting from the regression analysis must be of the following form:

$$ALC = a + b_1DV + b_2N_1 + b_3N_2 + b_4N_3 + b_5N_4 + b_6N_5$$

where:

ALC = average labor cost

DV = deposit variability

N_i = bank size

N_1 = 1 for banks with assets of less than two million
= 0 for all other banks

N_2 = 1 for banks with assets of five to ten million
= 0 for all other banks

N_3 = 1 for banks with assets of 25 to 35 million
= 0 for all other banks

N_4 = 1 for banks with assets of 55 to 70 million
= 0 for all other banks

N_5 = 1 for banks with assets greater than one million
0 for all other banks.

To not reject the hypothesis, the regression coefficient for deposit variability must be positive. Table VII summarizes the results of the multiple regression analysis. As the table reveals, the regression coefficients are consistent with the hypothesis. In addition, the table reveals that when bank size is held constant, deposit variability is a significant variable influencing the average labor cost of banks in the sample. In fact, in the step-up regression technique employed, the independent variable selected first in each of the years analyzed is deposit variability indicating that deposit variability has the highest partial r^2 value. Moreover, for each of the four years analyzed, the partial F ratio for deposit variability indicates a level of significance of .01. Finally, for the four years of data analyzed, the coefficients of determination are greater than .70, and the standard errors of the estimate range from .17 to .24.

In assessing the impact of deposit variability on average labor cost, it is useful to compare the results of the regression analysis when average labor cost is a function of bank size with the results of the regression analysis when average labor cost is a function of bank size and deposit variability. Specifically, the inclusion of deposit

TABLE VII

MULTIPLE REGRESSION ANALYSIS OF THE RELATIVE INFLUENCE OF SELECTED VARIABLES ON LABOR COST PER HUNDRED DOLLARS OF BANK ASSETS

		Bank Size 1	Bank Size 2	Bank Size 3	Bank Size 4	Bank Size 5	Deposit Variability
1963							
Constant	.603						
Regression Coefficients		-.117	-.340	-.548	-.495	-.532	.266
F Ratios		.728	6.932	14.613	9.879	9.654	18.115
Levels of Significance		.50	.01	.01	.01	.01	.01
Coefficient of Determination	.864						
Standard Error of Estimate	.170						
1964							
Constant	.360						
Regression Coefficients		-.241	-.241	-.420	-.626	-.491	.290
F Ratios		2.381	1.608	6.782	12.375	9.564	19.326
Levels of Significance		.75	.75	.01	.01	.01	.01
Coefficient of Determination	.851						
Standard Error of Estimate	.189						

TABLE VII, Continued

		Bank Size 1	Bank Size 2	Bank Size 3	Bank Size 4	Bank Size 5	Deposit Variability
1965							
Constant	.338						
Regression Coefficients		-.195	-.089	-.478	-.345	-.383	.713
F Ratios		2.060	2.334	5.162	5.242	7.105	10.494
Levels of Significance		.25	.25	.05	.05	.01	.01
Coefficient of Determination	.791						
Standard Error of Estimate	.244						
1966							
Constant	.405						
Regression Coefficients		-.171	-.271	-.440	-.320	-.348	.790
F Ratios		.278	3.953	4.887	7.649	7.974	19.696
Levels of Significance		.75	.10	.05	.01	.01	.01
Coefficient of Determination	.872						
Standard Error of Estimate	.171						

variability as an independent variable reduces the standard error term by as much as one-half (from a range of .33 to .34 to a range of .17 to .24). Moreover, the coefficients of determination increase from a range of .49 to .67 to a range of .79 to .86.

Although the dummy variable approach is used primarily to distinguish clearly the influence of observed differences in deposit variability on average labor cost from the influence of changes in bank output on average labor cost, several aspects of the multiple regression analysis with regard to bank size are of particular interest when the relationship between average labor cost and bank size is non-linear. In the first place, as Table VII reveals, when bank size is partitioned into discreet intervals (as opposed to the bivariate regression analysis of Chapter II where bank size was a continuous variable), for the smaller categories of bank size, a consistently high level of significance is not found to exist between bank size and average labor cost. Specifically, in two out of four years analyzed, for the range of bank output from one to ten million, differences in average labor cost appear to be explained by variables other than differences in bank size, and in all four of the years analyzed, for banks in the category of less than one million in assets, the relationship between average labor cost and bank size is significant only at .25 level or below. Moreover, it is clear from Table VII that the absolute values of the regression coefficients for bank size category four are less than the absolute values of the regression coefficients for bank size category three in three out of four years (1963, 1965 and 1966). This means that when deposit variability is held constant, the estimating equations tend to yield higher average labor cost figures for banks in size category four than for banks in size category three. Moreover, when differences in deposit variability are taken into account, the regression coefficients indicate that the largest bank size category will be associated with higher average labor cost than bank size category three in the years 1964, 1965 and 1966. Figure 8 depicts the average labor cost values for the five categories of bank size. The cost figures are generated using the estimating equations for each of the four years and holding deposit variability constant. The actual values for deposit variability of the banks in the sample range from 1.9 to 4.6 percent, but for graphical purposes a value of 3.0 is used.

The results depicted in Figure 8 clearly represent a departure from the conclusions reached in most existing studies on bank costs which conclude that average labor declines continuously as bank size increases. However, it is significant to note that no existing study estimates the impact of increased bank size on average labor cost while explicitly controlling for differences in deposit variability, as is done in the present estimating equation. This exclusion of deposit variability as an independent variable in the estimating equations of earlier studies may explain the differences in results.

As to why banks in the two largest size categories tend to have higher average labor cost than banks in size category three when differences in deposit variability are taken into account, it may be that banks which are large tend to compete more aggressively for new deposits than do middle size banks and that this in turn explains their higher average labor cost when differences in deposit variability are taken out. While there is no evidence to support this conjecture, it does suggest a possible area for future research.

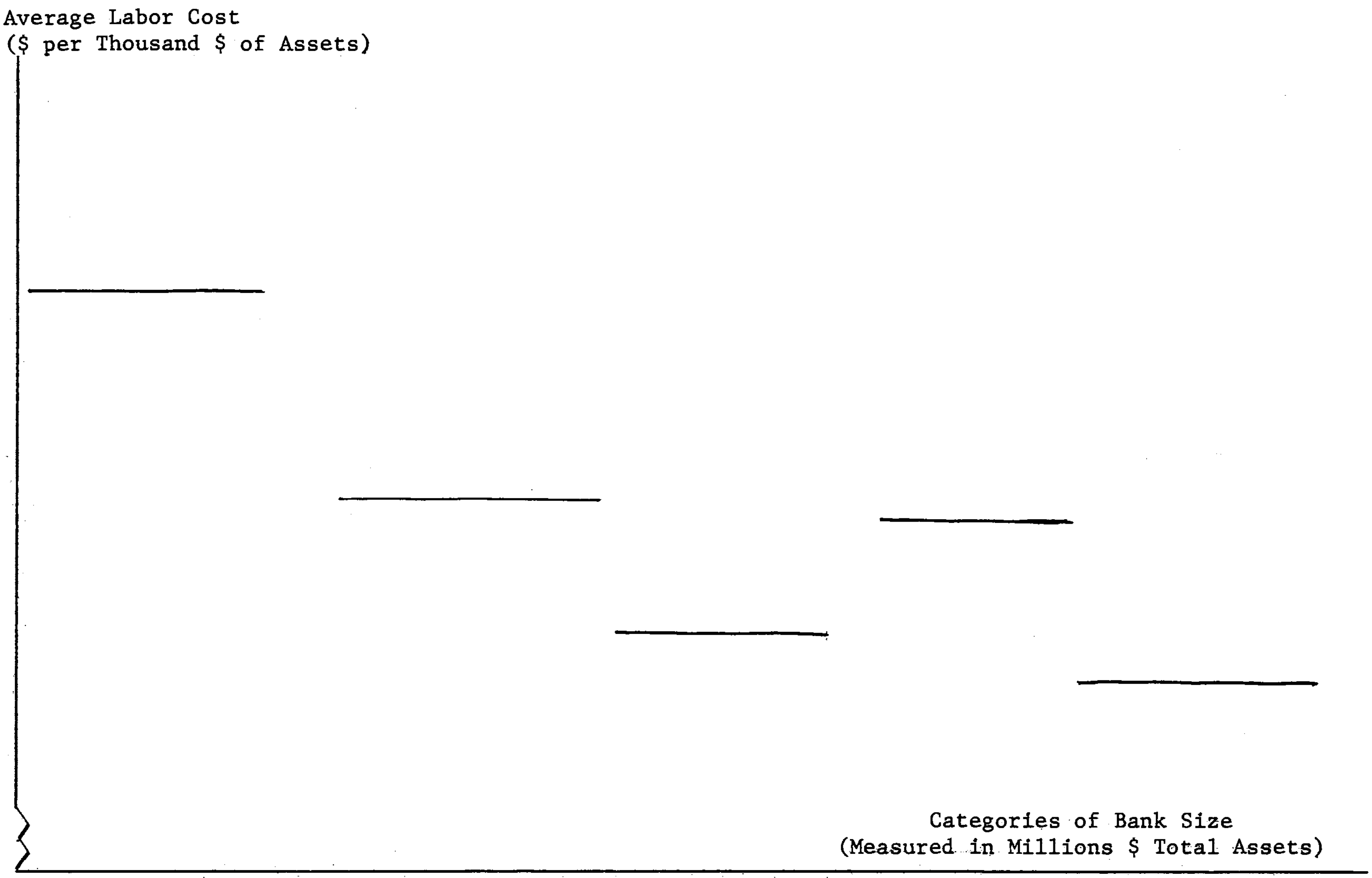

Figure 8. The Impact of Bank Size on Average Labor Cost with Deposit Variability Held Constant, 1963.

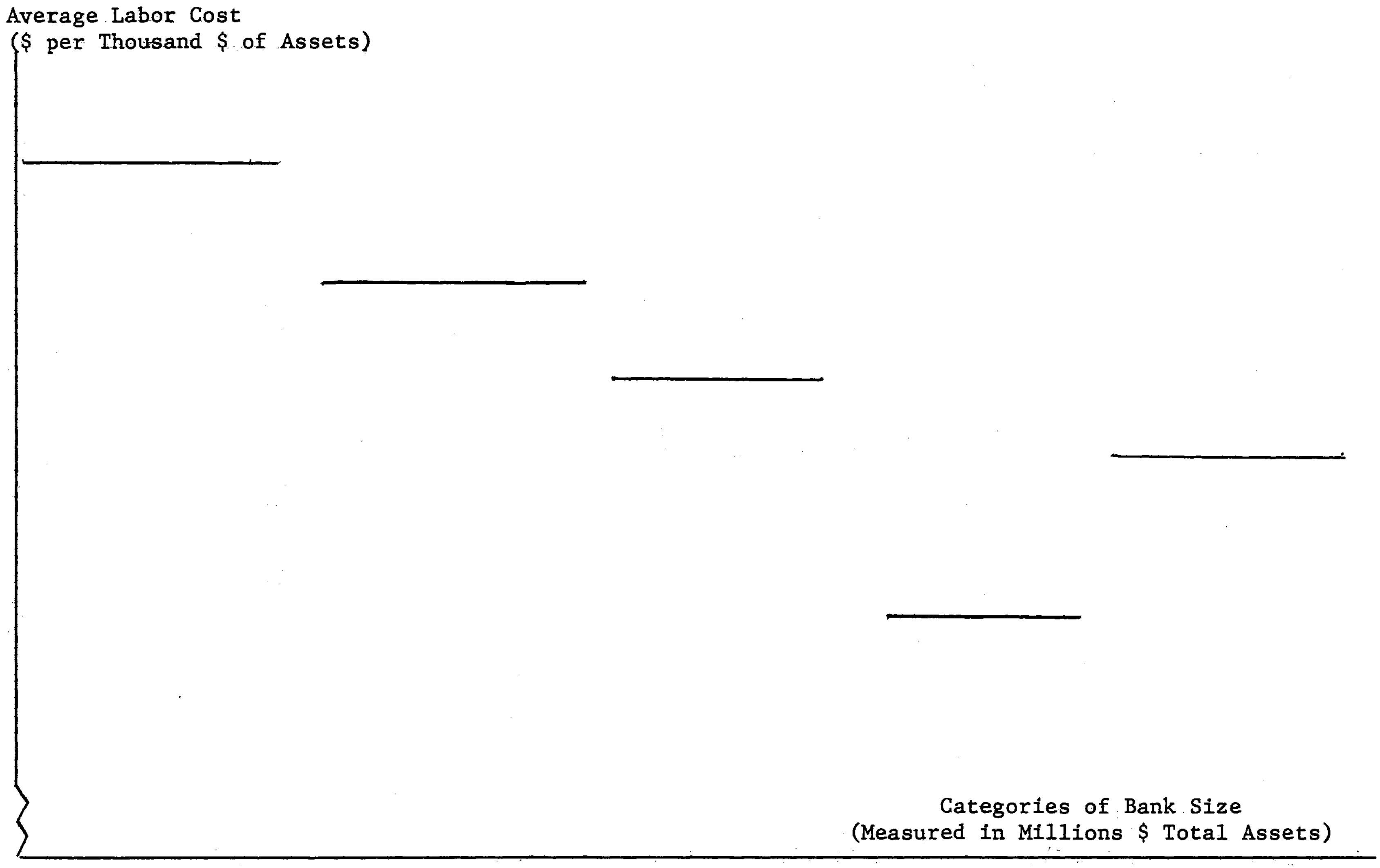

Figure 8B. The Impact of Bank Size on Average Labor Cost with Deposit Variability Held Constant, 1964

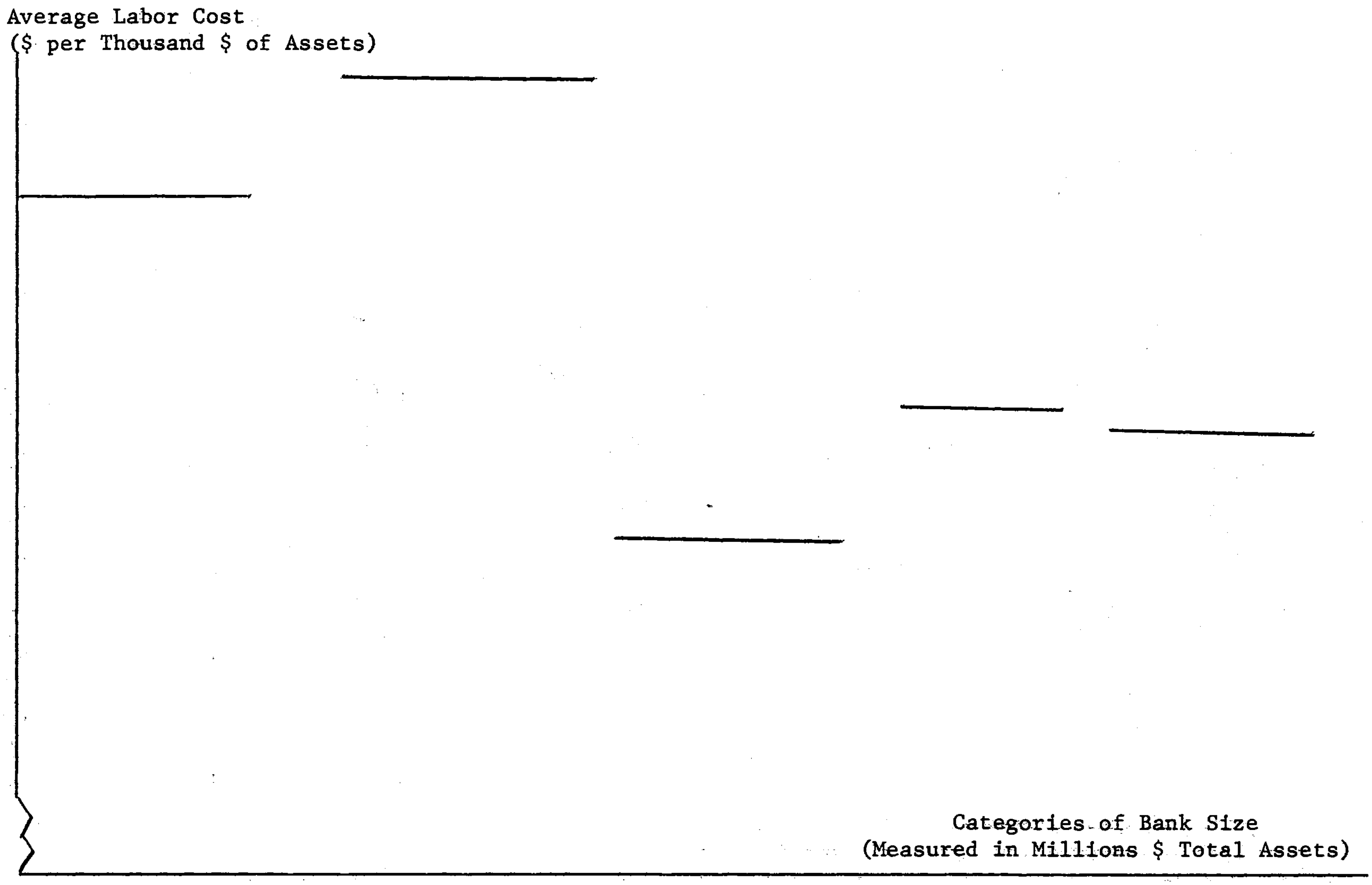

Figure 8C. The Impact of Bank Size on Average Labor Cost with Deposit Variability Held Constant, 1965

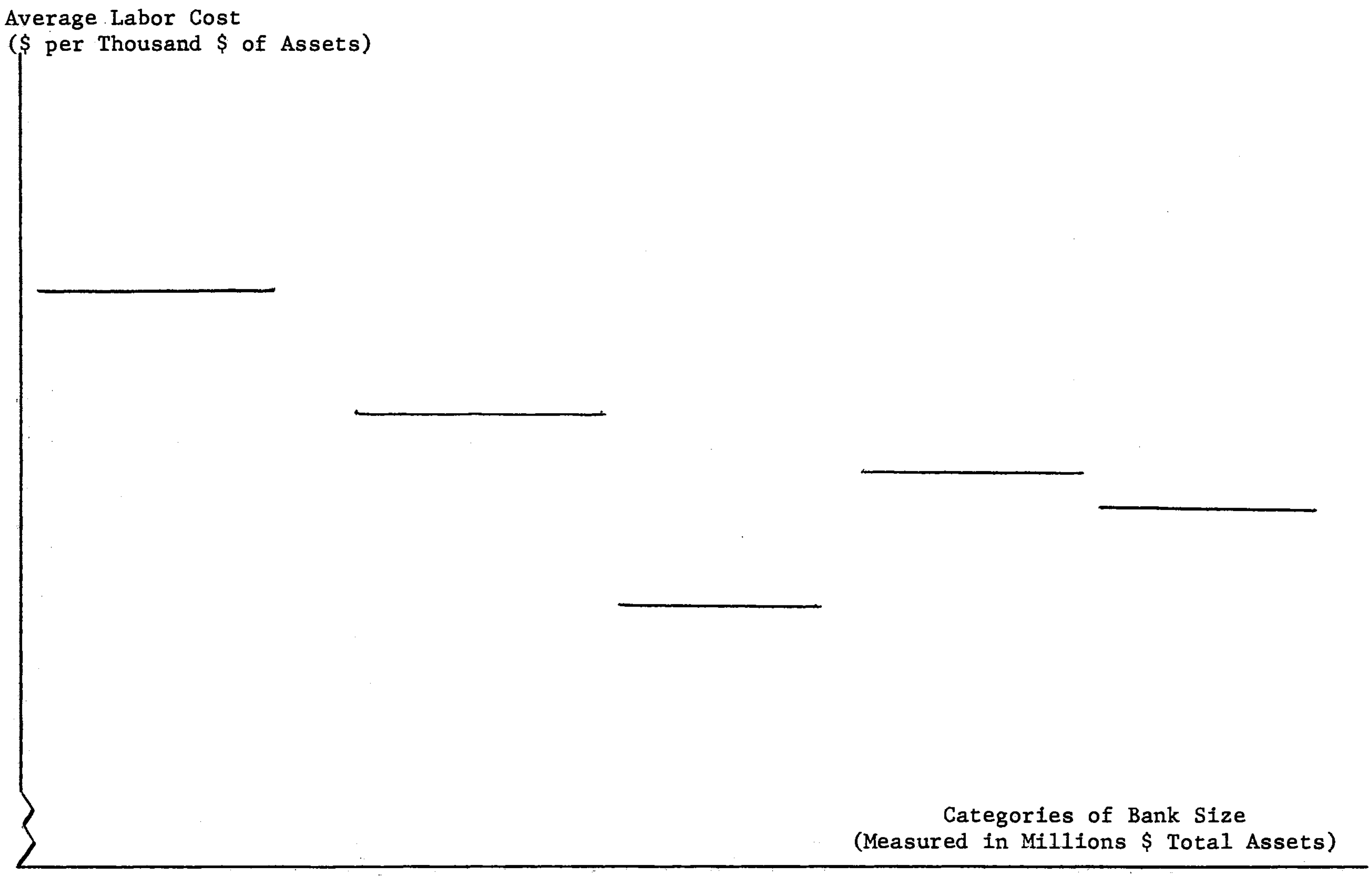

Figure 8D. The Impact of Bank Size on Average Labor Cost with Deposit Variability Held Constant, 1966

CHAPTER VI

SUMMARY AND CONCLUSIONS

Summary of the Theoretical and Empirical Evidence in Support of the Hypothesis

The hypothesis advanced in this study is that the average labor cost of a commercial bank is influenced by deposit variability. Specifically, it is hypothesized that, if everything else is held constant, increased deposit level variation results in increased annual average labor cost for the bank.

In Chapter II, a model was constructed which established, on a theoretical basis, the validity of the present hypothesis. By assuming that asset acquisition-sale is a function of changes in deposit level and that asset acquisition-sale entails labor activity, average labor cost was reduced to a function of deposit variability and bank size in the model. Chapters III and IV summarized the literature on economies of scale and deposit variability respectively.

In Chapter V, the hypothesis was tested. Using a multiple regression equation which contained deposit variability as one of the independent variables, and which contained five bank size dummy variables, a significant relationship was found to exist between average labor cost and deposit variability. The partial F ratios revealed that the level of significance for deposit variability was consistently at the .01 level in all four years analyzed. Moreover, the signs of deposit variability regression coefficients were consistently positive indicating that when bank size is held constant, increased amounts of deposit variability were associated with higher average labor cost in all four years analyzed. Finally, when deposit variability is included in the regression analysis the standard error term is reduced and the coefficient of determination is increased.

Conclusions

In its examination of the influence of deposit variability on the average labor cost of a commercial bank, the present study has followed a theory-of-the-firm or micro approach. That is to say, the present study is intended to provide operational information for the individual bank manager who is seeking ways to minimize his average labor cost. Since a large number of existing studies have already been devoted to the problem of isolating variables which influence the average labor cost of a commercial bank, the present study, in a sense, represents an addition to the existing literature on bank costs. However, virtually all of these earlier studies have concentrated on the relationship between bank size and average labor cost, and none of the existing studies has attempted to determine, either theoretically or empirically, whether average labor cost is influenced by deposit variability.

The implication of existing studies is that a commercial bank manager can reduce his average labor cost by expanding his level of output. Since bank output is defined as total assets, a bank manager's ability to expand output (that is, acquire additional assets) must ultimately come to rest on his ability to attract additional deposits. Consequently, one could conclude from these earlier studies that the bank manager who is interested in reducing his average labor cost should seek ways of acquiring additional deposits.

In the present study, however, a theoretical model has been constructed, and empirical evidence presented, which suggests that the individual bank manager who is seeking to reduce his average labor cost needs to take into account more than just the expansion of his bank's output. Specifically, he must also consider the magnitude of variation in his deposits from one reporting period to the next. Consequently, the present study has added an additional dimension to the problem of how to reduce average labor cost in commercial banking.

In summary, then, the conclusions reached in the present study are, first, that the individual bank manager who is seeking to reduce his average labor cost should place major emphasis on attracting the additional deposits necessary to establish a large enough scale of enterprise to permit a greater degree of specialization and division of labor, but, secondly, the individual bank manager needs also to be concerned with the stability of his deposits. To the extent that he is able to control the nature of the deposits he attracts, he should seek to acquire deposits which are as stable as possible. This conclusion presents two additional areas of research, namely the question of identifying those categories of deposits which are more stable and the question of whether a bank manager is able to attract consciously these more stable deposits.

With respect to the first issue, James N. Duprey's work suggests that some categories of deposits are more stable than others.[1]

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[1] J. N. Duprey, "Some Evidence on the Variability of Demand Deposits," unpublished research paper.

Specifically, Duprey found that banks which were characterized by lower overall deposit variability had a greater proportion of their deposits concentrated in the sub-categories of non-financial business accounts and a smaller proportion in farm, state and local governments and personal accounts than did those banks with higher overall levels of deposit variability.[2] This led Duprey to conclude that, "the growth of deposits accompanied by a systematic shift to higher proportions of demand deposits in the hands of business firms can bring scale advantages (to) demand deposit banking."[3]

Thus the Duprey study suggests that research to determine which categories of deposits are more stable should prove fruitful. Of course, the second question, as to whether it is possible for a bank manager consciously to determine the category of deposits he attracts, remains unanswered. Consequently, this question may provide a particularly significant area for future research.

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[2]Ibid., p. 6.

[3]Ibid., p. 8.

BIBLIOGRAPHY

Alhadeff, David A. Monopoly and Competition in Banking. Berkeley: University of California Press, 1954.

The American Banker's Association. The Commercial Banking Industry. Englewood Cliffs: Prentice-Hall, 1962.

Anderson, Bernard. "An Investigation into the Effects of Banking Structure on Aspects of Bank Behavior." (Unpub. doctoral dissertation, Ohio State University, 1964.)

Backman, Jules and Sametz, Arnold. "Workable Competition in Banking." The Bulletin of the C. J. Devine Institute of Finance (1962).

Bell, Frederick W. and Neil B. Murphy. "Economies of Scale in Commercial Banking: The Measurement and Impact." New England Business Review, Vol. 67 (March, 1967), 2-11.

Bell, Frederick W. and Neil B. Murphy. "Economies of Scale in Commercial Banking: Specialization and Technology." New England Business Review, Vol. 67 (April, 1967), 2-11.

Bell, Frederick W. and Neil B. Murphy. "Economies of Scale in Commercial Banking: The Overall Impact of All Cost Factors." New England Business Review, Vol. 67 (June, 1967), 13-19.

Bell, Frederick W. and Neil B. Murphy. "Economies of Scale in Commercial Banking: The Role of Costs in Banking Regulation." New England Business Review, Vol. 67 (July, 1967), 12-19.

Bell, Frederick W. and Neil B. Murphy. Costs in Commercial Banking. Research Report No. 41, Federal Reserve Bank of Boston (April, 1968).

Benson, George. "Economies of Scale and Marginal Cost in Banking Operation." National Banking Review, Vol. 2 (June, 1965), 507-549.

Carson, Dean C. and Cootner, Paul H. "The Structure of Competition in Commercial Banking in the United States." Private Financial Institutions. Englewood Cliffs: Prentice Hall, 1963.

Duprey, J. N. "Some Evidence on the Variability of Demand Deposits." (Unpub. research paper.)

Edwards, Franklin R. Concentration and Competition in Commercial Banking: A Statistical Study. Research Report No. 26, Federal Reserve Bank of Boston, 1964.

Edwards, Franklin R. "The Banking Competition Controversy." National Banking Review, Vol. 3 (September, 1965), 1-34.

Federal Reserve Bank of Chicago. "Competition in Banking: The Issues." Business Conditions, Vol. 67 (January, 1967), 8-16.

Federal Reserve Bank of Chicago. "Competition in Banking: What is Known? What is Evidence?" Business Conditions, Vol. 67 (February, 1967), 7-16.

Federal Reserve Bank of Kansas City. "Importance of Size and Other Factors Affecting Bank Costs." Monthly Review, Vol. 61 (April, 1961), 10-16.

Federal Reserve Bank of Kansas City. "Interpretation of Size-Cost Relationships in Banking." Monthly Review, Vol. 61 (March, 1961), 3-9.

Federal Reserve Bank of Kansas City. "Relationship of Bank Size and Bank Costs." Monthly Review, Vol. 61 (February, 1961), 3-9.

Federal Reserve Bank of Kansas City. "Relationship of Bank Size and Bank Earnings--Some Further Considerations." Monthly Review, Vol. 62 (February, 1962), 3-10.

Federal Reserve Bank of New York City. "Term Lending by New York City Banks." Monthly Review, Vol. 43 (February, 1961) 27-31.

Federal Reserve Bank of New York City. "Turnover of Business Loans at New York City Banks." Monthly Review, Vol. 44 (January, 1962), 10-15.

Flechsig, Theodore G. Banking Market Structure and Performance in Metropolitan Areas. Washington: U. S. Board of Governors of the Federal Reserve System, 1965.

Fraser, Donald R. "A Note on Deposit Stability." Business Review, Vol. 67 (March, 1967), 3-7.

Gramley, Lyle E. "Deposit Instability at Individual Banks." Essays on Commercial Banking. Federal Reserve Bank of Kansas City, 1962.

Gramley, Lyle E. "Growth and Earnings at Individual Commercial Banks." Essays on Commercial Banking. Federal Reserve Bank of Kansas City, 1962.

Gramley, Lyle E. Scale Economies in Banking. Federal Reserve Bank of Kansas City (June, 1965).

Greenbaum, Stuart I. "Banking Structure and Costs: A Statistical Study of the Cost-Output Relationship in Commercial Banking." (Unpub. doctoral dissertation, John Hopkins University, 1964).

Greenbaum, Stuart I. "Competition and Efficiency in the Banking System." Journal of Political Economy, Vol. 75 (August, 1967), 461-479.

Greenbaum, Stuart I. "A Study of Bank Cost." National Banking Review, Vol. 4 (June, 1967), 415-434.

Hicks, J. R. "Liquidity." The Economic Journal, Vol. 72 (December, 1962), 787-802.

Hicks, J. R. Value and Capital. London: Oxford University Press, 1939.

Horvitz, Paul M. Concentration and Competition in New England Banking. Research Report No. 2. Boston: Federal Reserve Bank of Boston, 1958.

Horvitz, Paul M. "Economies of Scale in Banking." Private Financial Institutions. Englewood Cliffs: Prentice Hall, 1963.

Horvitz, Paul M. and Shule, Bernard. "The Impact of Branch Banking on Bank Performance." National Banking Review, Vol. 2 (December, 1964), 143-188.

Jacobs, Donald P. Business Loan Costs and Bank Market Structure. New York: Columbia University Press, 1971.

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

Jacobs, Donald P. Business Loan Costs and Bank Market Structure. New York: Columbia University Press, 1971.

Kaufman, George G. "Bank Market Structure and Performance: The Evidence from Iowa." Southern Economic Journal, Vol. 32 (April, 1966), 429-439.

Kaufman, George G. and Latta, Cynthia M. "Near Banks and Local Savings." National Banking Review, Vol. 3 (June, 1966), 539-542.

Kohn, Ernest. Branch Banking, Bank Mergers, and the Public Interest. Albany: New York State Banking Department, 1964.

Leftwich, Richard H. The Price System and Resource Allocation. New York: Holt, Rinehart and Winston, 1961.

Motter, David C. and Carson, Deane. "Bank Entry and the Public Interest: A Case Study." National Banking Review, Vol. 1 (June, 1964), 469-512.

Motter, David C. "Bank Merger and Public Policy." National Banking Review, Vol. 1 (September, 1963), 89-110.

Orr, Daniel and Mellon, W. G. "Stochastic Reserve Losses and Expansion of Bank Credit." The American Economic Review, Vol. 51 (September, 1961), 614-623.

Phillips, Almarin. "Competition, Confusion, and Commercial Banking." Journal of Finance, Vol. 19 (March, 1964), 32-45.

Powers, John A. "The Existence of Economies of Structure and of Economies of Scale in Commercial Banking." (Unpub. doctoral dissertation, Perdue University, 1966.)

Rangarajan, C. "Deposit Variability in Individual Banks." National Banking Review, Vol. 4 (September, 1966), 61-71.

Rangarajan, C. "Variability of Demand Deposits." (Unpub. doctoral dissertation, University of Pennsylvania, 1964.)

Schweiger, Irving and McGee, John S. "Chicago Banking." The Journal of Business, Vol. 34 (July, 1961), 203-366.

Shull, Bernard and Horvitz, Paul M. "Branch Banking and the Structure of Competition." National Banking Review, Vol. 2 (March, 1964), 143-188.

Struble, Frederick M. and Wilkerson, Carroll H. "Deposit Variability at Commercial Banks." Monthly Review. Federal Reserve Bank of Kansas City, Vol. 67 (July-August, 1967), 27-34.

Struble, Frederick M. and Wilkerson, Carroll H. "Bank Size and Deposit Variability." Federal Reserve Bank of Kansas City. Monthly Review, Vol. 67 (November-December, 1967), 3-9.

Suits, Daniel B. "Use of Dummy Variables in Regression Evaluations." Journal of the American Statistical Association, Vol. 33 (1957), 548-557.

Wallace, Richard S. "Banking Structure and Bank Performance: A Case Study of the Small Market Areas." (Unpub. doctoral dissertation, University of Virginia, 1965.)

Weintraub, Robert and Jessup, Paul. A Study of Selected Banking Services by Bank Size, Structure, and Location. U. S. Congress, House Committee on Banking and Currency, 88th Congress, 2nd Session, 1964.

APPENDIX

TABLE VIII

BANK DATA, 1963

Bank Size (Million Dollars)	Average Total Cost ($ Per Hundred $ of Bank Assets)	Average Labor Cost ($ Per Hundred $ of Bank Assets)	Deposit Variability
100 & Above	2.342	.941	2.437
"	2.450	.993	2.507
"	2.385	.724	1.987
"	2.516	.989	2.318
55-75	2.392	.932	2.501
"	2.947	1.114	3.064
"	2.951	.997	2.603
"	2.950	1.095	3.031
25-35	2.607	.987	2.042
"	3.086	1.210	2.787
"	3.642	1.284	2.913
"	3.259	1.214	2.827
5-10	2.968	1.843	3.327
"	2.961	1.786	3.147
"	3.074	1.401	3.073
"	3.343	1.835	3.574
Below 2	3.701	1.904	3.956
"	3.849	1.846	3.243
"	4.119	2.030	4.502
"	3.843	1.877	3.956

TABLE IX

BANK DATA, 1964

Bank Size (Million Dollars)	Average Total Cost ($ Per Hundred $ of Bank Assets)	Average Labor Cost ($ Per Hundred $ of Bank Assets)	Deposit Variability
100 & Above	2.874	1.003	2.063
"	3.063	1.049	2.117
"	2.413	.749	1.474
"	2.695	.947	1.639
"	2.097	.889	1.645
"	2.732	1.039	2.459
"	2.584	.913	2.125
"	2.467	.949	2.073
55-75	2.667	.973	1.548
"	3.183	1.297	2.783
"	3.059	1.030	2.985
"	3.344	1.312	3.116
"	3.574	1.206	2.827
"	2.453	.974	2.431
"	2.867	1.002	2.647
"	2.891	1.745	3.068
25-35	3.247	1.389	2.429
"	3.163	.996	1.905
"	3.268	1.275	2.395
"	3.225	1.760	3.086
"	3.132	1.294	2.062
"	2.949	1.460	3.473
"	3.254	1.002	2.896
"	3.861	1.164	2.607
5-10	3.718	1.704	3.546
"	3.012	.897	1.943
"	3.646	1.645	2.962
"	3.575	1.273	2.669
"	3.861	1.612	3.721
"	3.487	1.287	2.875
"	3.712	1.354	2.897
"	3.613	1.937	4.260
Below 2	4.162	1.746	3.657
"	4.029	1.902	4.418
"	4.465	2.187	4.540
"	3.048	1.993	3.743
"	3.364	2.362	4.356
"	3.947	1.932	3.783
"	4.033	2.467	5.403
"	3.772	2.510	4.287

TABLE X

BANK DATA, 1965

Bank Size (Million Dollars)	Average Total Cost ($ Per Hundred $ of Bank Assets)	Average Labor Cost ($ Per Hundred $ of Bank Assets)	Deposit Variability
100 & Above	3.236	1.146	2.546
"	3.161	.976	2.673
"	2.749	.921	2.264
"	3.065	.839	2.125
"	3.110	.941	2.257
"	2.978	.890	2.219
"	2.916	.831	2.171
"	3.191	.973	2.342
55-75	3.145	.951	2.385
"	3.432	1.072	2.482
"	3.441	1.047	2.374
"	3.422	1.010	2.281
"	3.785	1.253	2.313
"	4.393	1.317	2.896
"	3.084	1.245	2.431
"	3.480	1.225	2.516
25-35	3.744	1.279	2.612
"	4.164	1.289	2.854
"	3.846	1.252	2.723
"	3.933	1.236	2.787
"	3.906	1.283	2.890
"	3.762	1.252	2.732
"	3.851	1.343	3.072
"	3.855	1.286	2.670
5-10	3.947	1.302	2.936
"	4.089	1.447	3.126
"	4.055	1.508	2.235
"	4.074	1.418	3.163
"	4.228	1.604	3.341
"	4.027	1.436	3.227
"	4.068	1.691	3.736
"	4.176	1.598	3.458
Below 2	4.754	2.008	3.946
"	4.453	2.143	3.721
"	4.292	2.079	3.299
"	4.091	2.184	3.545
"	4.310	2.287	3.604
"	4.274	2.327	3.921
"	5.099	2.876	4.029
"	4.183	2.958	3.517

TABLE XI

BANK DATA, 1966

Bank Size (Million Dollars)	Average Total Cost ($ Per Hundred $ of Bank Assets)	Average Labor Cost ($ Per Hundred $ of Bank Assets)	Deposit Variability
100 & Above	3.467	1.048	2.306
"	3.483	1.057	2.175
"	2.990	.852	1.420
"	3.334	.872	1.231
"	3.100	.952	2.138
"	2.956	.876	2.174
"	3.447	.770	2.130
"	3.327	.835	2.214
55-75	3.450	1.175	2.078
"	3.775	1.430	2.841
"	4.077	1.835	2.889
"	3.418	1.710	2.512
"	3.614	1.754	2.890
"	4.125	1.743	2,984
"	3.812	1.623	2.674
"	3.784	1.589	2.489
25-35	4.129	2.071	2.881
"	3.849	2.016	3.043
"	3.924	2.145	2.843
"	4.209	2.098	2.733
"	4.027	2.037	2.674
"	4.215	2.072	2.714
"	4.146	2.034	2.709
"	4.243	2.021	2.843
5-10	4.093	2.137	3.127
"	4.481	2.364	3.202
"	4.282	2.354	3.274
"	4.305	2.372	3.063
"	4.267	2.208	3.064
"	4.496	2.473	3.247
"	4.513	2.439	3.340
"	4.094	2.307	3.235
Below 2	4.207	2.405	3.467
"	4.254	2.684	3.726
"	4.258	2.812	3.904
"	4.367	2.793	3.740
"	4.853	2.819	3.954
"	4.601	2.711	3.673
"	5.335	2.890	3.944
"	4.964	2.403	3.742

VITA

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