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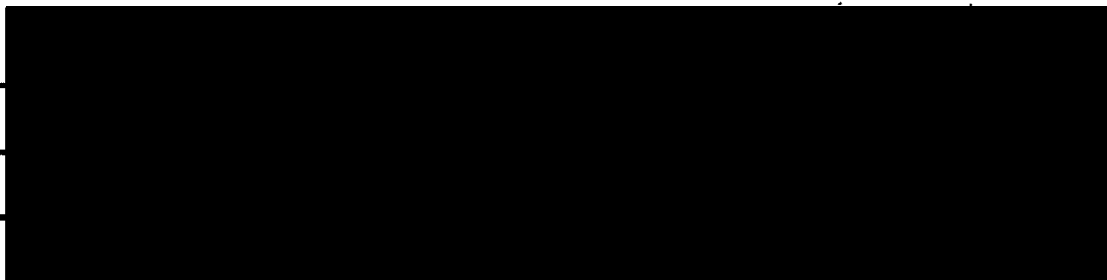
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**LIQUIDITY PRODUCTION
AND THE THEORY OF THE BANKING FIRM**

by

Annon Goldschmidt

B.A., The Hebrew University, Jerusalem, 1968.

M.B.A., The Hebrew University, Jerusalem, 1971.

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF**

DOCTOR OF PHILOSOPHY

in the Department

of

Economics and Commerce

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ABSTRACT

The subject matter of this dissertation concerns the economic aspects of the banking firm as a producer of liquidity (money services). In particular it focuses upon the integration of the production process of a bank with its role as a financial intermediary. Such an integration becomes the basis for a suggested link between the micro and macro foundations of banking. The relevance of such an analysis is suggested by the existing gap between most of the 'micro' models of banks which disregard the 'macro' role assigned to these institutions - namely, the supply of money. This gap is reflected in the well - known money supply equation, and might lead to sub optimal (monetary) policy recommendations.

The analysis employs a theoretical as well as an empirical approach in linking the two major segments of banking theory; banks as a vehicle for the implementation of monetary policy, and banks as privately owned, profit - seeking firms. This link is provided by defining bank output as liquidity (money in a very broad sense), and by incorporating the unique characteristics of banks into the standard producer - theory framework. Defining bank output as liquidity involves the use of characteristics instead of goods in building the demand - side of the model. The supply - side of our model is based on the idea that banks are not perfect competitors (they have the power to determine the net interest rate paid on

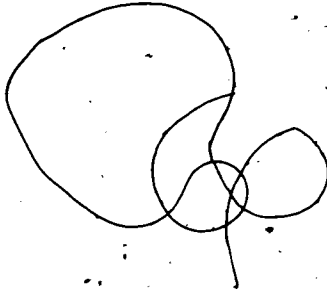
their deposits), and that reserves are but one more input in the production process of banks. Finally, the analytical framework is employed for an empirical investigation of the two concepts, liquidity and the production process of banks, used to link the micro and macro foundations of banking.

The study shows, first, that the producer - model built here, explains bank behavior in a way which is consistent with our daily experience with regard to the operation of banks. It predicts, in contrast with other models, that banks will always satisfy consumers' desire to acquire more deposits. It demonstrates that changes in the 'givens' (factor prices, technological changes, changes in government regulations, etc.) affect the banking firm and other profit - maximizing producers in a similar way. It is demonstrated that the role of banks as financial intermediaries and their production process are not two separate characteristics of these financial institutions. The model points to the fact that bank costs and efficiency considerations play an important role in the determination of the level of liquidity outstanding.

The empirical investigation provides an aggregate (liquidity) which might replace money (M_1) as the basic intermediary target of monetary policy. It is found that (U.S) banks have no economies of scale in producing liquidity, and thus administrative barriers to entry into this industry result in an inefficient banking system. Banks were found to

be inefficient producers, they employ too much labor relative to capital. It is suggested that this inefficiency might be eliminated as banks fully adjust their production process to the technological changes currently characterizing this industry.

To Tami, Erez, Amir, and Oren.



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Responsibility for any shortcomings in the final product rests solely with the author.

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CHAPTER 1

S U M M A R Y

A. The Purpose of this Study

The banking firm has often been recognized as unique in the sense that its production process and its role as a financial intermediary are considered two separate characteristics, the integration of which is almost impossible¹.

The macro relevance of banks is based on their ability to 'create' money which, at least for a monetarist, is of central importance in the determination of income and prices. At the same time, the micro relevance of banks is represented in a substantial number of models which try to explain the behavior of the banking firm, almost none of which are consistent with the macro view of banks as suppliers of money. In other words, there is a gap between two important segments in banking theory, the one that analyzes banks as a vehicle for the implementation of monetary policy, and the one that analyzes them as privately owned, profit - seeking firms.

This study is aimed at filling this gap, at linking the macro with the micro foundations of banking. It is argued that a consistent and comprehensive view of the micro aspects of banks should improve the implementation of monetary policy. Such a link is important, both for understanding the structure and the operations of one of the more important economic institutions, and for understanding some of the 'monetary' adjustments which follow from changes in the monetary base,

1

For this point see, for example, Murphy (1972).

interest rates, government regulations, and bank costs.

Even though this is mainly a study in the theory of money and banking it has immediate empirical implications. In the late 1960s, more and more researchers began to study the cost structure of banks in order to improve bank policy and control to the benefit of bank clients and the economic system at large. Baltenspreger (1972), Benston (1965 and 1974), Bell and Murphy (1968), Greenbaum (1966 and 1967), and Longbrake (1973), to mention only a few, were mainly interested in finding whether economies of scale characterize the production process of banks. No one comprehensive model of the banking firm was suggested, in these studies, as a background for the cost functions analyzed, so that the definitions of bank output and its production process were, to a certain extent, arbitrary².

Our study, on the other hand, offers consistent definitions of bank output, bank inputs, and input payments, definitions which are based on neoclassical producer - theory adjusted for the unique characteristics of the banking firm. Moreover, in the last chapter, we estimate banks' cost functions based on our suggested model.

The standard producer theory framework has been chosen, not because the differences between banks and many other producers for which this theory is applicable, are ignored, but because it is our view that banks' unique characteristics and

2

For example, all the cost studies mentioned don't regard interest paid on deposits as a direct cost of production.

the impact of these characteristics on the behavior of banks, as firms, can be better understood within a recognized (though sometimes disputed) framework, rather than constructing a special theory around these characteristics. A "special theory" approach sometimes yields strange results, as demonstrated in a most recent study by Levy-Carbova and Maarek (1978)³.

Many of the existing models of the banking firm⁴ do not explicitly include bank costs in their analysis of bank behavior, even though they define the bank as a profit-maximizing firm. These models also define bank output in mutually inconsistent ways. These are but two of the more important issues which prevent such models from accurately explaining the banks' reactions to changes in their economic environment. Our study tries to clarify these and other deficiencies in the existing banking literature.

3

In which, one of the conclusions is that, in the long run, an increase in the reserve requirements will push banks to open more branches.

4

As an example, see Klein (1971).

B. Bank Output

The central problem, with respect to the definition of bank output, is whether the bank is producing one and only one output, and what is its dimension.

As the banking firm is a producer of services, one is inclined to use its value added as a proxy for output. Such a practice is not uncommon⁵, it is also nicely related to the long disputed issue whether or not banks provide the economy with net wealth. However, we argue that, in the case of banks, a more specific output definition can be used—namely, liquidity.

We claim that producing and providing consumers with liquidity is the main characteristic of bank activity; that is, the sale of liquidity accounts for most of the bank's revenues (and thus, for most of its value added). We recognize that banks also produce some services which have almost no connection to the level of liquidity provided (such as safe-deposit boxes). Thus, we would accept that the bank, at least formally, is a multiproduct firm. At the same time, it is our view that these 'other' services are of minor importance for the understanding of the role and behavior of the banking firm, and, therefore, are best treated as "by products".

As liquidity may be interpreted in a very broad sense, as 'money', we actually argue for the position that banks are first and foremost producers of money, or more accurately, monetary

⁵

For example, see Greenbaum (1966).

services. In this respect, banks' production costs and profit-maximizing behavior co-determine the level of money (liquidity) in the economy. Such a view corresponds to, but is not merely a result of, our desire to link the macro foundations of banking (their role in determining the quantity of money) with their micro foundations (their behavior as profit-maximizing producers).

Our suggested concept of bank output is that of a flow. Bank customers enjoy a flow of monetary services derived from holding a stock (or stocks) acquired from the bank. Money itself, as opposed to liquidity services, is a stock variable. If money were regarded as bank output, the banking firm would have no function (aside from supplying the 'by products' mentioned before) once the desired level of money had been supplied, given that that level remained unchanged. The provision of a flow of liquidity services, on the other hand, requires the bank as a producer to incur costs.

Such a concept of bank output has immediate empirical implications. Most bank costs studies (see for example, Bell and Murphy, 1968; and Benston, 1965 and 1972) define bank output as the number of accounts, which is a stock variable. Thus, they face the problem just mentioned. To overcome this difficulty they add a flow dimension by incorporating a so-called 'homogeneity variable' into the estimated cost function. This variable is the turnover rate of accounts, which represents the level of services derived from the stock of deposits. Our

approach makes such a practice superfluous, and thus, the production function implied by it differs from the one used in the studies cited above.

One of the more important questions arising from the suggested approach towards the definition of bank output is whether the value added by the banking firm is embodied in its liabilities, its assets, or both. In this study, we define a measure for value added by the bank, termed "liquidity", based solely on the liabilities side of the balance sheet, even though we can hardly dispute the argument that banks' value added is distributed among borrowers, as well as depositors.

From a macro point of view, we want to capture the final impact of bank activities on the economy. Concentrating on bank liabilities is appropriate only if the overall result of changes in banks' asset-mix (loans), is short lived. Such a short lived impact is the finding of some recent studies (see Campbell, 1978) which look at changes in GNP and their relationship to changes in the level and structure of bank assets.

From the micro point of view, our approach would be appropriate only if all asset activities of banks were reflected in the composition of their liabilities. In this case, the asset activity 'produces' no service independently of liability activity. To the extent, however, that the loan structure may change without a corresponding change in the structure of the liabilities, our suggested approach will impute a downward bias to output.

In our approach, we ignore any services that may be associated with changes in asset composition, e.g., convenience accruing to borrowers as their desired terms to maturity are met. The theoretical advantage of this approach is that only part of banks' output which has a macro relevance (i.e. "liquidity") is modelled, allowing us to explore the link between banks as producers and their macro impact.

C. Demand and Supply of Bank Output

As just suggested, we define bank output as a flow of liquidity services; thus the demand for these services and their supply should be in the center of our producer-analysis of the banking firm. However, we conduct the analysis in terms of bank deposits, rather than liquidity services per se, since deposits are immediately linked to the observed production activity of the firm and since, as we show, there exists a well-defined transformation function between deposits and liquidity.

C.1 Deposit - Characteristics and Bank Output

Following a pioneering study by Chetty (1969), our suggested approach to the analysis of the demand for bank output is based on Lancaster's (1966) contribution to consumer theory.

The basic idea put forward by Lancaster is that (final) consumption is an activity in which goods, singly or in combination, are inputs to a consumers' production function, the output of which is a collection of characteristics.

In the present context, we argue that consumers use bank deposits in order to satisfy their needs for the characteristic "liquidity". Liquidity is regarded as the common characteristic of all bank deposits. Thus, consumers' utility ranks liquidity, and not deposits themselves. That is, in our analysis, consumers are treated as producers of a consumption characteristic called "Liquidity," and bank deposits serve as inputs into the consumers' production function.

For the purpose of simplicity and because of extensive previous use (by Chetty and others), we have chosen to use the CES production function to describe the nature of the transformation between deposits and liquidity. This function has the following form:

$$(1.1) \quad U = \left[\sum_{g=1}^e \alpha_g f(r_g) L_g^{-\rho} \right]^{-\frac{1}{\rho}}$$

where U is liquidity, ρ and α_g are the elasticity and share parameters respectively (in which consumers' tastes are embodied), r_g is the net (of service charges) interest rate on deposit type g ($g=1, \dots, e$), and $f'(r_g) < 0$ ⁶.

Before presenting the consumer's budget constraint, which, in conjunction with equation (1.1), enables us to derive the demand equations, we should emphasize the role of the interest rate in the functional relationship described above. Usually, the liquidity of an asset is defined in terms of percent of face value that can be realized in a given period of time, multiplied by the probability of realizing that percent. This ability to sell is a function of various variables, such as, the type of market in which the asset is traded, the face term to maturity (of financial assets), etc. We argue here that the potential liquidity embodied in any financial asset is a function of, in addition to the ability to sell, the willingness

6

This differs from the structure offered by Chetty (1969) and Moroney and Wilbbratte (1976).

to sell. Willingness to liquidate a specific asset is a decreasing function of its own interest rate: the higher the yield of a given asset (given the yields of alternative assets), the lower is the probability that the asset will be used to satisfy liquidity needs. Thus, even if the probability of realizing the face value of the asset is high, the liquidity embodied in it may be low, since it is not considered a liquidity-providing asset, but rather, is held because of the income it generates.

To derive demand equations for the various types of deposits, we employ a two-stage decision process:

(a) The saving-consumption decision, Here, Fisherian time-preference theory is adopted.

(b) The savings-allocation decision. This decision might be described either in terms of maximizing a utility function in which bank deposits, as well as other financial and non-financial assets, appear explicitly, or in terms of a characteristics-based portfolio analysis, which explains this allocation decision in terms of the yield and risk attached to each asset.

Since the amount of money invested in bank deposits should equal the part of one's savings designated for that purpose (F_B), the budget constraint has the following form:

$$(1.2) \quad F_B = \sum_{g=1}^e L_g$$

From equation (1.1) and (1.2) we derive a set of demand

equations for bank deposits. These equations have the following general form:

$$(1.3) \quad L_g^d = L_g (a_g, a_z, r_g, r_z, p, F_B)$$

where $g, z=1, \dots, 1$, $g \neq z$.

This form corresponds to the standard form of the demand equations derived in consumer theory, according to which the demand for each good is a function of its price (r_g), the price of substitutes (r_z), tastes (embodied in p and a_g), and that part of consumer's income designated for bank deposits (F_B).

Using these demand equations, we argue that a change in the yield on bank deposits has two effects: (i) an income effect, increasing the demand for a financial asset when its yield increases, (ii) a liquidity effect, decreasing the demand for that asset as its yield increases, since the consumer seeks other, lower yielding assets to satisfy his liquidity needs. It is recognized that the positive income effect is stronger than the negative liquidity effect, thus $\partial L_g / \partial r_g > 0$.

When evaluating the above analysis, three points should be remembered:

(a) Our classification of deposits is finer than the standard groups of demand and time deposits. According to our model, each type of deposit, within one of these two groups, constitutes a separate entity once it yields a unique return. Thus, if large time deposits carry a higher interest rate than small ones, these

are two different goods, since the amount of liquidity embodied in each is different. The same holds for high vs. low - turnover deposits, etc.

(b) The demand function for bank deposits, represented by equation (1.3), does not yield the average revenue function, as is the normal case. Recall, we assumed that bank liabilities supply enough information for deriving the level of liquidity produced; however, the bank enjoys most of its revenues from assets. These revenues should be added to those generated by selling deposits. Thus, the general form of banks' revenue function is as follows:

$$(1.4) \quad RV = t(Lg, SCg, r_L, Rg, s), g = 1, \dots, e$$

where SCg is the service charge on deposit type g , r_L is the average rate of interest on assets, Rg is the reserve requirement, and s is the equity - to - deposits ratio, both ratios serve us to extract the level of earning assets from the total assets held by the bank.

(c) The volume and mix of deposits which enter the deposits-liquidity transformation function (equation 1.1) are equilibrium quantities, themselves co-determined by the demand for, and supply of, deposits. Bank costs, which explain the relative supplies of these deposits, have not yet entered the analysis, except through their impact on r_L .

In an explicit supply-side analysis, we show the role of

bank costs in the determination of the level and mix of bank deposits, and thus, in the determination of the level of liquidity supplied.

C.2 Bank Costs and the Level of Output

The cost function we suggest to reflect the production activity of the banking firm is not different from the cost function of any other producer, except that some unique characteristics of banks require special consideration.

The first characteristic that may reflect some uniqueness of the banking industry is that, on theoretical grounds, one might claim that monopolistic, rather than perfect, competition best describes the market environment of banks (even in the absence of government regulations).

> We argue that money (in its broad definition) is a product with essentially infinite costs of determining quality by direct inspection of technical characteristics⁷. For any good, the higher these costs, the higher is the probability that its producer will incur real costs in order to establish a 'brand name', which will permit consumers to distinguish, almost costlessly, among the outputs of the competing firms. Consumers will find it very hard to infer the quality of the monetary services derived from a certain private money's technical characteristics, like the color of checks, and thus there is room for activities like advertisement, which result in product differentiation.

The conclusion of this argument is that the banking firm probably faces a downward sloping demand function⁸.

Another issue which is often discussed in the context of money production (and not mentioned in the context of the production of any other good) is the so-called 'unitary elastic' supply-function argument⁹. It is claimed that in the case of a perfectly competitive banking industry, the marginal cost function of producing nominal balances should be a rectangular hyperbula. This, of course, corresponds to the neutrality of money proposition, and to the fact that it costs nothing to "add zeros".

We argue that a unitary-elastic cost function can characterize banks' supply function for money only under the following (unrealistic) assumptions¹⁰, some of which are necessary, and some of which are sufficient:

(a) Bank costs 'do not matter'. If with a fixed monetary base, increasing the supply of deposits by one bank means, at least, attracting more reserves at the expense of other banks, this involves higher costs. More generally, non-zero marginal costs of production of nominal balances immediately make bank

8

When banks have the power to produce dominant money, and where deposit insurance does not exist, this conclusion is even more likely to hold.

9

See Gurley and Shaw, (1960), p.255. In fact, the very existence of a supply function for money is questioned in Horton (1969).

10

For a further discussion, see Pesek (1971).

costs "matter".

(b) There is only one bank in the system. If this does not hold, then an increase in one bank's output will have a less than proportionate effect on the price level; as the number of banks increases, the supply function approaches horizontal.

(c) There is only one kind of money. If government and private monies coexist, consumers will be holding a desired mix (in equilibrium) of both moneys. Any effort to change this mix has to be associated with higher marginal costs for the expanding bank, since it has to increase the (explicit or implicit) interest it pays on its money, and/or change consumers' tastes via advertising.

These points imply that the banks probably have an upward sloping marginal cost function.

One element of the bank's production process definitely differentiates it from most other producers - namely, the role of reserves in the production of deposits. Reserves could be classified as 'raw materials' with respect to their function in the production process, but, at the same time, part of this raw material is kept in the form of "excess" reserves. What is the price of this input? To the banking firm, it is revenue forgone by not expanding deposits and assets. There may also be a social cost attached to a given level of reserves, in the sense that it affects the level of prices, employment, etc. Which is the relevant price?

We argue that reserves are a factor of production, which

together with labor and capital, are used in the production of deposits. The level of reserves and the level of bank output are related in two ways: (i) each dollar of reserves accounts for one dollar of primary deposits; (ii) at the same time, by keeping a reserve ratio which is lower than 100%, the bank creates secondary deposits. The decision about the amount of secondary deposits to create is a well defined function of bank costs, the loan rate, and the deposit rate, and is an essential part of the production and cost functions.

As to this factor's payment (not to be identified with the revenue forgone, which is the "price" to the firm of excess reserves), we argue that it is bank interest payments¹¹. The fact that banks pay interest on secondary, as well as primary deposits, does not invalidate our argument, but, rather, points to the unique nature of reserves as a factor input - namely, that interest is necessary to retain reserves because all bank deposits are potentially primary. This is so in the sense that, when interest payments on deposits are stopped, we can expect deposit withdrawals and a corresponding (but fractional) reserve outflow. This implies that the rate of return of bank reserve is much above the "normal" rate since, dollar by dollar, they are used "more than once" in producing deposits.

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This is in contrast to the usual practice in bank-cost studies, according to which, interest is not regarded as a direct cost.

In integrating the above characteristics with the bank's production process, we make the following two assumptions:

(a) The individual bank is a price taker, insofar as the interest rates on loans and deposits are concerned (it is also a price taker with respect to wages and rents). This assumption, even though not crucial for the results derived, also subsumes the case of interest ceilings, which are common practice. The service charges can also be viewed as a proxy for liability management, which, in practice, is extremely important, and occurs by marginally building up and down interest rates on CD's.

(b) The bank exercises its monopolistic power by adjusting its service charges to changes in the demand and cost structure.

As the bank produces several types of deposits, we use two alternative structures to describe its production process:

(i) all deposits are produced via the same production function, and (ii) each deposit is produced according to a unique production process.

The suggested cost function under the one production-process assumption is:

$$(1.5) \quad C = C \left(\sum_{j=1}^{\ell} L_j \right) + b$$

where b are the fixed costs. Wages, interest payments, and rent are the three components of banks' total costs.

Under the multiple production-processes assumption, each deposit will be characterized by the following production

function:

$$(1.6) \quad C_g = f(L_g) + b_g$$

The analysis, here, focuses on bank deposits and their production process, while liquidity is in the center of our analysis. Equations(1.5) and (1.6) can now be attributed to the level of liquidity produced, using the deposits-liquidity transformation function (1.1).

D. Bank Equilibrium - Some Static and
Comparative Static Characteristics

As stated above, the bank may be analyzed as having one production process for all deposits, or as having various production processes, one for each deposit type. These two alternative structures imply two different descriptions of the equilibrium position of the banking firm, but they yield the same behavioral implications.

We argue that under the one production-process assumption, the banking firm should be analysed as a discriminating monopoly. The reason for that is that, though the various deposits are produced according to the same production function, and are therefor homogeneous with respect to their production costs, bank customers are nevertheless aware of the income liquidity trade-off of the different deposits. This trade-off makes interest arbitrage meaningless, since in equilibrium it is the interest rate plus the nonpecuniary return that is equalized across deposit types. Thus, different prices, for the different deposits, characterize the market for these financial assets. The 'physical' separation of markets (and different demand elasticities) that is the standard precondition for price-discrimination, is replaced here by a lack of incentive to arbitrage in an equilibrium characterized by different prices. By assumption, from the bank's view, only one product is being produced, and there is only one marginal cost function. Bank customers, however, consider the various deposits as different products

characterized by different demand elasticities, which reflect the different motives for holding the various deposits. This structure implies that the bank enjoys discriminatory power insofar as its pricing policy is concerned.

Bank profits are given by the difference between revenues and costs (equation 1.4 and 1.5 respectively). The bank equates its marginal revenues across all "markets" (deposit-types) with the marginal cost of producing deposits. This is achieved by varying the service charges (the control variable in our model) so as to maximize profits.

The model yields the equilibrium level and composition of deposits produced, and the interest rate paid on them, net of service charges.

From the above discussion, it follows that consumers' preferences and bank costs determine the level and composition of bank liabilities. The banking firm is a producer, the behavior of which is constrained by demand and supply forces. As bank liabilities correspond to a given level of liquidity, we argue that consumers' preferences (as well as the other demand characteristics), in conjunction with bank costs, determine the level of liquidity in the economy. As liquidity is at least one way to define "money" (for those of us who believe that such a definition is an empirical problem), we conclude that (given the volume of reserves) the level of money is co-determined by banks' operating costs and consumers' behavior. Since money plays a macro role, a link is provided between the micro and

macro foundations of banking, that is, between the role of cost and efficiency considerations in banks' operation, and the role of bank output in the determination of prices and income.

It is interesting to note that our analysis stands in contrast to Tobin's (1963) 'Natural Economic Limit' hypothesis, according to which banks operate at a point where marginal cost is less than marginal revenue. This result is based on a different model, in which reserves do not explicitly appear as a factor of production.

Moving to comparative statics, we analyze the relationship between bank behavior, on one hand, and technological changes, changes in relative input prices, and changes in the monetary base and reserve requirements, on the other. It is shown, that out of pure profit incentives, banks will never reject any reserve influx (in contrast to the conclusion derived by most of the more recent bank models (Karaken, 1967; Klein, 1971; Pesek, 1971; Sealey and Lindley, 1977)).

We also analyze liability management, one of the most important recent developments in banking, an innovation which involves banks in nontraditional borrowing arrangements. We show that banks react to price fixing in the market for their output (interest ceilings on deposits), as do most producers: they produce substitutes, the price of which is unregulated. The most important of these substitutes are CD's. Rationing, which is often mentioned in the context of a maximum price setting, is inapplicable to this analysis, since the banks

create the excess demand and simultaneously satisfy it by producing CD's.

In general, it is argued that integrating the unique characteristics of banks with a neo-classical production model provides a better understanding of the behavior of the banking firm than that found in the current bank-cost literature, and is capable of explaining recent developments in that industry. At the same time, this producer-model of banks describes a production process for liquidity, that is, bank money, providing a link between the micro and macro foundations of banking.

Under the alternative assumption of multiple production processes, we show that the bank is operating as a multiproduct multiplant firm. Each "plant" produces a different deposit according to its own production process. Each plant equates its marginal costs and revenues so as to maximize profits. The important point, here, is that both the one production process assumption (and various demand elasticities), as well as that of multiple processes, yield the same structure of deposit prices and the same equilibrium deposit mix. Moreover, when we analyze the adjustment processes of the bank (its reactions to changes in the "givens") and compare the results derived under the two structures, they are found to be consistent with each other and with our daily experience with regard to bank behavior.

E. Empirical Estimates--Banks' Production Function

Our empirical estimates of the cost-output relationship in commercial banks is based on the yearly data provided by 1000 U.S banks voluntarily participating in the Functional Cost Analysis program. A cross-section analysis of this detailed data (balance-sheet and income-statement items) was conducted for the years 1973, 1975 and 1977. Bell and Murphy's (1968) study serves as a means to isolate the empirical impact of the differences between our model and previous approaches. The main results are as follows:

(a) Our approach of defining bank output can be used to find the "liquidity" equivalent of changes in bank liabilities and to determine the amount by which the monetary base should be changed so as to maintain a given overall level of liquidity¹². On the assumption that this level of liquidity is consistent with stable prices, such an approach will ensure the continuation of this stability. However, as the liquidity function was found to be unstable (at least in the short run), a frequent revision of the parameters used is needed in order to make the above policy more efficient. Such an approach adds a practical dimension to the long discussed issue of the definition of money.

(b) We do not find any conclusive evidence for the existence of (consistent) economies of scale in bank operations. This holds whether liquidity is used as a measure of bank output,

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For this point, see also Chetty (1969).

or whether bank deposits serve this function. Thus, it is our view that banks' supervisory agencies should encourage more intense competition in the banking sector¹³. The existence of administrative barriers to entry may result in the operation of banks which are "too big" and thus are characterized by higher costs. The only benefits of these barriers seem to be in terms of 'supervisory convenience'.

(c) The high degree of government intervention in the operation of banks (one aspect of which is the above mentioned barriers to entry) is suspected of causing a resources-mis-allocation in this industry. It was shown that banks may employ too much labor, relative to capital, a result which is partially supported by other studies.

(d) Banks were found to have significant economies of scale in the employment of labor, as well as in the employment of capital (computer technology). Thus, it is hard to determine whether future developments in this industry will involve further use of a labor-saving technology, such as Electronic Fund Transfer Systems, or whether the gains from such a trend are close to being fully exploited.

(e) Finally, our study raises some doubts with respect to the validity of using the Cobb - Douglas production function

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Bell and Murphy (1968, p.224) reach a different conclusion: "It was demonstrated that the existence of economies of scale could present a dilemma to the regulatory agency. That is, the encouragement of both vigorous competition and low cost banking services might not always be mutually consistent".

in order to describe the production process of banks.

F. The Structure of this Study

In addition to this summary, our study includes:

(a) A literature survey (chapter two) in which we analyse, in detail, five of the more recent bank models representing various approaches to the micro theory of banks. These models are: Kareken (1967), Klein (1971), Pesek (1971), Sealey and Lindley (1977), and Towey (1974).

(b) An analysis of the demand for bank output (chapter three), which includes our definition of bank output, and the nature and characteristics of the demand function(s) facing the banking firm. Also included is a discussion of the transmission mechanism, as related to our concept of bank output, and the role of interest rates in the determination of the liquidity of financial assets.

(c) An analysis of the supply of bank output (chapter four), in which we discuss the competitive environment of banks, the nature of the banks' cost function, and the characteristics of bank equilibrium. As an application of our model, we analyze some recent developments in banking using the model.

(d) An empirical estimation of the cost-output relationship in a sample of U.S banks (chapter five). The structure of this section is close to that suggested by Bell and Murphy. This enables us to evaluate the empirical impact of the (theoretical) differences between our model and previous approaches.

CHAPTER 2

THEORIES OF THE BANKING FIRM - LITERATURE

SURVEY AND CRITIQUE

A. Introduction

Bank models range from the traditional analysis of banks as investors channelling money from surplus to deficit units, to a more sophisticated and unorthodox view which regards the banking firm as a producer rather than an intermediary.

Our survey will differentiate among several models of bank behavior according to the aggregate they use as bank output.

This aggregate, whether the bank is treated as a producer or as an investor, determines not only the behavioral results derived in those models but also the role attributed to the banking firm and to the industry in our economic system.

From the vast literature in banking theory we have chosen to present, in some detail, five models which represent opposing views about the role of banks and the way they operate.

The models chosen represent the three following approaches. First the traditional thinking in banking theory in which the balance sheet structure is the most important (and sometimes the only important) element in the explanation of the behavior of banks. Secondly the more recent portfolio approach, adjusted for financial intermediaries, wherein banks are maximizers of the yield on equity. Thirdly a new nonconventional stream in banking theory, wherein banks are producers which equate marginal revenues with the price of their output.

In this chapter we focus our criticism of the literature around four issues which seem to be crucial in modelling the behavior of the banking firm.

These issues are:

- (a) Bank output definition
- (b) Production costs and the operation of the banking firm
- (c) Properties of banks' process of adjustment to changes in the "givens"
- (d) Market structure of the industry.

In the first part of this chapter we present the various definitions of bank output used in the literature and discuss their deficiencies.

In the second part we present five micro models and structure our critique around the last three issues mentioned.

B. Bank Output

"Determining input and output depends in part on the scope of analysis. From a microeconomic viewpoint, i.e. concentrating on a bank as an individual unit, deposits are an input to banks and loans and investments are an output. From a macroeconomic viewpoint, i.e. concentrating on the banking system's impact on the whole economy loans and investments are inputs" (Mackara, 1975, p.72).

Such a view is hard to accept because it implies that the definition of bank output is as flexible as the purpose of the study at hand. This is not the case in the general micro production theory and we don't see any reason why banks should constitute an exception even though their output may well be more important for macro analysis than for a micro one.

For more specific definitions of bank output we can look on both sides of the bank's balance sheet.

B.1 Bank Deposits as Output

Pesek and Saving (1968, ch.12 and ch.13) claim that deposits, but not all deposits, should be regarded as bank output. Demand deposits alone constitute a meaningful output of the banking firm. This view follows from their effort to provide a link between monetary analysis of banks as suppliers of the major component of M_1 and micro theory of banks as producers of this component of the money stock. According to them all other deposits, like term deposits and saving accounts, should be considered as borrowed funds because interest is paid on them.

Pesek (1970, p.370) characterizes the nature of this output

as

"Bank money is not produced and sold outright
but like Xerox machines produced and rented."

A major problem with this approach is that the desire to link the monetary view with the micro view of banking on verbal grounds (using the term "money") creates the artificial division between demand deposits and time deposits on the basis of the explicit interest paid on them.

From the fact that the marginal utility from the different types of deposits should be equal we deduct that non pecuniary returns have the same value as pecuniary ones. The fact that the bank pays pecuniary returns in one case (time deposits) and nonpecuniary ones in the other (demand deposits) can not provide a basis for output identification. Why can't it be said that in the case of time deposits the customer pays \$1 in cash in return for a deposit and an explicit interest payment, and in the case of acquiring a demand deposit he pays \$1 in cash in exchange for \$1 of a more liquid form of bank output? Thus if a common denominator for all bank deposits can be provided, explicit interest payments could not serve as a mean to identify bank output among the different types of deposits. When one uses deposits as bank output the question arises whether the volume of transactions or deposits represents bank-product better. Gorman (In Fuchs, 1969, pp.155-199) summarizes this problem as follows:

"The services provided to depositors...can be classified into those reflecting the volume

of deposits hold and those relating to the volume of transactions. Among the former are such measures as liquidity and safety, among the latter are such services as book keeping and cheque clearing. The two groupings of possible outputs lead to radically different views of the functions of commercial banks and the relation of bank output and monetary policy..... Adopting the first view is equivalent to viewing banks as producers of money to hold..... Adoption of the second view is equivalent to viewing banks as facilitators of money payments."

Volume and turnover is the approach used in most cost studies. For example see Benston (1972), Daniel, Longbrake and Murphy (1973), Bell and Murphy (1968), Longbrake (1973), and Longbrake and Haslem (1975).

The argument in these studies is that volume and turnover cause the banks to incur costs, thus the 'turnover adjustment' applies to bank assets as well as to bank liabilities and therefore, according to those studies, deposits are not considered as the sole output of banks.

B.2 Bank Assets as Output

Another school claims that deposits should be considered as inputs and earning assets as bank output.

Sealey and Lindley (1977) suggest that deposits may be viewed as an intermediate product which is an input in the production of earning assets. As they put it (p.1254):

"The production process of the financial firm, from the firm's viewpoint, is a multistage production process involving intermediate outputs where loanable funds, borrowed from depositors and serviced by the firm with the use of capital, labor and material inputs are used in the

production of earning assets. This type of production is essentially analogous to the manufacturing firm where a production department produces and supplies an output which is directly an input in another process. Eventually, the intermediate output culminates in the final economic output of the firm."

They also claim that services received by depositors are more appropriately associated with the acquisition of economic inputs since these services require the banks to incur real costs, factor payments, without yielding direct revenue (no service charges are assumed). Part of these factor payments are in the form of services like book keeping, cheque clearing, etc.

Such an approach raises two basic questions:

(a) Is the fact that deposits yield no direct revenue to banks necessary and/or sufficient to preclude them from being treated as bank output?

(b) What is the real nature of these "factor payments"?

Towey (1974, p.59) provides the framework for answering the first question (the second one will be analyzed in chapter four):

"Deposits are like other financial claims in that the issuing firm derives little or no direct revenue from them... The relevant unit revenue stems primarily from earning assets which the issue of claims enables to obtain. The direct costs to society of producing these claims is virtually zero but resource using services and interest payments are offered as inducements to hold them. These indirect revenue, nil production cost and positive service cost features distinguish financial claims from goods and services whose production is customarily analyzed with price theory."

Thus the real issue at hand is whether the fact that certain kinds of deposits are not a source of revenue is more peculiar

than the fact that a substantial part of bank costs are incurred in the form of providing services as partial input payments. Which characteristic is more unique, the one implied by viewing deposits as an input or the one implied by viewing deposits as an output, is a matter of subjective judgement.

In our view, implicit and explicit interest payments may be viewed as made in order to attract reserves. Viewing deposits as bank input may be convenient but may not follow from a careful analysis of the banking firm and the nature of the exchange between this firm and its customers.

Klein (1971) also supports the view that bank assets are a proxy for output, because the real goal of the banking firm is to maximize the revenues from these assets and not the level of assets per se. Klein uses the 'direct revenue' criterion to define bank output (those items on the balance sheet which account directly for bank revenue are bank output).

B.3 Both Deposits and Assets as Output

A large number of studies suggest that both assets and deposits should be defined as bank output. Those studies essentially analyze the banking firm as a multiproduct producer.

This approach implies the following two major ways to define bank output.

a. The Multiple Output Measure: Such a measure is offered by Bell and Murphy (1968), and Benston (1972). In their studies the bank is represented by a number of separate production

processes (for this classification see; Adar, Agmon and Orgler, 1975) where the output of each process (or department) is measured by the number of accounts, thus banks' products are considered to be nonjoint.

"The typical commercial bank is a multiproduct firm engaged in servicing demand and time deposits accounts, processing business, installment and real estate loans accounts and providing many other services. From a cost standpoint all these functions or services may be regarded as different products.

These are not joint products but can be produced in varying proportions depending on local demand" (Bell and Murphy, 1968, ch. 12).

Samuelson (1966) suggests more than one test for examining the existence of jointness in production. One such test is specified and adjusted for banks in Adar, Agmon and Orgler (1975). Yet it has to be remembered that the results of such a test are sensitive to the assumed type of production function for different bank products. Nonjointness with a specific set of production functions does not exclude the possibility of jointness with another set.

Under some conditions¹, viewing assets and liabilities as bank output may look like double counting. As far as aggregates are concerned, they are two sides of one balance sheet. And as far as accounts are concerned, if every structure of bank assets implies a specific structure of liabilities, then focusing on the liabilities is enough for a consistent measure of bank output.

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For this point see chapter three section C.5.

b. The Weighted Output Measure: This approach is presented in Powers (1969), and Greenbaum (1965, 1966 and 1967).

In these studies bank output is represented as a weighted sum of selected balance sheet items. Powers suggests that the output concept must be tailored to the particular question asked in a specific study. Thus cost studies should be concerned with the level of services provided by the banks which in turn should reflect the dollar value as well as the expected yield over the banks' customers. He suggests defining output as the sum of the earning assets times their respective yields and the deposits times their respective interest rates.

Greenbaum offers another method of determining the weights in the above measure. He obtains them by experimenting with least square regression equations which define the relationship between the bank's gross operating income and its different lending activities. According to this approach higher weights are interpreted as reflecting more valuable services².

To this measure of output Greenbaum adds a nonweighted measure of "nonlending output" but he fails to integrate deposits with his weighted-output measure.

The attractiveness of such an approach is in integrating the demand side, consumers' preferences, with a definition of bank output.

When one uses the weighted - output measure approach in

2

If banks are engaged in less than perfect competition, higher weights will reflect monopolistic power rather than consumers' preferences.

an estimation of the banks' cost function he must remember that in order to get meaningful results, changes in output through time for a given bank must correspond to changes in factor inputs. But in the case of an output index, changes in the weights can cause changes in the value of the output without a corresponding change in inputs. In other words, it is not enough to "know" that two observations are on the same factor - output transformation curve in order to conclude that the value of the product (mix) at these two points is the same. The above points may correspond to two different price vectors. The value of the composite output is not invariant to changes in relative prices and thus the production function may not be well defined on its inputs³.

To conclude, we presented basically three ways of defining bank output: as bank deposits (specifically demand deposits), as banks loans and investments, and as both deposits, and loans and investments. Sometimes the money value of these different balance sheet items is considered the proper measure, other times the number of accounts, and some studies use a combination of these elements. In addition, single output (deposits, loans) and multiple output measures are used, so are weighted output measures. All those different approaches have their drawbacks on the way the banking firm is analyzed and on the behavioral implications of the different models.

³ For a discussion of this topic see Mundlak (1963, pp.433-436).

It is hard to find, in the literature surveyed, any analytical justification for the choice of a specific definition of bank output. It is also clear that some of the definitions mentioned are used because of convenience. In light of these remarks we will now discuss five of the major models of the banking firm.

C. Micro Models of the Banking Firm

In this section we present what we consider to be five major points of view concerning the behavior of the banking firm.

Curiously enough, all the micro models suggested in the literature use a single - output definition of bank product. We will classify the models surveyed according to the balance sheet item they use as bank output and our critique of these models will be concentrated around the following issues; production costs, adjustment process, and market structure.

C.1 Earning Assets as Output

Earning assets as bank output and deposits as an input is the measure Kareken (1967), Klein (1971), and Sealey and Lindley (1977), use as the basis for their models of bank behavior.

a. Kareken's Model.

Kareken defines a total revenue function which presents the sum of revenues from loans and reserves.

Total return on bank assets:

$$(2.1) \rho = \rho_L + \rho_R$$

Dollar return on reserves:

$$(2.2) \rho_R = r_R(D-L)$$

where r_R is the rate of return on reserves (assumed given) and D is the level of demand deposits.

Dollar return on loans:

$$(2.3) \rho_L = (r_L - c_L)L$$

where r_L is the rate of return on loans.

Average cost of one unit of loans:

$$(2.4) c_L = \alpha L$$

where α is a constant.

Inserting (2), (3) and (4) into (1) yields:

$$(2.5) \rho = r_L D + (r_L - r_R)L - \alpha L^2$$

Equation (2.5) provides a family of iso - revenue curves, each defined for a given level of d . r_L and r_R . Since the net rate of return on loans decreases as L increases there should be a mix of R and L which maximizes the net revenues. This mix, subject to a balance sheet constraint ($D < R+L$) implies an optimum bank size (level of deposits).

In other words, given the rate of return of loans and reserves there is an optimum portfolio for every stock of deposits with an associated maximum net revenue. The net revenue function itself increases at a decreasing rate with the level of deposits. Beyond a point where any further increase implies that only excess reserves (not loans) increase, it increases at a constant rate.

After determining the optimum portfolio for every given size, the bank has to determine its optimum scale of operations.

The cost function:

$$(2.6) \quad \gamma = (r_D + c_D)D$$

where r_D is the interest rate on deposits and c_D is the cost of services provided.

Upon assumption:

$$(2.7) \quad c_D = b(D)$$

where b is a constant.

Therefore:

$$(2.6)' \quad \gamma = r_D + bD^2$$

This cost function increases at a decreasing rate. The optimum scale of the bank will be determined at the point where $MC=MR$, given as point D' in figure 2-1.

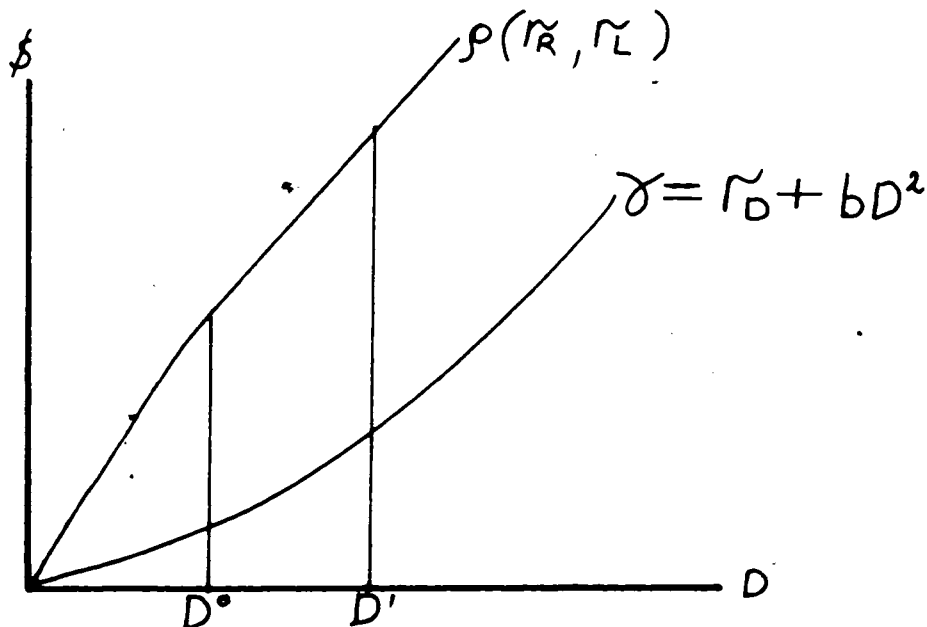


Figure 2-1 Kareken's Model

Comments:

Production costs - Kareken assumes a constant cost function for loans and deposits. Empirically this assumption is invalid. All the major cost studies (See, for example, Benston, 1965 and 1972, Baltenspreger, 1972, and Bell and Murphy, 1968) claim that banks enjoy economies of scale in their production process. Theoretically this assumption is needed since production costs don't play a central role in the explanation of bank behavior according to this model. Production costs codetermine the equilibrium position of the bank only because the given interest rate on deposits is added to the direct production costs (see equations (2.6) and (2.6)').

Production costs of reserves, which are a major source of revenues according to this model, are disregarded altogether. Even if one claims that the total level of R in the system has zero (social) costs this is probably not the case for the individual bank. For any level of excess reserves there are opportunity costs and for any level of reserves in general there are direct costs such as the costs involved in creating book entries.

The adjustment process - This model predicts two alternative behavioral patterns that stand in contrast to the observed behavior of the banking firm.

When $r_R > 0$ the model predicts an ever increasing level of excess reserves once the bank has reached the "critical" level of deposits, D' , in figure 2-1. This is because net revenues

decrease at a decreasing rate, (equations (2.3) and (2.4)), thus beyond a certain level of L , marginal net revenues will be negative.

This means that any additional increase in D will be allocated entirely to reserves. This implication is in contrast to the low level of excess reserves in the U.S (and in the Canadian) banking system despite the constant **growth of D** . Is this because all banks operate at a much lower level than D' ? If so, why do they intensify the competition for additional deposits?

When the legal reserve requirement is assumed to be zero (which is only a special case in Kareken's model) the model predicts that no reserves at all would be held as long as $D^0 < D'$, (figure 2-1), whereas when $D^0 > D'$, any increase in D will be allocated entirely to reserves. It is hard to accept that banks won't hold reserves in the absence of a legal requirement. When reserves costs are incorporated into the model, or if r_R is assumed to be zero (a case which Kareken does not exclude), we get the result that beyond a certain level of deposits the bank will reject any new influx of D because the marginal costs of supporting these reserves are greater than the marginal benefits. Such a behavioral prediction should be rejected on empirical grounds, banks, almost without exception, accept new deposits.

Market Structure - Kareken assumes perfect competition in the borrowing and lending markets. As we will illustrate in chapter

four, a careful analysis of the nature of bank deposits and the way they are produced should lead us to a different conclusion about the "true" market structure of the banking industry.

b. Klein's Model

Klein's (1971) model is a portfolio analysis of the banking firm as a rational, profit maximizing investor.

He uses a linear additive function of the following form:

$$(2.8) \quad E = (\sum X_j E_j - \sum \alpha_i R_i) / (1 - \sum \alpha_i)$$

where E_w is the rate of a return on equity, X_j are the proportions of total funds allocated to the j th asset ($J=1\dots n$), E_j is the rate of return on the j th asset, α_i are the proportions of total funds obtained through the issuance of the i th deposit ($i=1\dots m$), and R_i is the rate of interest on the i th deposit.

When a linear utility function defined on the rate of return is assumed, the banks' target becomes to maximize their rate of return. Klein assumes that banks have monopolistic power in the loans and deposits market but none in the government bonds market where the rate of return is random in time.

The assumed rate of return on reserves is a function of the penalty cost per dollar of cash deficiency where the deficiency itself is random with a finite mean. A standard maximization process under a balance sheet constraint yields that loans, government bonds and reserves are held to the point of equality of their respective marginal rates of return.

Comments

Production Costs - Klein's model has no reference to production costs and thus it can at best provide a description of the banking firm as an investor (with zero transaction costs) but not as a producer.

If production costs (such as wages) are incorporated into the model we get that the existence of government bonds in banks' portfolios implies the use of a scarce resource (Labor) and thus the existence of real costs in producing this output.

If wages are an increasing function (at least within some range) of this output we lose the central characteristic in Klein's model - namely, the existence of an endogenous price which pegs the system.

Without such a price, the marginal yields would be equated not to an exogenous interest rate but to the marginal costs of producing the various financial assets.

The adjustment process - According to Klein's analysis the bank will reject any incremental reserve influx when its level of deposits is such that the marginal costs of each additional dollar of deposits is equal to the marginal revenue from the asset it supports.

This analysis cannot explain the ever growing banking industry unless all banks are operating at a point where $MC < MR$. If this is not the case some other argument must be made in order to explain the ever increasing willingness of banks to accept new deposits. One such argument is that an additional

reserve influx shifts the marginal cost function. This means that there is an "active" equilibrium where banks seek new deposits (by branching for example) because at the existing level $MC = MR$, and a 'passive' equilibrium in which the banks only passively adjust to reserves influx. If we accept the argument that size per se is important to banks then they will always be in a state of seeking new deposits. Further comments on this issue will be made in chapter four.

Market Structure - Klein assumes that the appropriate market structure for the analysis of the banking firm is monopolistic competition. Like Kareken's choice of perfect competition there is nothing within the theory, nor any justification on empirical grounds, for this choice. As we suggested before, a closer look on the behavior of these financial institutions may reveal the nature of the market structure of this industry.

Miscellaneous - In this model we have an incomplete treatment of the risk factor, the result of which is a dichotomy between banks' portfolio yield (and the offered rate of return on their liabilities) and the costs and yields of the individual items like deposits and equity. As Pringle⁴ (1974, p.995) puts it:

"Klein's finding of independence (between its optimal loan policy and the rate paid on deposits) follows from certain key assumptions, among them assumptions regarding the structure of loans and deposits markets and the resulting elasticities of supply and demand functions, the independence found by Klein cannot be shown to hold in all cases on strictly theoretical grounds."

⁴ This section draws heavily on Pringle (pp.990-993).

If we outline four of Klein's more important assumptions we will understand the reason for this peculiar result and its restrictive behavioral implication. Those assumptions are:

- (a) The bank's owners are risk neutral.
- (b) The bank has monopolistic power in the loan market and monopsonistic power in the deposits market.
- (c) Perfect competition for government loans.
- (d) A single maturity period for loans and deposits - equal to the length of the period.

Under (a) through (c) the risk free government bond rate pegs the system and the loan policy becomes independent of costs, interest payment on deposits and required rate of return by equity holders.

In Pringle's terminology (p.992):

"His (Klein's) finding that the cut off rate of (risky) loans is E_g follows from his assumptions: (a) that E_g alone is exogenous and (b) the investors are risk neutral."

If we assume instead that banks do compete in the deposits (or loans) market and that the marginal costs of operating in this market are higher than E_g , the loan policy will be dependent upon the cost of this source. If instead of assumption (d) we assume that banks build a long term loan portfolio based on short term deposits and bank owners are not risk neutral but risk averse⁵ we will reach the same conclusion - namely, that

5

An assumption that is proved to be true by the fact that portfolios are diversified.

decisions concerning assets and liabilities are not independent.

Pyle (1971) derives the following behavioral conclusions from a very similar model but with the risk aversion assumption. He shows that the incentive of financial intermediation to take place is greater:

1. The larger the risk premium on loans.
2. The smaller the risk premium on deposits.
3. The greater the positive dependence between loans and deposits' yields.
4. The larger the variability of deposits' yields.
5. The smaller the variation of loans' yields.

He concludes (p.746):

"Asset (liability) portfolios cannot, in general, be chosen independently of the parameters of liability (asset) yields."

Thus Klein's behavioral implications are unique because of simplifying assumptions which have superior empirical counterparts.

c. Sealey and Lindley's Model

Sealey and Lindley (S-L) (1977) do incorporate production costs as an important explanatory variable of bank behavior. The most peculiar and interesting result is that equilibrium in the output market (earning assets in this case) is reached when $MC=P$ but this is not necessarily accompanied by the same equilibrium condition in the input (deposits) market even though perfect competition is assumed. This stands in contrast to

the micro analysis of any other producer and therefore deserves a more detailed presentation of the model.

The balance sheet constraint:

$$(2.9) \quad R + \sum L_i + \sum S_j \leq \sum D_g(1-d_g) + \sum D_g d_g$$

where R are the required reserves, L are loans ($i=1\dots m$), S are securities ($j=1\dots n$), D are deposits ($g=1\dots p$) and D_g are the legal reserve ratios.

The deposits' supply function:

$$(2.10) \quad \bar{D}_g = \psi(r_g), r'_g > 0$$

where r_g is the interest rate on the g th deposit.

$S - L$ regard deposits also as an intermediate product, thus:

$$(2.11) \quad D_g = D_g(X_k^g)$$

is the production function of deposits' services,

where X_k^g is the k th input used to serve the g th deposit, ($k=1\dots t$).

The production functions for securities and loans are:

$$(2.12) \quad S_j = S_j(X_k^j)$$

$$(2.13) \quad L_i = L_i(X_k^i)$$

Combining (2.9) through (2.12) yields:

$$(2.14) \quad \sum L_i + \sum S_j = \text{Min.} \left(\sum (1-d_g) D_g(X_k^g); \sum L_i(X_k^i) + \sum S_j(X_k^j) \right)$$

"The economically relevant factor combinations for this type of production function are those combinations where (the two constraints) are mutually limitational, thus insuring that none of the factors are available in superfluous quantities" (S-L, 1977, p.1277).

From (2.11), (2.12) and (2.13) the relevant cost functions are derived;

$$(2.11)' \quad C_g = C_g (D_g)$$

$$(2.12)' \quad C_j = C_j (S_j)$$

$$(2.13)' \quad C_i = C_i (L_i)$$

As various deposits are substitutes in the production of earning assets, a cost minimizing combination could be determined by minimizing (2.10) and (2.11)', subject to (2.11). This yields a function of the following form:

$$(2.15) \quad C_D = C_D (\sum L_i + \sum S_j)$$

From which a profit function is derived:

$$(2.16) \quad \Pi = (\sum r_i L_i + \sum r_j S_j) - (\sum C_i (L_i) + \sum C_j (S_j))$$

where r_i is the market rate on loan type i , and r_j is the market rate of security type j .

From this profit function it can be seen that the marginal costs of producing earning assets include the marginal costs of acquiring funds ($r_i = \partial C_i / \partial L_i + \partial C_D / \partial L_i$), contrary to Klein's result.

To illustrate the equilibrium in the output and input

markets let us follow S-L's example of one input (D) and one output (E).

$$E \leq (1-d)D$$

$$E = E(X)$$

$$C_D = C_D(E)$$

$$C_L = C_L(E)$$

$$C = C_D(E) + C_L(E).$$

This is illustrated in figure 2-2.

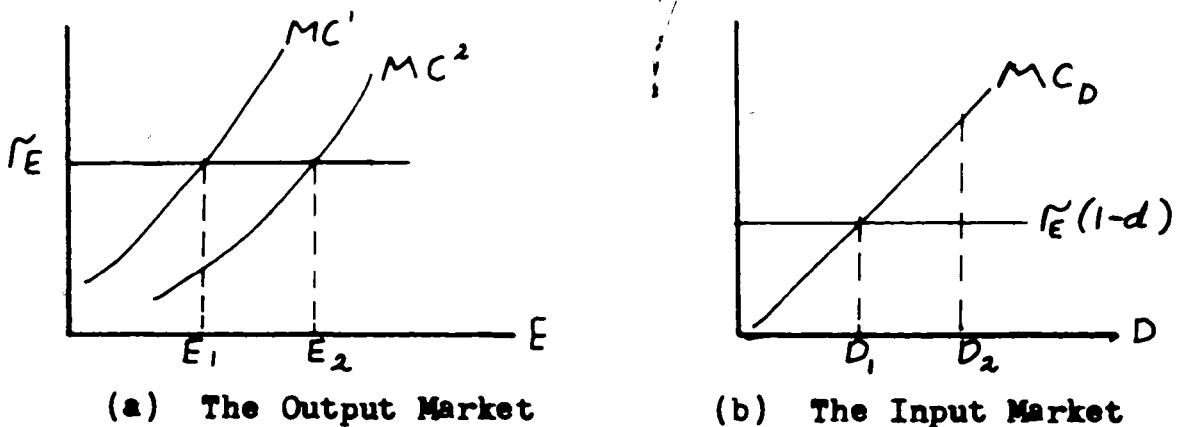


Figure 2-2 S - L Model

(E_1, D_1) is the initial equilibrium. A decrease in the production costs will shift the MC function to MC^2 , this results in an equilibrium (E_2, D_2) in both markets but the marginal product of deposits (r_E) and the reserve ratio (d) are constant and thus the "equilibrium" in the input market implies:

$$w_{p_D} < MC_D.$$

Comments

The adjustment process - This model presents a peculiar result as much as the nature of bank equilibrium and its adjustment to changes in the "givens" (like factor prices) are concerned. Here, the equality between the marginal costs of "producing" deposits and the value of their marginal product is neither a necessary nor a sufficient condition for a stable equilibrium of the banking firm. This is a result of an inconsistent treatment of deposits in this model. At one stage deposits are regarded as an input used to produce earning assets, at the same time S - L claim that the bank has to allocate real resources to the production of this "input". Why have these deposits not been regarded as an output in the first place? Presumably, it would not enable S - L to define the earning assets as output.

This ambiguous treatment of deposits and the assumption of monopsonistic power in the deposit market are responsible for the strange result illustrated in figure 2-2.

If S - L had been consistent with their equation (2.10) then the equilibrium in the input market should have been the monopsonistic type of equilibrium where the marginal factor price equals the value of its marginal product. Also, it is impossible to claim that the bank faces a horizontal Vmp (of deposits) curve because even though r_g and d are given, the net return is not constant for a bank facing rising marginal costs of producing these deposits.

This model suffers from the same problem mentioned with respect to Klein's model, that of not differentiating between passive adjustment and active search for new deposits. This model again implies the possibility of deposits rejection by the bank.

Market structure - S - L assume that banks are monopsonists in the input (deposits) market and perfect competitors in the output (earning assets market). Aside from the inconsistent analysis of banks' monopsonistic power (as mentioned above) this model, again, makes no effort to reveal the market structure of this industry based on the unique nature of the individual firms.

C.2. Deposits As Output

Deposits as bank output is the message of three studies, Pesek (1970), Saving (1977), and Towe (1974), Saving's general idea resembles Pesek's one while his treatment of bank costs is limited only to interest rates vs. a broader concept of factor payments. The later includes interest as well as wages and rent, a concept which is shared by Pesek and Towe. For this reason we shall concentrate on the models offered by Pesek and Towe alone.

a. Pesek's Model

Pesek tries to present the equilibrium (not the optimum) quantity of money (M_1) as the sum of the equilibrium quantity of currency and the equilibrium quantity of demand deposits.

Assuming: (a) a given quantity of high powered money,

(b) a fixed cash to deposits ratio, he is able to focus the analysis on the forces which determine the equilibrium in the deposits market alone.

According to Pesek bank product (demand deposits) is not produced and sold outright but produced and rented.

In the case of the acquisition of a primary deposit, the customer pays \$1 for each dollar of a demand deposit and some service charges (r_s) for being able to use this product which, physically, stays with the bank. In the case of the acquisition of a secondary deposit the borrower gets a demand deposit on which he pays service charges in exchange for an I.O.U. In addition to the service charges the borrower also pays a "rental charge" (r_e) which is the interest on the loan. Thus the revenue variables are r_s and r_e .

The suggested cost variables are:

r_e - The (opportunity) cost of required reserves.

r_i - Costs of managing the investment portfolio.

r_m - The costs of servicing deposit accounts.

r_t - Normal profits, taxes, insurance expenditures, etc.

Given these variables and a production function, the marginal and average cost functions for the firm and the industry can be determined.

As to the demand function for bank output, it, according to Pesek, should satisfy two conditions:

(a) The high powered money constraint, $H=C+R$.

(b) The minimum price constraint, $R_m^c = R_m^d$.

Given a positive reserve ratio and a fixed H , the first constraint implies that the demand for deposits depends on the public's holdings of currency which decrease as the quantity of demand deposits increases.

The second constraint is derived from Pesek's "convertibility clause".

"The banker is subject to a convertibility clause that imposes on him the obligation to exchange on demand \$1 of currency for \$1 of demand deposit... It is easy to see that this convertibility clause leads to the establishment of a fixed minimum price (purchasing power) of deposits" (Pesek, 1970, p.367).

When P_m^d is lower than P_m^c arbitrage, which is assumed to be costless, will equate the two prices. As C and D are substitutes, an increase in the service charges (r_s) will result in an increased demand for C at the expense of D. This relationship and the bank's supply and cost functions are illustrated in figure 2-3.

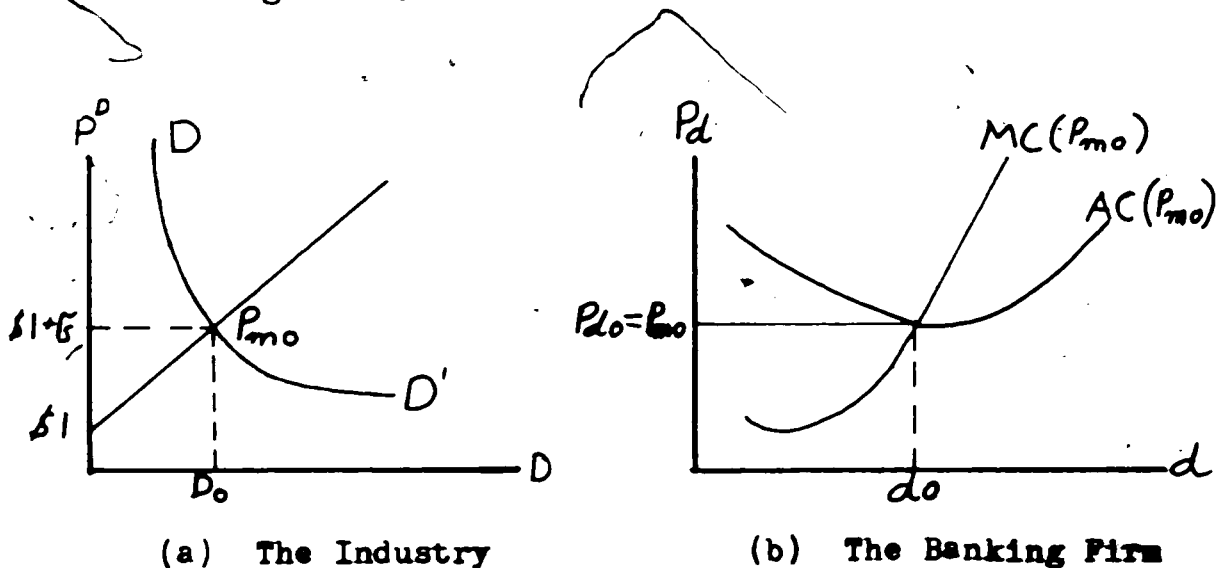


Figure 2-3 Pesek's Model

Since arbitrage costs are assumed to be zero, the price of demand deposits (their value in terms of a basket of goods) P_d , should be equal to the price of currency (in terms of the same basket) P_m .

The price the consumer pays for \$1 of demand deposits is equal to \$1 of currency plus the service charges. Thus at the point of equilibrium $P_m = P_d = 1+r_s$.

As the value of our representative basket of goods moves together with the general price level, the demand for deposits corresponds also to a given price level. Thus each point on the DD' curve corresponds to a different price level and the average and marginal cost functions are defined for a given price level only.

Comments

Production costs - In this model we find for the first time a detailed analysis of the banking firm as a producer and thus production costs become the focus of the analysis. However, the reason that these costs are classified according to the balance sheet items (reserves, deposits, etc.) and not according to the type of input (wages, rent, etc.) is not clear.

We may also question the role of reserves' opportunity costs as direct production costs unless we are shown a direct link between the level of reserves and the volume of bank output.

The adjustment process - The adjustment process of the banking firm to changes in the 'givens' as implied by this model is

unsatisfactory because of two reasons:

(a) This model, as the ones surveyed before, offers no explanation for the bank's reaction to an incremental reserve influx and thus does not exclude rejection of new deposits.

(b) Pesek fails to recognize that the demand function (DD' in figure 2-3) is not the average revenue function for the banking firm and thus (P_{m0}, D_0) can not describe the equilibrium price and quantity.

The main source of bank revenues are not the service charges but the rental payments from direct and indirect (loans and investments) renting of output. Those interest payments are recognized by Pesek in his price and cost variables specification but are not analytically incorporated into his model (figure 2-3). Incorporating these revenues into the model means that the demand function for deposits ceases to represent the average revenue function which the bank faces. The moment the demand function and the average revenue function are not identical - the equilibrium position of the banking firm and the industry, and the adjustment process can be described and analyzed differently.

Market structure - Pesek recognizes the existence of the convertibility clause and the minimum price constraint implied by it but fails to see the link between these characteristics and the market structure of the banking industry.

The issue is whether the existence of the convertibility clause and the derived minimum price constraint does not imply

that competition in this industry can hardly be perfect. The reason for this may be that there will probably be different degrees of consumer's confidence in the ability of the banks to exercise their duty (converting demand deposits into cash)⁶. If the banking firm can effect this degree of confidence, the demand function it faces won't be horizontal. Thus the banking firm and the industry should instead be analyzed in terms of monopolistic competition.

To use Klein's (1974) terminology, when each bank can affect the perceived level of its consumers' confidence it means that it is producing a unique output in the sense that the relationship between its money (demand deposits) and government money (currency) carries a different price than another bank's money. Thus extreme product differentiation may be the result where it makes little sense to analyze banks as perfect competitors.

b. Towey's Model

Towey's (1974) model resembles Pesek's analysis but in this model we find, for the first time, an explanation of the adjustment of the banking firm to any increase in the level of reserves. Towey also tries to provide an answer to the unsolved issue of what is the "true" market structure in which the banking industry operates. His structural assumptions are:

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This argument may not hold when the deposits are guaranteed by a formal or informal deposit insurance scheme. For this point see chapter 4, section B.

- (a) Service charges (and the quantity of services provided) are the only means through which banks compete for their share of the total level of reserves.
- (b) Banks hold no excess reserves.
- (c) The desired level of equity is a fixed fraction of the level of deposits.
- (d) The earning assets 'department' is characterized by the conditions of perfect competition.
- (e) Only demand deposits can be considered as bank output.

The cost function:

$$(2.17) \quad C = C(D, Z_1, \dots, Z_s)$$

where D are demand deposits and Z are the services (including interest payment) rendered.

The revenue function:

$$(2.18) \quad G = p(1-r+e)D + \sum A_i Z_i D_i$$

where p is the rate of return on the, homogeneous, earning assets, r is the reserve ratio on demand deposits, e is the equity ratio, and A_i are the charges levied in return for bank services ($i = 1 \dots s$).

The revenue function (1.18) shows that Tovey overcomes the problem mentioned in connection with Pesek's model. In his model the earning assets are an important source of bank revenues. Thus, his average revenue function, which includes revenues from assets as well as deposits, is different from

the usual demand function which stands for the revenues from output only (whether it is deposits or earning assets).

Bank profits are given by

$$(2.19) \quad \Pi = p(1-r+e)D + \sum A_i Z_i D_i - C(D, Z_1, \dots, Z_s)$$

The first order condition for maximum profits when the level of services can be adjusted is:

$$(2.20) \quad p(1-r+e) + \sum A_i Z_i = \partial C / \partial D + (\partial C / \partial Z_i) (\partial Z_i / \partial D) - (A_i D) \partial Z_i / \partial D$$

and when the service charges can be adjusted it is:

$$(2.12) \quad p(1-r+e) + \sum A_i Z_i = \partial C / \partial D - (Z_i D) \partial A_i / \partial D$$

The first two terms in equations (2.20) and (2.21) constitute the marginal revenue, and the first term on the right hand side of these equations constitutes the marginal costs. The other terms on the right hand side are the variation costs, the cost to a producer of modifying the i th term of his offer sufficiently to change his quantity sold by one unit.

But Tovey wants to carry on his analysis in terms of perfect competition and thus claims (p.63)

"Suppose a bank finds that customers' response to a service improvement is such that $(\partial D / \partial Z_i) \rightarrow 0$ thus the variation cost goes to zero at this point. This involves the quality modification counterpart of the familiar Marshallian competitive result (for a qualitative invariant product); in both situations firms operate where marginal costs equal marginal revenues. Furthermore, when the qualitative change can be and is readily duplicated by others in the quest for profit, the resulting tendency toward dimensional standardization in the industry even in the short run

makes the symmetry with the Marshallian competitive outcome even more apparent".

The equilibrium position according to this is represented by point A in figure 2-4.

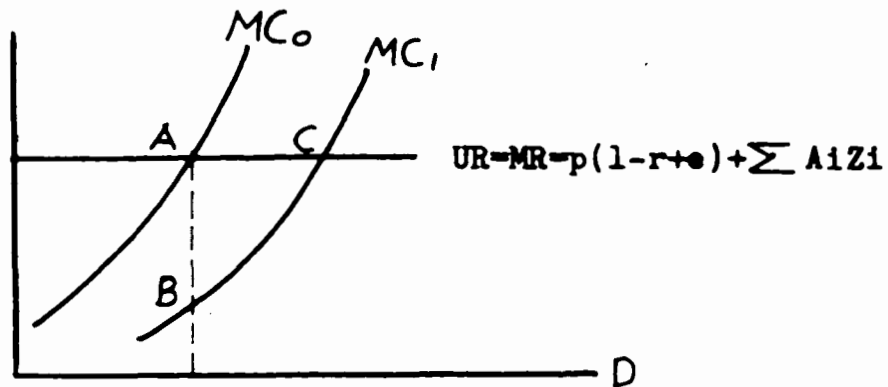


Figure 2-4 Towey's Model

To see the adjustment mechanism let us follow Towey's analysis of a change in r . This change has two effects:

"The Earning effect", as r goes up the UR function goes down ($\partial UR / \partial r = -p < 0$).

"The Reserve Cost Effect", as r goes up each bank increases the volume of services it offers such as to compensate itself for the initial loss of deposits. This collective effort makes each bank's own services less effective in attracting reserves, the MC function shifts to the left.

When the level of reserves in the system is increased (by OMO for example) MC_0 shifts to MC_1 (figure 2-4) as a result of

the reserve cost effect. At point B $MR > MC$, according to Towey, output will be increased by raising the services level and thus the bank will move to point C. As this increase in services is done by all the banks which gained reserves, it imposes a pecuniary externality on other banks since their old level of services is able to attract fewer deposits, thus shifting the MC function back to the left. This process will continue as long as deposits are not expanded by the full multiple of reserves.

Comments

The adjustment process - Towey's model offers, for the first time, an explanation why banks won't reject new deposits even though it is at a point where the marginal cost of producing them is equal to their marginal revenue. When the bank faces a reserve influx its cost function is shifting thus 'forcing' an expansion of output.

Yet, the adjustment process as described has some behavioral implications which seem to be in contrast to the daily experience.

As an example; The increase in the level of services, per dollar of deposits, which according to Towey, accompanies a reserve influx can yield the result that the MC function will shift to the original position so that the increased level of deposits can be explained only by the entry of new banks. We do not observe this relationship between OMO's and the number of banks.

We think that the U shaped cost function is due to the increased level of scarce resources and their decreasing efficiency in supporting a higher level of deposits. Among these resources are those needed to provide a higher volume of services produced, which does not imply an increase in the level of services per dollar of deposits which shifts the MC function backwards according to this model. We contend that banks do not increase the level of services per dollar of deposits when there is an increase in the level of reserves. They may do so in order to attract a larger fraction of reserves outstanding but not necessarily as a reaction to an exogenous increase, Thus Towe's mechanism, changes in the level of services, is not necessary and may yield strange results in explaining the dynamics of bank behavior.

Market Structure - Towe assumes that banks have monopolistic power in one market, the deposits market, and are perfect competitors in the loans market and, yet, wants to derive the equilibrium solution of the system in terms of perfect competition. The reason for that peculiar analysis is that Towe does not derive the "monopolistic power" characteristic from the nature of the banking firm but simply assumes it and thus later on he assumes it away.

Towe's treatment of the variation cost is ambiguous and stands in contrast to his analysis of the adjustment process. By assuming that banks possess monopolistic power through their ability to vary service offers the model should show, as

Scitovsky (1952 p.255) points out, that at the equilibrium point the price the bank charges for its product is equal to the marginal costs of production plus the variation cost. The later equals the product price over the demand elasticity.

But Towey claims (see equations 2.19 - 2.21 on page 60) that because of the quest for profits, at the equilibrium point, marginal costs alone will equal the price of the product which means that the quantity of deposits produced is insensitive to the banks' monopolistic power in the deposits market. If so, Towey's maximization procedure is not correct. On the other hand, only if banks do have some monopolistic power in the product market can one claim that competitive forces will result in changes in the volume of services per dollar of deposits. Thus, this model leaves us with no clear idea about an 'appropriate' market structure (if any) of the banking industry.

Miscellaneous - Towey's model ignores all the other kinds of deposits with the exception of demand deposits.

How should time deposits be treated? Are they an input or an output? If they are an input, what is the basic difference between them and demand deposits? If they are an output, how do we aggregate them with demand deposits? There are no answers to these questions, and others, which makes the model

unable to capture and explain all bank activities⁷.

⁷ This problem exists also in Pesek's model, but he incorporates time deposits into the analysis in another place. See Pesek and Saving (1968 ch. 12).

D. Summary

In this chapter we presented five models of bank behavior which represent different and sometimes opposing views about the role of banks and the way they operate. Our main findings are summarized around the following four points:

(1) Bank output definitions

Bank studies use different definitions of bank output less out of solid theoretical justification and more because of convenience in terms of the analysis at hand.

Some studies define banks' earning assets as their output, an approach which implies that deposits should be regarded as an input. Yet the fact that some deposits yield an explicit income to banks (and thus are closer to being an output) makes this view inconsistent. This brings some models to define deposits as an input and an intermediate product at the same time.

Other studies regard deposits as bank output. In this case the problem is that earning assets and not deposits are the main source of revenues for the banking firm, this fact is not incorporated into most of the models.

Another problem with this approach is that only demand deposits are regarded as bank output and the treatment of other types of deposits is, again, ambiguous and inconsistent.

Yet other studies use assets and liabilities together as bank output with different methods of aggregating both sides of the balance sheet.

(2) Production Costs and the Operation of the Banking Firm

The different micro models in banking theory suggest two basic views concerning the role of the individual bank and the banking industry in our economic system.

(a) The intermediation role. Banks are (rational) investors borrowing short term money and investing it in long term securities. By so doing they are not different from any other intermediiator. The intermediation role is usually analyzed along the line of Portfolio Theory, banks try to maximize the expected yield and their investment portfolio (loans and securities) given the degree of risk (if uncertainty is assumed) they are ready to bear.

These models disregard "production costs" altogether and therefore wages, rents, etc. do not appear as explanatory variables in their behavioral predictions.

(b) The producer's role of banks. The models which provide this view suggest that banks' behavior should be analysed along standard micro economic lines. Thus a production process and the derived cost function play a dominant role in deriving the empirical implications of these models.

(3) Properties of Banks' Process of Adjustment to Changes in the "Givens"

Most of the models, of both types, fail to explain the adjustment of the banking firm to changes in the "givens". This point is crucial to the analysis due to the extent of government regulation over this industry.

Most models predict that banks would reject deposits if they already operate at the equilibrium point where marginal costs equal marginal revenues. Size itself as a motive for continuous growth and changes in the reserve requirement and the level of total reserves as affecting the cost functions, are disregarded.

Thus these models yield some peculiar predictions about the behavior of the banking firm.

(4) Market Structure of the Industry.

The theory surveyed does not offer a way to identify the environment which surrounds the banking firm, the market structure which best describes the way banks operate. It also does not try to identify some crucial characteristics of the banking firm which may reduce the alternatives as to the appropriate structure. Some models open their analysis in a framework of monopolistic competition and end it in deriving behavioral conclusions which are based on the 'perfect competition' assumption. Other models find it convenient to describe the deposit market as perfectly competitive and the loans market as monopolistic.

In the next two chapters we offer a model of the banking firm which suggests answers to the four problems mentioned.

CHAPTER 3

THE DEMAND FOR BANK OUTPUT

A. The Role of A Theory of the Banking Firm

Our study into the behavior of the banking firm is based on what appear as two misconceptions about the nature of operation and the unique role of this institution in our economic system:

(a) Banks are usually treated as financial intermediaries and the physical production process is most often neglected. As Murphy (1972, p.614) puts it:

"Commercial banking is an interesting industry because in my opinion it is difficult to construct an integrated theory of the banking firm that treats liquidity management, portfolio selection, pricing policy and physical production processes simultaneously."

When one uses the "banks as intermediaries" concept for a description of the banking firm, as does Klein (1971) for example, bank operating costs are hardly mentioned and become irrelevant as far as bank behavior is concerned. Thus one may jump to the unwarranted conclusion that banks are insensitive to those costs.

(b) Banks are responsible for the existence of one financial asset-namely, demand deposits, which plays a role much beyond that attributed to almost any other asset produced, in that it is assumed to have a direct effect on the price level and national income.

Thus, a study into the behavior of the banking firm involves a micro analysis of an institution whose existence has an important role in the macro context.

The money stock determination equation may best serve

to illustrate this point. This equation (identity) has the following form:

$$\Delta M_1 = \frac{1+c}{R_{qd}+tR_{qt}+e+c} \Delta B$$

where c is the cash to demand deposits ratio, t is the time to demand deposits ratio, e is the excess reserve to demand deposits ratio, R_{qd} and R_{qt} are the reserve requirements against demand and time deposits respectively, B is the monetary base and M_1 is the money stock (currency and demand deposits).

This equation explains changes in the money stock in terms of changes in the monetary base and a multiplier which is a function of some fixed coefficients.

Almost no behavioral assumption is made concerning the determination of c , t and e . Bank portfolio behavior is given no role.

"Banks are caught between exogenous cash and fixed reserve ratios and public preferences, the latter determining how much of the cash supply the banks get. Expansion to the limit of reserves is assumed always to be profitable" (Chick, 1977, p.87).

If bank costs do not matter then the above equation may adequately describe both the macro aspect of banks, their role in the money creation process, and a peculiar micro aspect, operating in a "mechanical" way which can be described by a handful of (almost) fixed coefficients.

If, on the other hand, bank costs do matter, that equation neither describes the "true" relationship between the central bank's decision variables, B , R_{qd} and R_{qt} and the money stock,

nor any consistent relationship between bank costs, consumers' preferences and the variables c , e and t .

If bank costs should be part of the analysis as we suggest, one may establish a connection between the conventional demand side analysis of the macro importance of bank output (as M in the utility function, etc.) and a supply analysis of the micro foundations of bank output.

The holders of assets which yield liquidity services (bank deposits in our analysis) decide their optimal holding on the basis of their price, but this price is the simultaneous result of these assets holders' preferences and the factor costs of producing these assets. That is, the micro/macro interaction aspect can be reduced to the intersection of demand and supply considerations, and the connecting link is the price of liquidity services.

We are not the first to express interest in bank costs, but almost all the existing cost studies focus on tests of the economies of scale hypothesis in banking, and none of them is concerned with the analysis of the production costs as part of a comprehensive micro model of the banking firm. Further, none of these studies makes the connection to conventional micro analysis.

To summarize:

"Banking is unique amongst industries in that it is at once a privately owned, profit seeking industry and a critical vehicle for the implementation of monetary policy" (Bean and Schwandt, 1976, p.12).

Our study is aimed at analyzing this unique nature of the banking firm, indentifying a meaningful measure of bank output and incorporating the various balance-sheet and income-statement items into a comprehensive model of bank behavior, thereby explaining the link between the determinates of bank behavior and the supply of 'money'.

B. Introduction

In chapter one we presented four issues around which we focused our critique of the existing banking theory. These issues were:

- (a) Bank output definition
- (b) Production costs and the operation of the banking firm
- (c) Properties of banks' process of adjustment to changes in the "givens"
- (d) Market structure of the industry

In this chapter we provide our definition of bank output. A definition which is directly linked to our view about the role of the banking firm and the industry in a money economy.

The second part of this chapter explores the nature and the characteristics of the demand function(s) facing the banking firm.

Thus this chapter deals with one element of the 'money' stock determination process--namely, consumers' preferences with regard to bank deposits. Consumers' preferences are analyzed by using Lancaster's (1966) characteristics approach with bank deposits serving as "goods" and liquidity serving as characteristics.

C. On the Definition of Bank Output

We will concentrate here on some arguments, theoretical as well as pragmatic, which lead us to suggest a somewhat non-conventional definition of bank output-namely, liquidity.

We will explain how banks' value added, the level of liquidity they provide, and the volume and structure of their liabilities are related to each other. We will also explain the conditions under which concentrating on bank liabilities provides a good analytical and empirical method for analyzing the level of bank output. Our way of analyzing this issue will be contrasted with some other works which share a common view as to the role and the characteristics of the banking firm.

C.1 Value Added and Bank Output

When looking for a meaningful definition of bank output, or the output of any other firm which produces a service rather than a tangible good, one is inclined to use their value added as a proxy for their output.

Usually, value added is defined as revenues less purchases from other firms and depreciation, plus the increase in inventories. This value added is of course equal to the gross product originating (GPO) which includes all the factor payments.

In the case of financial institutions those factor payments include interest (and dividends) paid to depositors. In order to avoid double counting the GPO includes only net interest payments, but this, as Ruggles and Ruggles (1956, p.60) point

out, will in most cases be a negative amount:

"The interest and dividends received by such institutions often exceeds the interest that they pay out...gross product for these institutions might then be negative".

Ruggles and Ruggles suggest that in order to account properly for all bank activities it is necessary to treat all interest and dividends which the bank receives as if they were paid to depositors and as if the depositors in turn repaid most of this money to the bank for renting banking services.

Thus banks' value added consists of the explicit income (service charges etc.) and the imputed income which is equal to the interest and dividends received less those paid.

Banks' value added was first used by Dean (1977) to interpret Pesek's (1976) propositions about the importance of costs and efficiency considerations to the understanding of bank behavior.

"What, I believe, PS¹ meant to say was that liquidity services, over and above the value of any such services provided by bank assets, is measured by the difference between interest earnings on assets and interest payments (net of service charges) on deposits. A generous reading would find this 'value added' formulation implicit in Pesek's present paper" (Dean, 1977, p.920).

Thus the liquidity creation function of banks is reflected in the income (wealth) they are generating which itself is a function of the difference between the income they receive and pay out.

I

We may add here that if a link is provided, as it is later on, between banks' value added and 'money', then it follows that bank money (inside money) is net wealth, and the higher the production costs of that money, the higher is the level of wealth generated by banks².

This notion of net (monetary) wealth is meaningful in terms of conventional income accounting as we agree with Dean (1977) that the greater part of banks activity is picked up by the existing (national) accounting procedures.

Greenbaum (1966) extended the idea of using the value added as a proxy for bank output (see chapter two, section B.3) by finding the regression coefficients between the banks' gross income and its different lending activities; he interpreted those coefficients as the value attached, by bank customers, to the different activities.

C.2 From Value Added to Liquidity

Although we fully agree that the value added concept is an appropriate method for describing the output of many firms which produce services rather than tangible goods, we want to suggest that, in the case of banks, a more specific definition can be used-namely, liquidity.

We want to concentrate on what we consider to be the central characteristic of bank activity-namely, the production of

2

For this issue see Friedman and Schwartz (1969), Johnson (1969), Patinkin (1965, 1969), Marty (1969), and Pesek and Saving (1967).

liquidity services which is, thus also the more important component of their value added.

We do not deny that a variety of services provided by banks (such as safe-deposit boxes) have almost no connection to the level of liquidity provided, but it is felt that these services are of minor importance for the understanding of the behavior and role of banks in a money economy.

We are redefining the intermediation role of banks to be more of a liquidity production role and less of pure intermediation. Thus liquidity is the central monetary aggregate and it is also the central aggregate as far as understanding the behavior of the banking firm is concerned.

Liquidity can be viewed as money in a broad sense and so banks maintain their traditional macro function of supplying (part of) the money stock. A more immediate advantage of using liquidity as a proxy for bank output is the stock - flow conversion provided by it.

In production theory the analysis is conducted in terms of flows. The producer converts inputs into a flow of goods sold and reproduced. If money in any narrow sense (like M_1) is used to describe bank output (the approach taken by Pesek, 1970, who regards only demand deposits as bank output), the problem of a stock - flow conversion arises.

Money itself is a stock variable, if it is regarded as bank output the banking firm would have no function to perform once the desired level of money has been produced, given that this

level is unchanged.

Pesek claims that the fact that demand deposits change hands frequently gives the needed flow dimension to the stock of money.

"If bank money is a stock, it is not comparable to a stock of Rembrant paintings but rather to a river, constantly renewed in the mountains and constantly disappearing in the valley, with the banker controlling the sluice" (Pesek, 1970, p.360).

Along the same lines, he argues that the continuous existence of this money stock (demand deposits) required continuous activity, and thus costs, by the banker to support the ever changing (hands) of this stock.

We interpret the turnover element of the money stock not as adding, by itself, a flow dimension to this stock but as reflecting the fact this stock is used via the derived services. We consume monetary services (or liquidity) which have of course the dimension of a flow. In this respect money is not different from a good such as houses or highways. Once built they generate a flow of services and must be maintained by a flow of costs, yet we do not consider them as a flow once built.

This brings us to conclude that the flow element of the money stock (however defined) is derived from the function this money stock performs, providing liquidity (monetary services). Liquidity thus becomes the ultimate output of banks, while the turnover of the money stock is only one aspect of this function.

Thus liquidity as bank output provides us with a direct flow concept of banks' production process.

To summarize; Although we do recognize that banks' value added may best represent a quantifiable measure of their output, we want to suggest the use of liquidity as an alternative measure. This is based on our feeling that whatever is produced by banks and does not contribute to the level of liquidity supplied by them, is of minor importance as far as its quantity and its costs of production are concerned. It is also of minor importance for understanding the behavior of the banking firm and for linking the micro and macro foundations of banks.

C.3 From Liquidity to Deposits

We began our discussion about the 'proper' definition of bank output by using the value added concept as a proxy. We then concentrated the analysis on what is probably the component that accounts for most of the bank's value added; the level of liquidity it produces.

Here, we want to further narrow the focus of our discussion and suggest a measure for the level of liquidity generated which is based solely on bank liabilities, even though we realize that the bank's value added is distributed among borrowers as well as depositors.

We argue that the level of liquidity supplied by a bank is best captured by the nonpecuniary services of its deposits. The appropriateness of such an argument should be analyzed in the macro as well as the micro context.

As far as the macro context is concerned, we want to

capture the long-run impact of bank activity on the economy, and thus considering only bank liabilities will be appropriate if the (permanent) impact of the asset activity on the economy is negligible.

Campbell (1978) in his recent empirical study, claims that;

"The results presented here imply that, in the long run (more than six months), it makes little difference whether monetary policy influences bank securities holdings as opposed to loans. This follows from the fact that neither loans nor securities nor their proportion of total bank assets make a significant contribution to the explanation of fluctuations of GNP when these are used as independent variables in equations with the standard indicators of monetary policy" (p.250).

If we would take this as the most recent empirical evidence in favor of the pure monetarist approach (money, however defined, is the most important explanatory variable of GNP), and against the credit view (money is more like a by-product and bank portfolio composition is the most important explanatory variable of GNP), then an approach that tries to capture the more permanent result of bank activity would focus on its liabilities.

As much as the micro context is concerned (capturing the 'true' cost and production structure of the banking firm), the asset activity is not less important than the liability one as long as the banking firm incurs real costs in supporting that activity. The important question here is whether asset servicing affects the level of liquidity derived from bank liabilities or not.

If it could be claimed that each and every asset mix

corresponds to a specific liabilities mix, then the asset activity of a bank produces no liquidity of its own.

If, however, there are portfolio changes (which involve real costs) that are not reflected in a corresponding change in the liabilities structure, then excluding bank assets from the definition of (its output) liquidity is deficient. However, the gains in terms of comprehensiveness and predictive power of such a model may still outweigh the loss³. As we do not know of any empirical evidence that suggests full independence of the bank's assets mix from its liabilities mix, we will proceed on the assumption that bank deposits capture most of bank output (as defined here).

C.4 Interest on Deposits and Bank Output

As implied by the discussion in the previous section, bank output in our model is based on the volume and mix of its deposits⁴.

Pesek (1970) and Towe (1974) suggest that the level of bank output is equal to the volume of demand deposits outstanding. We want to suggest that not only demand deposits but all bank liabilities (excluding equity) embody a certain degree of liquidity and thus they all should be considered as components

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For the empirical implications of this issue see chapter 5.

4

A way to estimate the level of liquidity implied by a given level and mix of liabilities will be discussed in section B.

of bank output. As long as demand deposits, are not the only deposits that yield liquidity services no differentiation among the various liabilities should be made.

The question of the amount of liquidity provided by the various deposits becomes an empirical problem (not less than a theoretical one) and the argument that ad-hoc theorizing is not able to yield a satisfactory definition of bank output, still holds. Pesek (and implicitly, Towey) gives an interesting reason for his choice of demand deposits as bank output. He claims that the fact that interest is paid on all deposits except demand deposits implies that these liabilities serve as "borrowed funds"⁵, as an input rather than as bank output.

It may indeed look strange to argue that time deposits should be considered as bank output while realizing that interest is paid on behalf of this "output". This is a 'product payment', a terminology absent in production theory where we use 'factor payments' and 'product revenues'.

It seems to us that Pesek's use of interest payments on deposits as a means to differentiate between bank output and inputs, follows from his position on the "demand deposits as net wealth" debate (see for example, Pesek, 1976). According to his view inside money, demand deposits, should be regarded as a net (wealth) asset for the economy since when interest is not paid on them they represent a positive capitalized value of a stream of income to their holders (equal to the services

⁵ For a discussion of this point see Pesek and Saving (1968) ch.13.

flow) and, at the same time, these deposits are not a (bank) liability but rather an asset produced and sold.

When the market rate is paid on bank deposits, the capitalized income stream to their holders, derived from them, will be offset by an equal capitalized stream of interest which is a liability to banks, and thus no net asset is created.

Without taking a position on this debate⁶ we want to argue that differentiating deposits according to the return they yield has no relevance for the analysis of banks as producers of liquidity.

We treat banks' interest payments on deposits (explicit as well as implicit) as an input payment, an input which is supplied to the bank in exchange for deposits.

When primary deposits, of any kind, are acquired, the depositors (the central bank, the government, or private individuals) supply the bank with reserves which are an input without which no deposit can be produced. In this sense it is, analytically, advantageous to regard the interest as being paid on reserves rather than on deposits.

The fact the banks pay interest on secondary as well as primary deposits does not invalidate our argument but rather points to the unique characteristics of reserves and their role

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For the view that the payment or none payment of interest can not form the line of demarcation between money and borrowed funds, see Marty (1969).

in the bank's production process⁷. One of these characteristics is that interest is necessary to retain the reserves held by the bank because all bank deposits are potentially primary deposits in the sense that when interest payments on them are stopped, we can expect deposits withdrawals which corresponds to a reserve outflow. Thus interest is paid in order to maintain a given level of reserves which are used (in conjunction with other factors) to produce deposits.

It has to be recognized that the rate of return "earned" by bank reserves, implied by the above discussion, is much higher than what may be considered as a "normal" rate of return. This is a result of a phenomenon which is peculiar to the banking firm—namely, the ability to use the same physical quantity of one input (reserves) more than once in the process of producing its final output. The deposit multiplier accounts for the fact that the rate of return on reserves is some multiple of the "normal" rate of return.

To summarize:

(a) Interest payments on deposits cannot be used to differentiate between deposits which serve as 'borrowed funds' (inputs) and deposits which are part of bank output. Those who use interest payments as a means to identify bank output, face

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We will further elaborate on this issue while analyzing the production process of the banking firm, see section E, chapter 4.

the risk of analyzing banks which produce nothing since when explicit interest payments on demand deposits are not forbidden, or when the existence of implicit payments is recognized⁸ (such as a lower borrowing rate for holders of compensating balances), consistency requires that demand deposits should also be regarded as 'borrowed funds'.

(b) All bank liabilities, except equity, have to be taken into account when measuring the level of liquidity produced by banks.

C.5 Deposits and the Level of Liquidity

As explained (see section C.2) the flow dimension of bank output is achieved by analyzing the banking firm as a producer of liquidity.

Up to now, our discussion was concentrated around bank deposits and thus we have to provide a link between deposits and the level of liquidity produced. Such a link may have the form of liquidity "equivalents" or the degree of liquidity of these deposits. If each deposit could be characterized by a unique liquidity weight then this would suggest that there is a well defined function between the level and composition of bank liabilities (deposits) and the level of liquidity they provide.

One approach towards the identification of such liquidity weights is offered by, among other, Kaufman (1969), Timberlake

⁸ Becker (1975) shows, in his survey article, that those implicit payments are significant.

and Fortson (1967), and Neihans and Hewson (1976).

The basic idea behind their approach is that the degree of liquidity (or moneyness) of various financial assets can be revealed by regressing nominal income against these assets, the resulting regression coefficients are interpreted as the liquidity weights.

Neihans and Hewson suggest attaching liquidity weights to the different assets and liabilities of Eurodollar banks in order to find their "net liquidity creation" position. These weights are determined by regressing nominal income against each asset and liability.

Another approach is suggested by Chetty (1969) who measures the moneyness of near-moneys.

His approach is also based on the demand side of the system, he offers a method for determining the degree of substitutability between different financial assets and M_1 . Following Lancaster's (1966) characteristics approach, he assumes that consumers combine cash and demand deposits with other financial assets as inputs to produce a given level of characteristics the most important of which is moneyness. By specifying a production function for these characteristics and a budget constraint he gets a testable model which yields a set of moneyness levels for different volumes and compositions of financial assets.

Both approaches mentioned suffer from the same deficiency - namely, they reflect theories based almost solely on the demand side of the system, ignoring the fact that changes in the level

and mix of deposits are co-determined by demand and supply (cost) forces.

It has to be noted that even though the above views are deficient because the supply side is unspecified, the bias in the empirical estimates may be small since the demand for money function is generally accepted as being "stable"⁹. More specifically, if, as we argue, bank costs play an important role in explaining bank behavior and at the same time also affect consumers' behavior through their impact on the prices that banks charge, then these costs play an important role in the determination of the liquidity weights themselves.

This means that only after the supply and demand functions for bank deposits are specified and the equilibrium level and composition of deposits is derived, can one use the techniques mentioned before in order to calculate the liquidity equivalents of bank deposits.

Such a method¹⁰ assures us that producers' costs as well as consumers' preferences are adequately taken into account in the determination of bank output.

As is the case with any factors of production which are used efficiently, where at the point of equilibrium the ratio of their marginal products equals the ratio of their respective prices, the marginal product of each deposit, which now becomes

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Also important here is the question whether the demand for demand deposits relative to that for time deposits is stable.

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The method will be detailed in sections F and G, chapter 4.

an input into the consumers' liquidity production function, should equal its price over the "output price" (characteristics' price in our case). In other words, the marginal product of each deposit in liquidity creation is its liquidity weight.

When there is a change in bank costs as a result of a change in wages for example, the relative yields on bank deposits may change, which implies that consumers may change their desired deposit composition which, in turn, will bring about a change in the marginal products of these deposits (at the new point of equilibrium) in liquidity production. Thus there is a direct link between the level and structure of bank costs and the level of bank output defined as liquidity.

When consumers' tastes and/or the consumption technology change (the deposits-liquidity transformation technology changes while bank costs stay fixed), we will find that the deposit mix produced by banks has changed and that the level of liquidity provided by banks might also change¹¹.

To summarize:

Banks produce liquidity through the creation of an "intermediate product"-namely, deposits.

A given level of liquidity, implied by a given level and composition of deposits, is co-determined by the banks, through the prices they charge, and by consumers through the characteristics of their consumption technology which transforms deposits

II

All the above arguments are explicitly derived in section F, chapter 4.

into the highest possible level of liquidity.

D. The Nature of The Demand Function

The demand for bank output is the demand for liquidity which is, according to our model, provided by this financial institution.

As was argued in the previous section, the relation between liquidity on the one hand and the level and composition of bank deposits on the other, is well defined and thus the level of liquidity can be actually measured. This means that we may express the demand for liquidity in terms of the demand for deposits (which are, in turn, used by consumers to produce the highest attainable level of liquidity). This two-stage process of acquiring liquidity is integrated into one equilibrating process since the demand functions for deposits are derived from a utility function defined in terms of liquidity.

D.1 Characteristics and The Consumption Technology

Our approach towards the derivation of the demand functions for bank deposits is based on Lancaster's (1966) contribution to consumer theory:

"We assume that consumption is an activity in which goods, singly or by combination, are inputs and in which the output is a collection of characteristics. Utility or preference orderings are assumed to rank collections of characteristics and only to rank collections of goods indirectly through the characteristics that they possess" (Lancaster, 1966, p.133).

Our central hypothesis here is that consumers use bank deposits in order to satisfy their liquidity needs.

Liquidity is assumed to be the common characteristic of all bank deposits. Consumers' utility thus ranks liquidity and not deposits themselves.

The same approach could be described in terms of a "consumption technology", consumers are treated as "producers" of a consumption good called "liquidity", and bank deposits are inputs into the consumers' production function.

a. The Utility Function

Following Chetty¹² (1969), and only because it simplifies the theoretical analysis, we use here a constant elasticity to scale production (utility) function which has the following form:

$$(3.1) \quad U = (\alpha_D (D)^{-\rho} + \alpha_T (T / (1+r))^{-\rho})^{-1/\rho}$$

where ρ is the elasticity of substitution parameter, D are demand deposits, T are time deposits, r is the net (of service charges) interest rate on time deposits, and α_D and α_T are the distribution parameters which have the following form:

$$\alpha_D = MPP_D (1/\rho)^{-\rho-1}, \quad \alpha_T = MPP_T [U(1+r)]^{-\rho-1}$$

and are closely related to consumers tastes. A change in tastes, as to the ordering of B and T in U, will be reflected in changes in α_D and α_T which correspond to the new average and

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Only as much as the notion of measuring the nearness of near moneys is concerned. Our structural equations and the derived demand functions (for D and T) are different from Chetty's. It is our view that Chetty's analysis is deficient in explaining the link between interest rate changes and liquidity.

marginal values of D and T in the production of U.

The following assumptions are made:

- (a) There are only two types of bank deposits, D and T.
- (b) Each type in (a) (within itself) is homogeneous with respect to size, turnover, etc.
- (c) $r_D = 0$, based on the prohibition to pay interest on demand deposits.
- (d) All consumers are identical.

The first two assumptions will be relaxed later on. The parameter $\frac{1}{b+rt}$ which appears in equation (3.1) reflects a somewhat modified definition of the level of liquidity embodied in every financial asset.

The liquidity of an asset is usually defined in terms of its holder's ability to realize its face value. Pierce (1966), for example, claims that the ability to realize the face value of an asset is a function of the time elapsing between the decision to sell it and the actual selling activity, and the nature of the market in which this asset is traded.

Our modification of the above view is that the level of liquidity embodied in each asset is a function of both the ability of its holder to realize its face value and his willingness to do so. This willingness is in turn a decreasing function of the interest rate¹³ (yield) derived from this asset.

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Which is assumed given for each consumer. The determination of the net yield of bank liabilities will be discussed in chapter four.

The higher the yield the lower is the liquidity value of a time deposit since our willingness to use it as cash (liquidate it) decreases as the opportunity costs rise¹⁴. This decrease is independent of our ability to liquidate this asset.

To capture this element in our liquidity generating function we multiplied time deposits by an arbitrarily chosen (decreasing) function in r_T .

The described consumption technology, equation (3.1), represents Lancaster's simplest case in which the goods are inputs into the production of one characteristic-namely, liquidity.

Thus equation (3.1) yields an aggregate (U) which is the liquidity equivalent of a given level of deposits. This is the output on an iso-product map or the utility on a preference map.

Technological changes in the production (consumption) process which change the level of utility from a given level and composition of deposits, such as the introduction of Electronic Funds Transfer Systems, could be accounted for by adding a shift parameter to equation (3.1). However, developments that change the relative importance of the various deposits in the production of liquidity, such as an increased awareness of the use of cheques, should appear as changes in the parameters ρ and α ; and thus in the shape of the iso-product (indifference)

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This analysis does not contradict the frequently used relationship according to which an increase in M , which increases the level of liquidity, corresponds to a decrease in interest rates.

curves derived from the utility function described in (3.1)¹⁵.

b. The Budget Constraint

In order to derive the demand functions for time and demand deposits from equation (3.1), our representative consumer has to have a given level of wealth available for investment in these financial assets.

We envisage this decision as being made in two stages while the third stage describes the allocation of a pre-determined budget among D and T.

In the first stage the saving-consumption decision is made. We adopt here the Fisherian time-preference theory as an explanation of this decision. This is illustrated in figure 3-1.

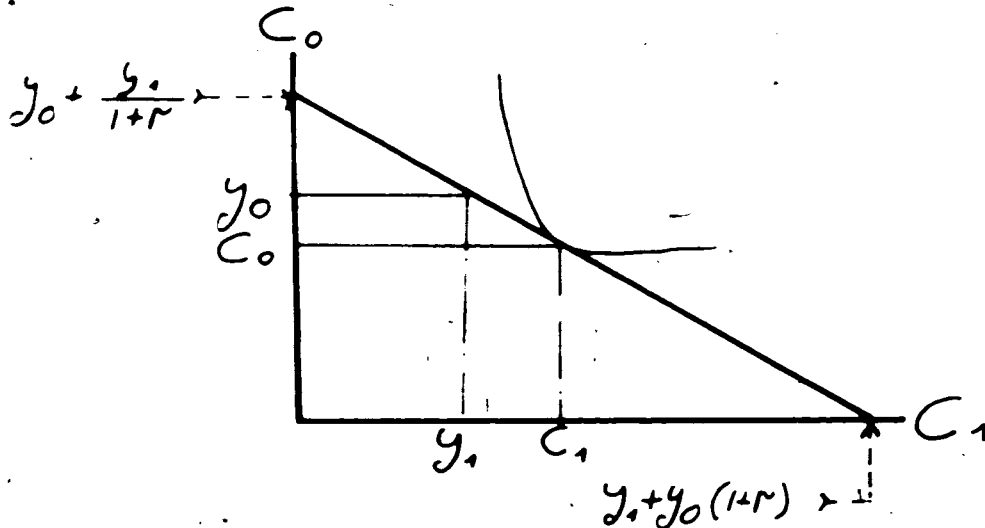


Figure 3-1 The Saving - Consumption Decision

¹⁵ The shape of this iso-product curve is $\frac{\partial RTS}{\partial U} = -(\rho + 1) \frac{\partial \ln(T/(1+r))}{\partial \ln U}$ where RTS is the rate of technical substitution between T and D in the production of U.

The consumer allocates his expected two-period income flow (y_0, y_1) between present (c_0) and future (c_1) consumption, given the 'market' interest rate r , such as to maximize his consumption utility over the two periods.

Our representative individual saves $y_0 - c_0$ of his current income and his (accumulated) savings provide the budget constraint for the second-stage decision.

In the second-stage decision the allocation of savings (the accumulated stock of past savings and the flow of current savings $y_0 - c_0$ in figure 3-1) is made. One can think of this decision in terms of maximization of a utility function which includes financial (F) and other (NF) assets. The yields on these assets (r_F and r_{NF}) and characteristics like risk, provide the necessary parameters for this portfolio decision. Our representative consumer will allocate F^* of his (accumulated) savings to financial assets and NF^* of his savings to all other assets.

If we assume that banks are the only institution which supplies financial assets then $F^* (=F_B)$ becomes the relevant budget constraint for the third-stage decision.

If, however, there are other financial institutions which produce financial assets (all of which have probably a liquidity component in them), an explanation of the allocation of F^* among these institutions is necessary. One such explanation might be based on treating all financial institutions as one industry in which the demand for and supply of its output determine the

aggregate level of financial assets produced and consumed, the share of banks, insurance companies, etc. is being determined according to their individual cost functions given the "market price" of that output.

Another way of explaining the allocation of F^* among banks and other financial institutions is by using, again, the portfolio decision process described above.

For the analysis here it makes no difference whether the allocation of savings among F and NF , and the allocation of F^* among banks and other financial institutions, is a two-stage decision or is made simultaneously.

We assume that there is a difference (aside from the liquidity provided) between bank deposits and other financial assets and thus F^* is the level of wealth that will be allocated among bank deposits.

The three-stage decision process just described is based on the following assumptions:

- (a) The utility functions used in each stage are separable.
- (b) There are no feedbacks from one stage to the previous one (i.e., a change in the deposit yield does not affect the saving-consumption decision).

If these two assumptions seem too restrictive a more general approach should be used. According to this alternative approach, the consumer has one utility function defined in all goods one of which is "liquidity". For each of these goods there exists a well defined production function describing the

inputs and the production (consumption) technology. The liquidity production function is specified in equation (3.1).

Following this construction of the problem, the consumer makes the allocation decision concerning all goods, including liquidity, simultaneously. Given input prices, this decision yields also the optimum inputs allocation among the respective goods.

The equilibrium solution of the two alternative systems described above (given our assumptions) will be identical. According to the three-stage decision the consumer maximizes utility (liquidity) given a budget constraint, and according to the simultaneous decision process he minimizes the budget needed to achieve a given level of utility (liquidity).

It seems to us that the purpose of analyzing one component of the "Grand" utility function-namely, liquidity is better served by using a stepwise process which enables us to focus on that step which is of most interest to us.

The budget constraint that we get from the three-stage analysis is of the form:

$$(3.2) \quad F^* = D+T = F_B$$

Given the amount of money the consumer wants to invest in banks' financial assets (F_B), he may choose to invest it all in demand deposits, in this case $F_B = D$ (and no income is generated) or to invest it in time deposits in which case $F_B = T$, or any combination, One may look on cash as a third investment option out of this budget but this is not the case. According to our analysis, the level of cash held will be

determined according to the "other" (NF) assets-allocation decision and thus it is not part of the financial assets allocation problem.

D.2 The Demand Functions

After describing the relationship between bank deposits and (the consumer good) "liquidity", and after analyzing the nature of the utility function and the budget constraint concerning bank deposits and liquidity, we proceed to the derivation of the demand functions for bank deposits.

As explained, $(1 + r_T)^{-1}$ appears in the utility function as a shift parameter representing the trade - off between the deposit yield and its value (marginal product) in liquidity production.

In order to simplify the exposition let us define:

$$(3.3) \quad Z = T(1+r_T)^{-1}$$

Thus equations (3.1) and (3.2) become:

$$(3.1)' \quad U = \left[\alpha_D(D)^{-\rho} + \alpha_T(Z)^{-\rho} \right]^{-1/\rho}$$

$$(3.2)' \quad P_B = D + Z(1+r_T)$$

As will be shown, the analytical results derived from equations (3.1) and (3.2) are equivalent to those derived from

equations (3.1)' and (3.2)'.

The consumer maximizes his utility from bank deposits, in terms of their liquidity, subject to his budget constraint.

Forming the Lagrangian:

$$(3.4) \quad G = [\alpha_D(D)^{-\rho} + \alpha_T(Z)^{-\rho}]^{-1/\rho} - \lambda [D + Z(1+r_T) - F_B]$$

Differentiation with respect to D, Z and λ yields the following first order conditions for maximum:

$$(3.4a) \quad \frac{\partial G}{\partial D} = -\frac{1}{\rho} [\alpha_D(D)^{-\rho} + \alpha_T(Z)^{-\rho}]^{-1/\rho-1} [-\rho \alpha_D(D)^{-\rho-1}] - \lambda = 0$$

$$(3.4b) \quad \frac{\partial G}{\partial Z} = -\frac{1}{\rho} [\alpha_D(D)^{-\rho} + \alpha_T(Z)^{-\rho}]^{-1/\rho-1} [-\rho \alpha_T(Z)^{-\rho-1}] - \lambda(1+r_T) = 0$$

$$(3.4c) \quad \frac{\partial G}{\partial \lambda} = -F_B + D + Z(1+r_T) = 0$$

Dividing (3.4a) by (3.4b) yields the following:

$$(3.4d) \quad \frac{\alpha_D}{\alpha_T} \left(\frac{D}{Z}\right)^{-(\rho+1)} = (1+r_T)^{-1}$$

From which we get:

$$(3.5) \quad D = Z \left(\frac{\alpha_D(1+r_T)}{\alpha_T} \right)^{1/(1+\rho)}$$

$$(3.6) \quad Z = D \left(\frac{\alpha_D(1+r_T)}{\alpha_T} \right)^{-1/(1+\rho)}$$

Equation (3.2)' combined with equation (3.6) yields:

$$(3.7) \quad Z = F_B \left(\left[\frac{\alpha_D (1+r_T)}{\alpha_T} \right]^{\frac{1}{1+\rho}} + (1+r_T) \right)^{-1}$$

Equation (3.7) is the demand function for time deposits, written in its general form (3.7), it becomes:

$$(3.7a) \quad Z^d = Z(\alpha_D, \alpha_T, r_T, \rho, F_B)$$

As the transformation between Z and T involves only r_T which appears also in the demand function for Z, the demand function for time deposits can be written as:

$$(3.7b) \quad T^d = T(\alpha_D, \alpha_T, r_T, \rho, F_B)$$

The demand-deposits demand function based on the assumption that $r_D = 0$, can be presented as a residual:

$$(3.8) \quad D = F_B \left(1 - \left(\left[\frac{\alpha_D (1+r_T)}{\alpha_T} \right]^{\frac{1}{1+\rho}} + (1+r_T) \right)^{-1} \right)$$

Written in its general form:

$$(3.8a) \quad D^d = D(\alpha_D, \alpha_T, r_T, \rho, F_B)$$

The partial derivatives for the demand for bank deposits are as follows:

$$(1) \quad \frac{\partial Z}{\partial r_T} = \frac{F_B}{\alpha_T} \frac{\left(\left[\frac{\alpha_D (1+r_T)}{\alpha_T} \right]^{\frac{1}{1+\rho}} + 1+r_T \right)^{-2}}{\left[\frac{\alpha_D (1+r_T)}{\alpha_T} \right]^{\frac{1}{1+\rho}} + 1+r_T}$$

$$F_B \frac{1}{1+\rho} \left(\frac{\alpha_D (1+r_T)}{\alpha_T} \right)^{\frac{1}{1+\rho}} \left(\frac{-\alpha_D (1+r_T)}{\alpha_T} \right) / a > 0$$

Since $\partial Z / \partial r_T > 0$ we get that $\partial T / \partial r_T > 0$, which corresponds

to a change in tastes in our ordinary demand function¹⁶.

$$(ii) \frac{\partial Z}{\partial r_T} = \frac{-F_B \left(1 + \frac{\alpha_D}{\alpha_T} \left[\frac{1}{1+\rho}\right] \left[\frac{\alpha_D(1+r_T)}{\alpha_T}\right]^{\frac{1}{1+\rho}-1}\right)}{a} < 0$$

As much as the demand for Z is concerned, r_T stands for the "willingness" component in our definition of liquidity. The higher the interest rate, the lower is the value of time deposits as an input in liquidity production. As far as the demand for T is concerned, this effect may be treated as a substitution effect. At the same time, the increase in r_T produces also an income effect, people will demand more time deposits as the share of explicit income has increased. If the positive income effect is greater than the negative substitution effect we will get that $(\partial T / \partial r_T) > 0$ which is the "normal" case.

$$(iii) \frac{\partial Z}{\partial F_B} = \left[\left(\frac{\alpha_D(1+r_T)}{\alpha_T} \right)^{\frac{1}{1+\rho}} + (1+r_T) \right]^{-1} > 0$$

This implies that as income rises the demand for Z (and thus for T) increases.

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The analysis assumes that $\rho > -1$ which implies convex isoquants.

$$(iv) \frac{\partial Z}{\partial \alpha_T} = -F_B \left(\frac{1}{1+p} \right) \left(\frac{\alpha_D (1+r_T)}{\alpha_T} \right)^{1/(1+p) - 1} \left(\frac{1+r_T}{\alpha_T} \right) / a > 0$$

$$(v) \frac{\partial D}{\partial F_B} = 1 - 1/\sqrt{a}$$

In order for demand deposits to be a normal good (the demand for which increases as income increases) we must have:

$$\boxed{\sqrt{a}} > 1$$

which always holds since α_D , α_T , and r_T are all positive.

Thus we see that changes in the demand for bank deposits are related to income, prices, and tastes in the way predicted by our standard consumer theory.

We can now illustrate the equilibrium position of our representative consumer according to the two alternative structures used.

When the liquidity production function is defined as follows (see equation 3.1):

$$U = f(D, T/(1+r_T),)$$

and the budget constraint is (equation 3.2):

$$F_B = D+T$$

the equilibrium solution is illustrated in figure 3-2.

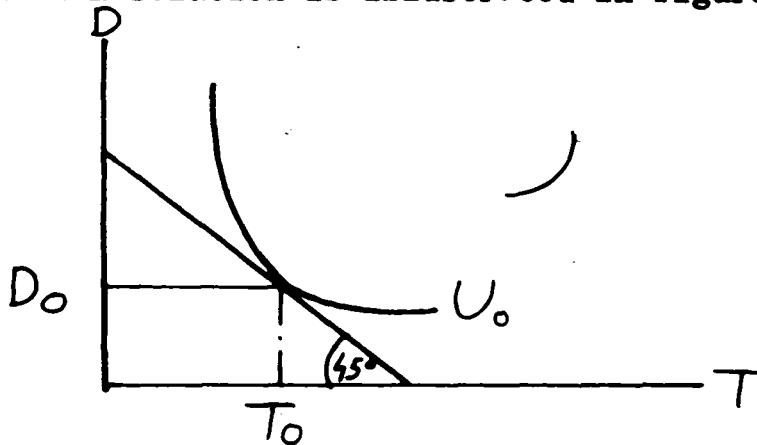


Figure 3-2 Liquidity and Consumer Equilibrium

The budget line has a slope of 45° since the maximum amount that the consumer can allocate to demand deposits or time deposits is equal to his income F_B . The allocation implied by point A is (D_0, T_0) .

When the interest rate on time deposits goes up the whole indifference (isoquants) map shifts upwards and to the right, thus the vector (D_0, T_0) is producing less liquidity than before. This result corresponds to the role of r_T in the utility function as described before. As r_T goes up, the value of T in the production of U goes down and thus (T_0, D_0) is producing less liquidity than before.

This point is further illustrated in figure 3-3.

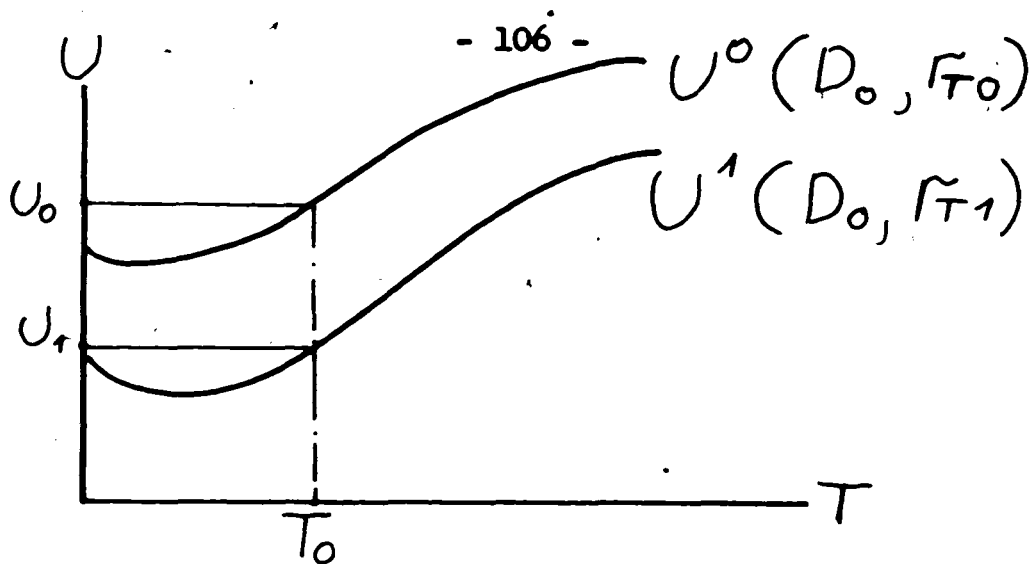


Figure 3-3 Changes in the Interest Rate and Liquidity

If the level of demand deposits is held constant, an increase in r_T from r_{T0} to r_{T1} reduces the level of liquidity embodied in a given volume of time deposits (T_0) from U to U_1 .

To show the income and substitution effects discussed before let us return to the model represented by equations (3.1)' and (3.2)':

$$(3.1)' \quad U = \left[\alpha_D (D)^{-\rho} + \alpha_T (Z)^{-\rho} \right]^{-1/\rho}$$

$$(3.2)' \quad F_B = D + Z (1 + r_T)$$

The (partial) equilibrium solution implied by this structure is illustrated in figure 3-4.

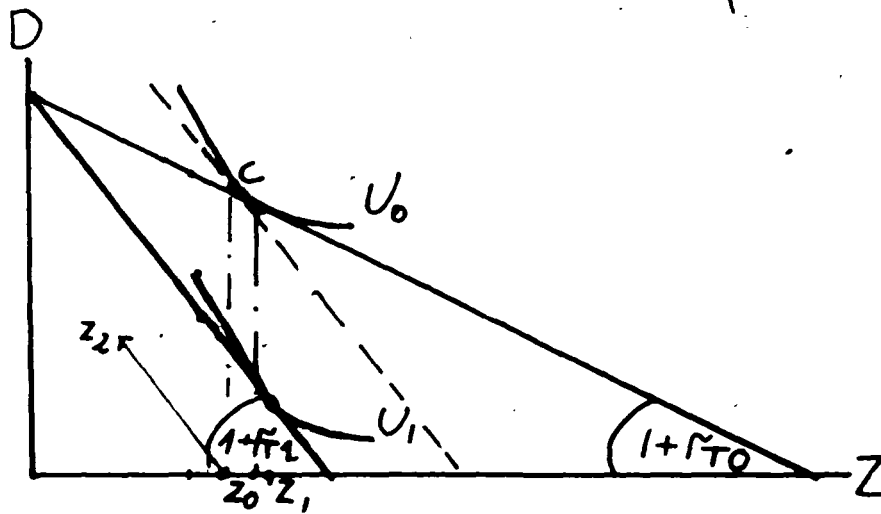


Figure 3-4 Liquidity Production and the Income and Substitution Effects

As r_T increases from r_{T0} to r_{T1} , the slope of the budget line increases and the equilibrium level of liquidity achieved via the given budget decreases from U_0 to U_1 .

If we compensate the consumer for the increase in r_T (add an income that enable him to enjoy U_0) he will move to point C, thus decreasing his demand for time deposits (Z_2).

On the other hand, if the income effect is positive and strong enough, the new equilibrium, point K, would imply an increase in the level of time deposits held which is the usual relationship implied by $(\partial T^d / \partial r_T) > 0$.

This is only a partial equilibrium analysis since, as the demand for time deposits increases and the demand for demand deposits decreases as a result of the increase in r_T , the banks will enjoy a larger volume of excess reserves (assuming higher reserve requirements on demand deposits than on time

deposits). At the same time, if the loan rate follows r_T , the opportunity costs of holding excess reserves increase. Both changes may induce banks to increase the level of deposits supplied and bring about further changes in prices and yields,

To summarize:

When the interest rate on bank deposits rises, a given level and mix of these financial assets can "produce" a lower level of liquidity than before, their value as inputs in the production of liquidity is reduced. As a result of the increase in the interest rate, the demand for the relevant deposit, as an input, will decrease. However, the increase in the yield on that deposit will cause an increase in the demand for that financial asset. Thus to say that an increase in the demand for a financial asset is associated with an increase in its yield is to say that the income effect is stronger than the liquidity (substitution) effect¹⁷.

D.3 Liquidity and the Transmission Mechanism

The analysis in the previous section can be extended to incorporate the macro implications of a change in the yield of financial assets, bank deposits in our case.

As was explained, a given increase in the interest rate on time deposits decreases their value as inputs in the production of liquidity, thus a given level and mix of bank

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An analogy can be drawn between this case and the case of a consumer who receives his income in goods.

deposits will produce a lower level of liquidity. If we follow the view that the level of spending is associated with the level of liquidity ("moneyness") in the economy, we get a further insight into the transmission mechanism—namely, that this increase in the yield on bank deposits, which reduced the level of liquidity in the system, will probably bring about a reduction in the level of spending and income¹⁸.

It has to be noted that the relationship between a change in r_T and the level of liquidity produced was presented as a partial equilibrium analysis, and thus the relationship between a change in r_T and spending and income might be less immediate than presented.

This view of the transmission mechanism is not equivalent to the Keynesian money-interest rates-investment channel, according to which an increase in the money supply will, through liquidity preference, lower "the" interest rate¹⁹, this reduction in the cost of borrowing will stimulate investment which will raise income through the multiplier mechanism:



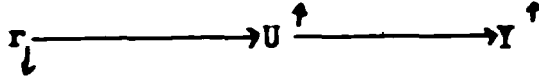
As we center the analysis on liquidity and not on M , let us replace M by U . Our view of the transmission process will thus be:

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A testable proposition based on this view is whether the income velocity of M_2 decreases as r_T increases.

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Which may differ from the interest rate we focus the analysis on.



The major difference between these two approaches is that in the Keynesian system the change in the money supply initiates the change in the level of income through a change in the interest rate. In our system, a change in the net interest rate²⁰ initiates the change in the level of liquidity, which is considered here as a more appropriate aggregate than money as much as the determination of Y is concerned.

The same point can be extended to the comparison of the monetarist view on the transmission mechanism with our analysis

"The process following an exogenous change in the supply of money begins with changes in the prices and yields of financial assets and spreads to nonfinancial assets. These changes in the prices of financial and nonfinancial assets influence spending to produce new assets and spending on current services. At the same time, these changes alter real wealth of the public relative to income and thereby affect consumption"(Park, 1972).

The exogeneous shock in our system is not a change in the money supply but a change in the net interest paid by banks which causes a change in the level of "money"(broadly defined) in the system. In addition, we are extracting that part of M_2 (or $M_3 \dots M_n$) that reflects its contribution to the level of liquidity and not just "declaring", following monetarists, that T should be part of the definition of money.

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Due to a change in banks' costs for example.

However, these differences do not exclude the portfolio adjustment process from taking place, neither do we deny the impact of this process on Y as stipulated by the monetarist approach. When the interest rate on time deposits changes, consumers will change their deposit mix and may also change their desired level of (total) financial assets thus causing a chain reaction which works itself out from financial to real assets, and to the level of spending and income.

D.4 Deposits Heterogeneity -

We have carried the analysis in terms of only two types of deposits-namely, time and demand deposits. We also assumed that each type, within itself, is homogeneous. This homogeneity refers mainly to three characteristics of bank deposits;

- (a) Size
- (b) Activity or turnover
- (c) Mix (the composition between regular chequing accounts and special accounts, long and short term time deposits, etc.)

If bank deposits are heterogeneous with respect to these and other characteristics, the two-deposits type model will be inadequate. Each characteristic determines a unique type of deposit since each characteristic implies different costs of production and thus a different net yield²¹. This means that

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A high turnover implies relatively higher costs of production to the bank, and thus a lower net yield to the depositor which reflects the higher degree of liquidity of this type of deposit.

the value of each deposit in the liquidity production process is also affected by its characteristics.

This brings us to conclude that when demand and time deposits are themselves heterogeneous with respect to various characteristics, this division (into time and demand deposits) become meaningless. In this case, a subdivision should be made according to the different characteristics, and the demand function for each sub-group of deposits should be specified.

In order to keep our model as compact as possible we will continue to assume that each type of deposits is homogeneous, and thus the demand functions already derived represent the demand side of our model. The theory presented here can, however, be extended in an obvious fashion to incorporate a finer breakdown of bank deposits into such sub-groups.

E. Summary

In this chapter we focused our attention on the following two topics:

- (a) The definition of bank output.
- (b) The nature and characteristics of the demand functions facing the banking firm.

Bank output is defined here as liquidity where by this we mean all the nonpecuniary returns from bank deposits.

We explained how banks' value added, the level of liquidity they provide, and the volume and structure of their liabilities are related to each other. We explored the conditions under which concentrating on bank liabilities provides an appropriate method for analyzing the level of bank output.

In the second part of this chapter we presented the form and structure of the demand functions for bank deposits, based on our central hypothesis that these deposits are inputs into a liquidity production process. It was shown that these demand functions have the same structural form as the demand function for any other good.

The net yields on bank deposits play a central role in our theory of financial intermediation. In this chapter we analyzed the impact of changes in these yields on the level of liquidity supplied. We also demonstrated the implication of our theory of interest rates and liquidity for the understanding of the association between income and money.

As these interest rates are co-determined by consumers'

preferences and by the producers' (banks) cost structure, it is essential to develop the supply side of the model in such a way that will enable us to understand the pricing policy of the banking firm. This is done in the next chapter.

CHAPTER 4

THE SUPPLY OF BANK OUTPUT AND THE
EQUILIBRIUM OF THE BANKING FIRM

A. Introduction

The central hypothesis behind our analysis of the demand for bank output is that, as explained in chapter 3, consumers use bank deposits as inputs into a "moneyness", or liquidity, production process. Thus the final good demanded from the banking industry may be viewed as liquidity rather than deposits. Following the same reasoning we want to suggest as the central hypothesis of the supply side analysis, that banks are producers of moneyness, or liquidity¹. They produce this good indirectly by providing the public with various deposits, each of which carries a unique degree of liquidity. By aggregating the liquidity "equivalents" of these deposits² we get a measure of bank output.

Thus a supply or cost analysis of banks should be made in the light of the assumption that all bank deposits have a common property. They all serve as liquid assets to some degree, and what is usually considered to be a deposits - production analysis becomes here a liquidity - production study.

The discussion in this chapter is centered around the three issues which were previously identified (see chapter 2) as weak points in the existing banking theory.

Those issues involve:

- (a) Production costs and the operation of the banking

¹ For a discussion of the arguments for that definition of bank output see chapter 3, section C.

²

See equation 3.1, chapter 3.

firm.

(b) The properties of the banks' adjustment process to changes in the 'givens'.

(c) The market structure of the banking industry.

The analysis of these three issues provides the foundation for the supply side of our model of the banking firm, and enables us to examine the effects of changes in the "givens" on the equilibrium position of banks.

This chapter presents two mutually exclusive assumptions about the technological characteristics of the banks' production process.

(a) All deposits are produced via the same production function.

(b) Each deposit is characterized by a unique production process.

The analytical differences, regarding the equilibrium of the banking firm, arising from these differing assumptions are discussed.

In addition to a pure supply analysis (sections B through F) this chapter addresses itself to the previously discussed (see chapter 3, section A) link between banks' costs and the level of liquidity in the economy.

In two digressions (sections F.3 and H₁) we describe:

(1) Some analytical properties of an alternative approach towards the definition of bank output.

(2) Some recent developments in U.S banking as explained

by our model.

M

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B. Banks and Competition

As mentioned in chapter 2, one of the common problems of existing models of bank behavior is the lack of a consistent view of the competitive environment of the banking firm. The most frequently used framework is that of perfect competition (see Kareken, 1967; Klein, 1971; and Pesek, 1970), although banks as monopolists, in the deposits or assets market, is also not uncommon (see Sealey and Lindley, 1977; and Towey, 1974). We could not detect any analytical effort to justify the use of either of these alternatives. We therefore conclude that either this point is considered obvious in these studies or that analytical convenience dictated the use of an "appropriate" market structure.

In this section we want to put forward the idea that there is a plausible case for the characterization of banks as monopolistic competitors in the output (represented by their deposits) market.

The characteristics of this market structure as described by Leftwich (1973, pp. 289-290) are:

"There are many sellers of the product in an industry characterized by monopolistic competition, and the product of each seller is in some way differentiated from the product of every other seller... When the number of sellers is large enough so that the actions of any one have no perceptible effect upon other sellers, and their actions have no perceptible effect upon him, the industry becomes one of monopolistic competition... Product differentiation leads some consumers to prefer the products of particular sellers of these or others. Consequently, the demand curve faced by an individual seller has some

downward slope to it and enables the seller to exercise a small degree of control over his product price."

The crucial statement in this quotation is that some consumers will prefer the product of a particular seller. In our case, some consumers may prefer liquidity "bought" from bank A to that "bought" from bank B. This preference may be based on some real or imagined characteristics which distinguish bank A's product from bank B's, and which determine the relative quality of monetary services expected from the various private moneys (bank deposits).

One can consider three different dimensions to the quality of the monetary services derived from deposits held with a certain bank. These three dimensions give rise to what might be termed consumers' confidence in that bank³.

(a) The first dimension refers to the price level in terms of the private money held (in a system of many different private moneys). The higher that price level is in comparison to the one expected when the deposit was made, the lower is the value of the monetary services derived from that money. In general, the greater the price stability, in terms of a specific private money, the greater is the confidence in that bank.

(b) The second dimension refers to the degree of liquidity and solvency of a specific bank. The higher the perceived degree of liquidity and solvency in comparison to the one

3

Some of the arguments here follow Klein (1974).

expected when the deposit was made, the higher is the value of the monetary services derived from that money. The sounder the bank's liquidity position, the lower is its default risk and the higher is the degree of consumers' confidence in the ability of this bank to perform its duties (among which is the conversion of private money into government money).

(c) The third dimension refers to the general degree of satisfaction derived from a certain private money. This degree of satisfaction is a function of all the components which determine the quality of monetary services from a certain private money, aside from stability and liquidity, i.e. convenience, prestige, etc⁴. The higher that degree of satisfaction, the higher is the value of the monetary services derived from deposits held with that bank.

Each of these dimensions gives rise to the ability of banks to affect the degree of consumers' confidence in the absence of any discrepancies between the expected and realized quality of their output. In other words, the existence of consumers' confidence which can be manipulated by banks by improving their safety devices, improving the quality of management and workers, more intensive branching etc., accounts for a downward sloping demand function facing each bank. When the number of banks is "large enough" the market structure becomes that of monopolistic competition.

⁴ Russell (1975, p.42) claims that this makes monopolistic competition in banking inevitable.

There is, however, an important difference between dimensions type (a) and (b) and dimension type (c).

Dimension type (a) plays a role only in a system where banks have the power to produce dominant money (currency). The moment the government takes over this function, price stability becomes a function of government actions and not of private money production.

Dimension type (b) usually only plays a role in systems where deposits are not insured or where the government does not guarantee them in any formal or informal way. This situation is rare and thus consumers' concern about bank liquidity has a very minor effect on their decision with regard to the bank they choose.

Thus currently, dimension type (c) is almost the only one pertinent to consumers' attitude towards bank output. Is there a difference between the role of that dimension when "money" is the product and when any other consumer good in the subject of the analysis? Are we not concerned about a potential discrepancy between the expected and realized level of "cooling services" derived from a refrigerator we bought? The answer to these questions is a matter of degree rather than of substance. However, in our view, it is sufficient to permit the conclusion that monopolistic competition is the most appropriate structure for describing the competitive environment of the banking industry.

Following Klein (1974), we want to suggest that money is

a product with essentially infinite costs of determining quality by direct inspection of technical characteristics. In other words, consumer goods can be differentiated according to the costs (direct and indirect) involved in the determination of their quality by direct inspection. The higher those costs are the higher becomes the probability that the producers of those goods will incur costs in order to establish a "brand name" which will permit consumers to costlessly distinguish between the output of the competing firms⁵.

In that the homogeneity of output is a necessary condition for the existence of perfect competition, the creation of a brand name implies a less than perfectly competitive structure. We do not claim that bank deposits (money) are the only product with high costs of "quality determination" but we suggest that the higher these costs, the greater is the likelihood that the industry is engaged in monopolistic (or oligopolistic) competition. Since these costs in the case of money are very high, perfect competition could hardly describe the market structure of that industry.

To summarize: in the absence of government monopoly over the supply of currency and of any formal or informal deposit insurance scheme, banks are, almost by the characteristics of their product under these conditions, monopolistic

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This reminds us of Alchian's (1969) explanation of price rigidity by the existence of information costs faced by consumers. The higher these costs the stronger is the incentive to create a "brand name".

competitors. If these conditions do not hold, there is still a high probability that some kind of monopolistic competition best describes the banking industry's market structure.

The derivation of this conclusion is independent of the empirical phenomenon of government controls over banks. It may be noted however, that these controls make perfect competition in this industry impossible.

C. The Bank's Marginal Cost Curve

In this section we want to suggest that the banks' marginal cost function is upward sloping and thus that the size of banks is determinate. This determinacy is a precondition for a meaningful analysis of banks' equilibrium and for the analysis of some of the dynamic aspects of bank behavior.

It is often claimed that the marginal cost function (which is also the firm's supply function in the case of a perfectly competitive industry) of nominal balances should have the shape of a rectangular hyperbola. Gurley and Shaw (1960, p.255-256) present this idea as follows⁶:

"Assume that commercial banks are in real profit equilibrium and that all real variables in the economy are at equilibrium levels. Now suppose that commercial banks, for whatever reason, purchase additional nominal bonds and create additional nominal money. Growth in nominal money raises prices of current output, money wage rate and nominal bonds equiproportionally. Since money is assumed to be neutral, the bond rate of interest and other real variables are unchanged by this nominal expansion. It follows that the banks' nominal revenues, expenses and profits rise in the same proportion as nominal money, leaving real profits as they were.

Bank expansion has affected no real variable, including real money desired by spending units and the reward from spending units to banks for financial services. The nominal size of commercial banks is adventitious. This means that nominal money and the price level are indeterminate. It matters to no one, including the banks, whether some index of nominal money and the price level is 1,100 or 1000. Nominal money is subject to no rational rule and is free of guidance by any hand, visible or invisible."

⁶

here. A zero required and/or desired reserve ratio is assumed

If the demand for nominal balances is also assumed to be a rectangular hyperbula⁷ the size of the banking firm (whether it is a monopolist or a perfect competitor) is indeterminate.

Contrasting this conclusion with the empirical evidence about the determinate size of the banking firm, forces us to modify this theory of the relationship between bank costs and their level of output.

In what follows we will claim that the unique characteristics of the banking firm and the nature of its output, imply an upward sloping marginal cost function rather than the rectangular - hyperbula shape predicted by the neutrality of money proposition, it follows that bank size is determinate.

Pesek (1970) identifies two conditions which are necessary and sufficient to explain the rectangular - hyperbula shape of banks' marginal cost function;

(a) There exists only one monopolist/banker such that the firm's and the industry's marginal cost functions are identical.

(b) There exists only one kind of money.

When the banking system consists of one bank only, then an increase in the money output ("adding zeros" by this banker) would have a proportional effect on the price level and all the real variables (including profits) will stay the same.

For a discussion of this issue see Johnson (1972, ch.15).

This is illustrated by the curve SS' in figure 4-1.

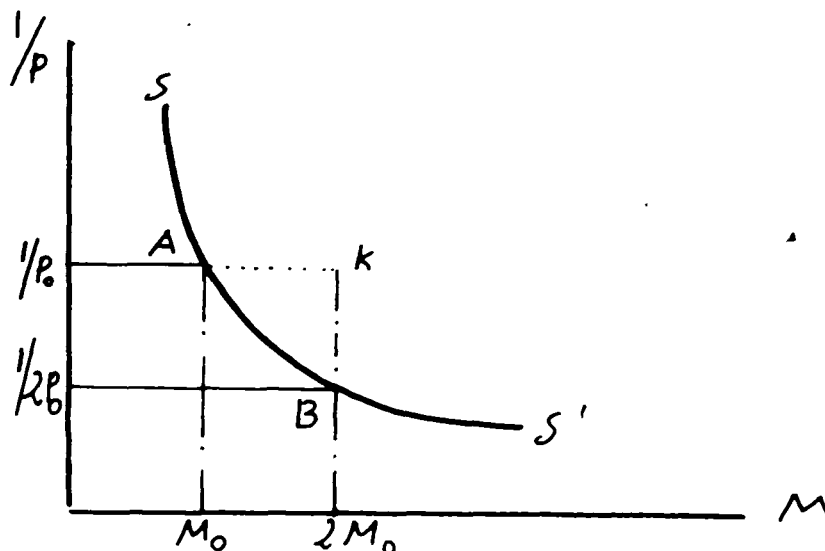


Figure 4-1 Banks' Supply of Money Function -
The Neutrality Proposition

However, when there are n banks in the system (which together have a monopoly over the supply of money), the increase in the quantity produced by each bank (from M_0/n to $2M_0/n$) is expected to have a much smaller effect on the price level. In the extreme case, there would be no effect at all on P . In this case the function describing the relationship between P and the quantity of M produced by that bank will be AK in figure 4-1. When we describe the quantity supplied with respect to the bank's costs then, on the assumption of decreasing marginal productivity in the production of bank money, we get an upward sloping supply function.

As to condition (b), the existence of government money and private money side by side implies that (even with the existence

of only one bank) there will be a desired mix of these moneys in private portfolios. Any effort to change this mix by the private bank, implies an increased outlay on advertisement etc. If we assume again decreasing marginal productivity of bank inputs we would get an upward sloping cost function⁸.

As an extension of the previous arguments let us consider specifically one input which is central to the banks' production process - namely, reserves. Let us assume that both the level of high powered money and the cash to deposit ratio are fixed. Under these conditions, when one bank wants to increase its output it has to attract reserves from other banks, thus it has to offer a higher price (interest rate on its deposits). So, considering this input only we get, again, an upward sloping marginal cost curve for the individual bank.

To summarize: A unitary elastic cost function can characterize banks' supply-for money function only under the following unrealistic assumptions, part of which are necessary and part of which are sufficient.

- (a) Banks' costs "do not matter".
- (b) There is only one bank in the system.
- (c) There is only one kind of money. Specifically, there is no distinction between high powered money and bank money.

Analysing banks as producers of money and not as using

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For this point see Pesek (1970, p.377) and Moore (1968, ch. 7). Moore's analysis is on the broader impact of financial intermediation.

their "pen's fountains" to create this good, implies that capacity limits, real factor costs, competitive considerations etc., determine the shape of their cost function, just as is the case with any other industry.

In other words, the fact that it is costless to "add a zero" (increase the nominal quantity of money) implies nothing about the marginal costs of producing real cash balances (or monetary services). This distinction is often ignored in the optimum quantity of money literature.

Concluding that the bank's marginal cost function is upward sloping implies that the size of the bank is determinate even if the demand (for nominal balances) function is unitary elastic.

The determinate size and the upward sloping marginal cost function of the banking firm, enable us to apply the standard micro theory for analyzing the cost structure, equilibrium, and some dynamic aspects of bank behavior.

D. The Industry's Marginal Cost Curve

When an industry is engaged in monopolistic competition, which it was suggested above is the market structure that best describes the economic environment of banks, the construction of an aggregate cost curve is rather an unsatisfactory practice for two reasons:

(a) Product differentiation makes the unit sold by one seller somewhat different from that sold by another one.

(b) No single price prevails for the differentiated product of this industry, the different prices will depend upon consumers' judgment with regard to the comparative "qualities" of the differentiated products.

Thus, the market as a whole exists, but a meaningful discussion would be better served by analyzing the single producer, and describing the "market" in linguistic terms only.

Each banking firm, and the industry as a whole, is subject to a minimum price constraint on its demand deposits. This is a result of the convertibility clause which makes it mandatory to exchange \$1 of demand deposit for \$1 of cash. In order to show the implications of this constraint, let us assume that there exists some representative price for this product across the industry.

Empirical cost studies such as Benston's (1965 and 1972) and Bell and Murphy's (1968) suggest that there are economies of scale in producing demand deposits. They may arise from (pecuniary) externalities like a reduction in the service charges

per unit of computer time⁹ as a result of (real) economies of scale in the computer industry. It is also possible that within a certain range of output there are real economies of scale in the banking industry. If we combine the minimum price constraint with a downward sloping "Industry Wide Changes"¹⁰ cost function implied by the existence of economies of scale, we reach a result which is somewhat counterintuitive. (For a thorough discussion of this issue see Friedman, 1976, pp.92-101).

This point is illustrated in figure 4-2 which reproduces Friedman's figure 5.11 on page 101.

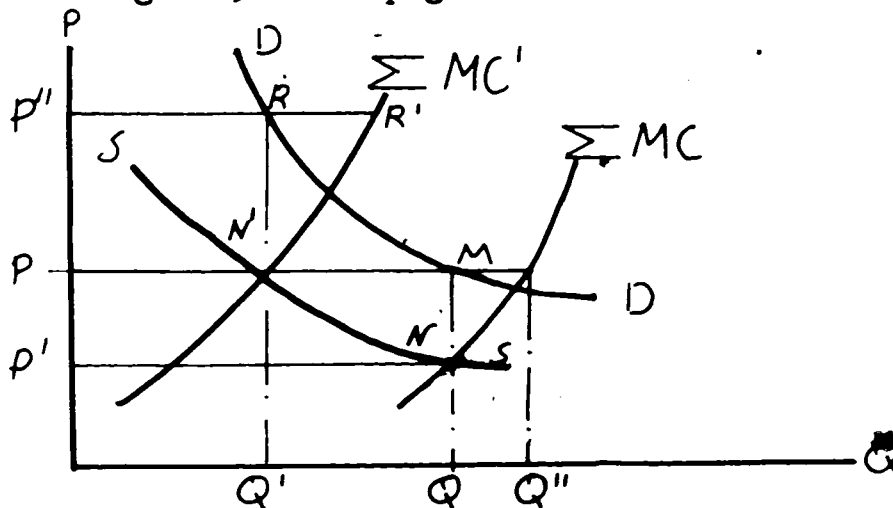


Figure 4-2 Economies of Scale and the Minimum Price Constraint

9

Or EFTS equipment.

10

The long run marginal cost function which takes into account changes in input prices which result from changes in the demand for inputs by the industry as a whole.

Using Friedmand's analysis (pp. 100-101) of this point:

"Let SS be the (Industry-Wide-Changes) supply curve, DD - the demand function, and OP the minimum price legally enforced¹. Since at this price the amount demanded... (OQ) is greater than the amount supplied... (OQ') it might appear that there is no problem of rationing the amount demanded among suppliers eager to produce the larger amount at the legal price. This is, however, false as can be seen by supposing, tentatively, that only OQ' is produced. In this case the price would not be OP' but OP" since the eager demander would bid up the price. But if the output of the industry is OQ', the individual firms will be trying to adjust in light of the marginal cost curves that correspond to the technical conditions and conditions on the factors market associated with point N' on SS. To each separately, the marginal cost curve rises and so the sum of these marginal cost curves ($\sum MC'$) will rise.

Accordingly, if the industry's output were OQ' and the market price were OP" individual firms would try to produce more than OQ'... The attempt of individual firms to expand output to P"R' would have two effects: the actual expansion in output would (1) lower the price because of conditions of demand and (2) change the technical conditions and conditions on the factors market in such a way as to shift the marginal cost curves to the right, when price had fallen to the legal minimum, OP, output would be OQ, but at this output technical conditions and conditions on the factor market are these associated with point N on the supply curve.....individual firms think they would like to produce an output of OQ"... This analysis illustrated how it is that whereas to each individual producer separately his supply curve shows the maximum

II

In our case this price may or may not be equal to the value of \$1 of each in terms of a basket of goods. This depends on whether there are service charges on demand deposits and whether arbitrage costs (between cash and bank deposits) are zero.

amount he will be willing to produce... a negatively sloping curve for the industry shows the minimum quantity that would be supplied at each price."

Thus, empirical findings of the existence of economies of scale in the banking industry¹² (adjusted for our concept of output) might suggest that the quantity of money (liquidity services) produced by the banking industry, is the minimum amount that will be produced for a given price, not the maximum amount as is suggested by the deposit multiplier theory of money supply determination.

Aside from any theoretical importance of this issue the question is whether the "industry-wide-changes" MC function of the banking sector is really downward sloping.

As mentioned before, it looks as if capital (computer, EFTS equipment, etc.) may explain the existence of pecuniary externalities in banking. However, there is an input, bank reserves, which is used only by banks and may be responsible for pecuniary diseconomies in this sector.

Labor and capital are necessary but not sufficient to produce deposits and thus liquidity. Bank reserves are as important in the production process. Even though this input is unique to the banking industry¹³ it is also used by consumers as a substitute, to a certain degree, for bank money. When the monetary base is fixed, any increase in the total output of

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See, for example, Bell and Murphy (1968) ch.4.

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For a discussion of this point see section E.

the banking industry reflects, according to the multiplier theory, a decrease in the C/D ratio (given the excess reserve ratio). This decrease is a result of the higher opportunity costs of holding cash. It is equivalent to a higher input facing the banking industry and constitutes a pecuniary diseconomy.

To summarize, a downward sloping MC curve for the banking industry, combined with a minimum price constraint, renders inappropriate the simple deposit multiplier theory. The maximum amount of money suggested by that theory is not produced.

It is fruitless to speculate whether the "industry-wide-changes" supply function of the banking industry is downward sloping and thus whether or not "Friedman's" case applies to it. However, even if this should not be the case it does not contradict the empirical findings of several bank cost studies (e.g. Benston, 1965; Bell and Murphy, 1968) which conclude that economies of scale do characterize the banking firm. These cost studies refer to short run cost curves (fixed input prices) while our analysis deals with long run (industry-wide-changes) marginal cost curves.

E. The Role of Reserves

Bank deposits are produced by three factors of production, capital, labor, and reserves (plus other "raw materials").

It can hardly be disputed that most bank employees do not constitute a specialized group of workers, many of them can fit into jobs in almost any other service industry.

As far as bank machinery (capital) is concerned, its uniqueness may be thought of in terms of the level of activity per customer, in comparison to that ratio in other service industries, but this characteristic does not make the type of capital used unique. Thus it can be said that banks compete for these factors in the nation-wide market (or in regional markets in the case of labor) and that rents and wages are given as far as the banking firm and industry are concerned¹⁴.

The third factor of production, reserves, is unique in the sense that other producers do not compete with banks in a 'reserve market'. This is not to say that other producers do not use money as a factor of production, but, unless these producers use cash for these purposes, this money is itself produced by banks (with the use of reserves). This uniqueness of bank reserves deserves special consideration.

¹⁴

Bell and Murphy (1968) reach the same conclusion even though their reasons are different.

It has to be noted that bank reserves should not be identified with currency acquired from the public in exchange for a primary deposit. Reserves can also be increased through the acquisition of deposits with the central bank, either by selling government bonds or by borrowing (using the discount window). They may also be increased via a direct switch of deposits by the government from the central bank. As we want to pursue the analysis in terms of a fixed monetary base, we will constrain ourselves to the case of acquisition of cash from private depositors. In what follows we examine two aspects of bank reserves: government control and the role of this factor of production, and the unique role of reserves in banks' production process.

Government Controls and Bank Reserves

It is hard to conceive of a reserve market in the regular sense where a marginal cost curve of producing these reserves intersects with a demand function to determine the equilibrium price. This difficulty arises from the ambiguity of the costs of production of reserves.

The direct cost, (printing and administrative costs) to the government of increasing the quantity of currency and thus of bank reserves, is negligible. Thus we don't get an upward sloping supply function, and when the system is not controlled the optimum quantity of money should be at the point where $MC=MR=0$.

On the other hand, if bank reserves (not only currency) are a function of a legal reserve requirement, which itself is derived from some policy targets like full employment, price stability, growth, etc., the social cost of producing reserves is positive and can be measured in terms of the opportunity costs of not achieving these targets. Should these costs be of any importance to the banking firm?

Government (macro) considerations have an additional impact on the micro analysis of the banking firm. It is often claimed¹⁵ that reserve requirements constitute merely an excise tax on private money production. If the government imposes this tax just to create consumers' confidence in banks, then government controls only replace private decisions. However, if the legally imposed reserve ratio is higher than the one which would be the outcome of an unconstrained private optimization process, then these "excess" reserves can not represent a factor of production from the bank's point of view, but rather a tax.

As the single producer of private money is at the center of our analysis we wish to concentrate on his considerations and behavior, thus 'social costs' do not play a role here. The cost of reserves for the individual bank is the revenue forgone (interest and service charges), a concept which will

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See, for example, Klein (1974).

be further explained in the next section. This will constitute the price for banks trading in excess reserves.

E.2 Bank Reserves and the Production Process

Bank reserves are a factor of production which, together with labor and capital, is used in the production of deposits.

Labor and capital alone are necessary but not sufficient to produce bank output. Although banking theory recognizes the role of reserves in banks' operation, to the best of our knowledge no cost study incorporates it in the estimated cost and production function.

In what follows we analyze the explicit role of reserves in the bank's production process.

When a primary deposit is purchased, the depositor exchanges reserves, an input, for the final output. The factor payment in this case is the interest the depositor receives. This (and our view¹⁶ that interest payments are necessary to retain a given level of reserves) enables us to regard these interest payments as being made on behalf of the reserves required as inputs to the production process.

By the nature of bank operations, the desired reserve ratio is less than one, and therefore the reserves used to produce the primary deposit may also be used to produce a certain volume of secondary deposits. The I.O.U's exchanged

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For a discussion of this point see chapter 3, section C.4.

by debtors for their secondary deposits are not by themselves a factor of production, but are a legal (or commercial) necessity which accompanies the physical production process.

Implied by this analysis is the view that aside from the direct role of reserves in the production process of the banking firm, they may also have an indirect effect on the level of bank output.

After a primary deposit has been sold in exchange for reserves, the bank has to make a decision about the further use of this input. It faces two alternatives with respect to this decision:

- (a) hold it as excess reserves,
- (b) produce secondary deposits.

The final decision will be made according to the marginal costs and benefits of each alternative.

A decision to hold the acquired level of reserves, or part of it, as 'excess' reserves and not as required reserves (not to be loaned up), should be explained in terms of the direct benefits which arise from holding excess reserves. These benefits resemble those from holding inventories.

The direct benefits may be described in terms of a lower probability of a cash deficiency, and thus a decrease in the expenditures due to the penalty on cash deficiencies. In this sense excess reserves play the role of a buffer stock

like any other inventory, although this is an inventory of inputs rather than of the final product.

In the absence of deposit insurance, the level of excess reserves held by a bank may also affect (sophisticated) consumers' decisions as to where to purchase their deposits. Thus excess reserves may affect the level of future output¹⁷.

This view about bank reserves and their role in the production process is illustrated in figure 4-3.

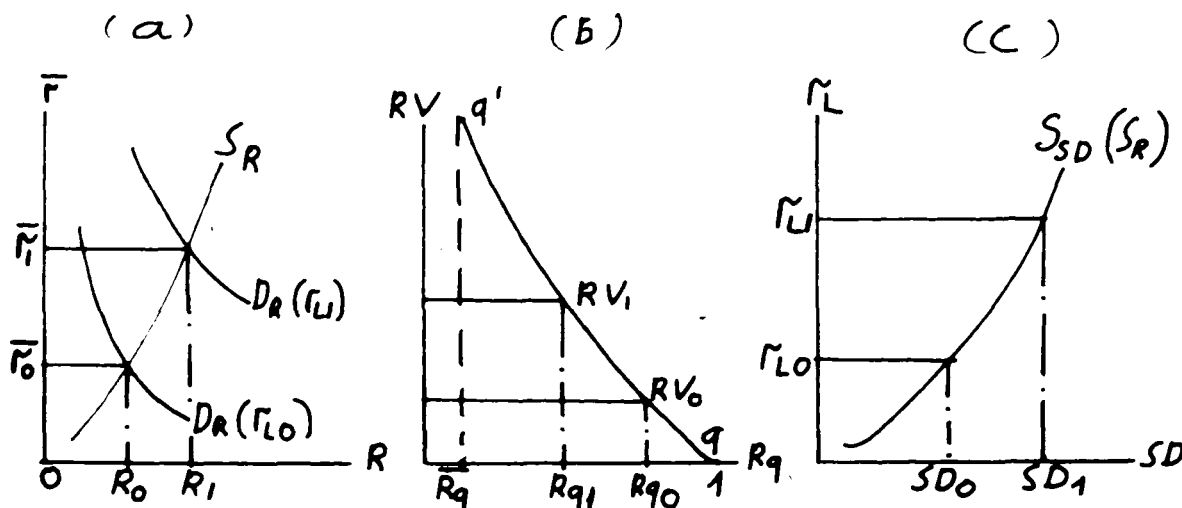


Figure 4-3 Bank Reserves and the Production Process

In panel (a) the interest rate on deposits (\bar{r}) is determined by the intersection of the supply function of reserves S_R which is also the demand function for primary deposits, and the demand function for reserves D_R , which is assumed to depend on the market loan rate r_L , given the bank's production costs.

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For this argument see section B.

The bank acquired OR_0 of reserves which it may keep as 'excess' reserves, or as 'required' reserves when it elects to sell secondary deposits.

Panel (b) presents the process according to which the bank decides upon the two alternatives mentioned. The curve $q'q$ ¹⁸ describes the relationship between the revenues forgone per unit of excess reserves (opportunity costs of holding reserves), $RV=SC+r_L-\bar{r}$ (SC-service charges), and the required reserve ratio Rq ¹⁹. The upper limit of this ratio is 1. The lower limit is \bar{Rq} , the minimum fraction the bank wants to hold regardless of its opportunity cost (\bar{Rq} may be close to zero).

After the desired reserve ratio (Rq_0) is determined the bank allocates its reserves (OR_0) among vault cash or deposits with the central bank ($Rq_0 \cdot OR_0$) and secondary deposits ($(1-Rq_0) \cdot OR_0 = SD_0$). Secondary deposits are assumed to be transferred to other banks and thus constitute reserves for them. This allocation is described in panel (c).

If the interest rate on loans, which is assumed given, increases from r_{L0} to r_{L1} , panel (c), the demand function D_R in panel (a) will shift upward and to the right because the value of the marginal product of reserves has increased. The interest rate paid by the bank will increase to r_1 , and the

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This curve is defined for a given structure of deposits.

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For simplicity we assume a zero legal reserve requirement.

equilibrium level of reserves acquired by the bank will be OR_1 in panel (a). If we assume that $\Delta \bar{r} < \Delta r_L^{20}$ then the revenues forgone increase to RV_1 in panel (b), and the desired reserve ratio decreases to Rq_1 .

These two effects increase the equilibrium level of secondary deposits sold from SD_0 to SD_1 in panel (c).

Figure 4-4 illustrates a change in consumers tastes and its impact.

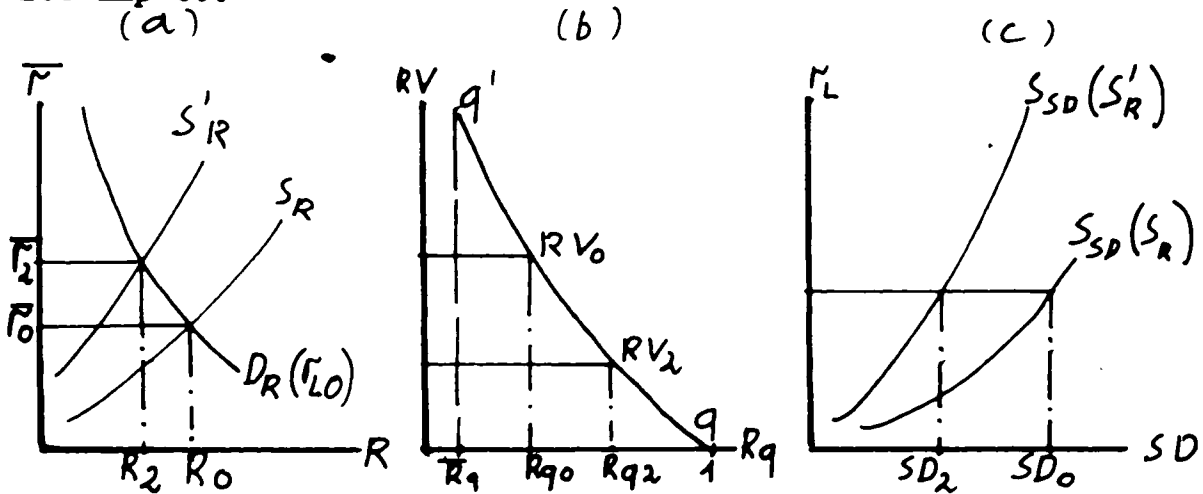


Figure 4-4 Bank Reserves and a Change in Consumers Tastes

If consumers, for some reason, offer less reserves at each interest rate to banks, the supply (of reserves) function shifts to the right (S'_R). This brings about an increase in the interest rate paid by the bank to \bar{r}_2 and a decrease in the

equilibrium level of reserves (primary deposits) from OR_0 to OR_2 . Assuming that $\Delta r_L = 0$, the revenues forgone decrease to RV_2 and the reserve ratio increases to Rq_2 . At the same time, the level of secondary deposits offered at each loan rate decreases because of a 'quantity effect', a decrease in the supply of reserves to the bank. Thus the supply function of secondary deposits shifts to the left and the new equilibrium level of secondary deposits produced will be $SD_2 = OR_2 \cdot (1 - Rq_2)$.

To summarize; changes in cost and revenue parameters may have two effects which codetermine the quantity of total reserves acquired and the fraction used to produce secondary deposits. These two effects are;

(a) The "Quantity Effect" - as the supply of reserves shifts, for one reason or another, the quantity of primary and secondary deposits will change.

(b) The "Substitution Effect" - as the opportunity costs of holding cash - reserves change, the desired reserve ratio will change, thus affecting the quantity of secondary deposits produced without affecting the level of primary deposits.

When bank reserves are incorporated in such a way into the bank's production process, interest payments made by the bank should be part of its production costs. This is not, however, the common practice in empirical cost studies²¹.

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See, for example, Bell and Murphy (1968) and Benston (1965, 1972).

F. Equilibrium of the Banking Firm

As was mentioned earlier (see section D), it is hard to present the equilibrium of the banking industry since, according to our analysis, this industry is characterized by a high degree of product differentiation and thus no unique output or price can be identified. For this reason we will concentrate on the analysis of the equilibrium of the banking firm, and refer to the "market" later on when we discuss the macro implications of our model).

A second complication in the analytical derivation of the equilibrium of the liquidity producer follows from the discussion in section C.3, chapter three. There we claimed that attributing all bank costs to the level of deposits produced will be the correct procedure if, and only if, the asset services rendered by banks are all captured in the level and mix of their liabilities. In other words, if bank assets "produce" no output of their own, if every asset mix is reflected in a corresponding liability mix then all costs should be attributed to the level of liquidity as based on bank deposits. A cost of a portfolio adjustment, becomes really the cost of the corresponding change in the deposits mix, and thus the costs of a change in the level of liquidity produced. This approach would constitute the "upper bound" for liquidity production costs.

If, on the other hand, asset - structure changes are independent from such changes on the liabilities side of the

balance sheet, then a definition of output which is based solely on bank liabilities would imply that only those costs needed to support a given level and mix of bank liabilities (deposits) should be attributed to that measure of output. This would constitute the "lower bound" for bank liquidity production costs.

In this section we analyze banks equilibrium as implied by the Upper Bound approach only. We derive the cost function of the banking firm (the supply side), the revenue function (the demand side), and describe the adjustment of the bank to changes in "givens" such as consumer tastes, reserve requirements, etc.

In section F.3 we illustrate the necessary adjustments in the set of equations derived here, as implied by the Lower Bound approach.

a. Definitions

- A - bank assets (excluding reserves)
- CU - currency with the public
- CV - vault cash
- C - total production costs
- D - demand deposits
- DCB - bank deposits with the central bank
- E - bank equity
- L - bank liabilities
- PD - primary deposits
- Rq - the required reserve ratio

- Re - the excess reserve ratio
RV - total revenues
r - the net interest rate on deposits
R - the interest rate on loans, and the investments' yield
SC - service charges
SD - secondary deposits
T - time deposits
TD - total deposits
π - bank profits

b. The Assumptions

(1) The sole object of the banking firm is profit maximization.

(2) All assets that are available to the bank are homogeneous one - period assets.

(3) The form and parameters of the demand function which the bank faces are identical ("homogeneous" consumers).

(4) The individual bank is a price taker as far as the interest rates on loans and deposits are concerned ²². It is also a price taker in the labor and capital markets.

(5) Only service charges are not parametric (i.e. they are determined by the bank). Variation in other terms correspond closely to this variable, so that the charge becomes an index for all output terms.

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This assumption, though not critical for the results derived, can be justified on the grounds of interest ceilings. Such ceilings are not uncommon.

(6) The level of services per unit of bank output is fixed²³.

(7) The required reserve ratio is greater than zero.

(8) No taxes.

(9) Stockholders' equity is a function of the level of deposits.

(10) Bank deposits are homogeneous with respect to size, turnover, and composition.

F.1 The Cost Function

The derivation of the bank's cost function can be approached in two ways:

If we assume that all the different deposits (demand deposits, saving accounts, term deposits, large and small deposits, high and low turnover accounts, etc.) are produced according to the production process, then one cost function could be specified for all deposits taken together. Such a construction implies a very specific set of characteristics for the equilibrium position of the banking firm.

If, however, we assume that the different deposits are produced in different ways, that each deposit has its unique production process, then the bank should be considered as being composed of a number of "departments" each of which is

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Assumptions (5) and (6) enable us to simplify the analysis in the sense that a simple price - quantity relationship is derived. Allowing for changes in the level and quality of bank services won't change the results.

characterized by a unique production function.

This alternative assumption is often made on the ground that demand deposits are more labor intensive than time deposits, and that technological changes affect these two types of deposits differently²⁴.

As we are interested here in the analytical properties of our model, we will pursue the two approaches, and derive alternative sets of characteristics of the equilibrium position of the banking firm.

A Single Production Process; In producing deposits the bank uses labor (L) which receives a given wage rate (w), capital (K) which receives a given rent (i), and reserves on which the bank pays the interest rate (r).

Thus, the variable costs of production are:

$$(4.1) \quad wL + iK + \sum_{j=2}^{\ell} r_j L_j$$

The costs of supporting a given level of deposits should be a function of the level of services needed to attract these deposits. According to our assumptions(5) and (6) these services are represented by SC , and these costs are treated as part of the deposits production costs. We assume that the decision about the desired reserve ratio is a "long run"

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For a discussion of the "technological" aspect see Daniel, Longbrake and Murphy (1973).

decision in comparison to the service charges decision, and thus the opportunity costs of holding excess reserves become part of the fixed costs, b , of producing bank deposits. Costs of bank equity should be considered here as part of b .

Taking these considerations into account, the short run cost function of the banking firm is²⁵;

$$(4.2) \quad C = C \left(\sum_{g=2}^l L_g \right) + b$$

Multiple production processes; Under this assumption we get the following cost function for each type of deposit:

$$(4.3) \quad C_g = f(L_g) + b_g \quad 26$$

where C_g are the direct costs of supporting that deposit and the cost of producing the assets that are related to that deposit. Empirically, the identification of the "indirect" cost might be impossible.

The bank's total cost function would be:

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Constructing one cost function for the various deposits, even though they are produced via different production processes, would imply that equation (4.2) should include a variable representing the deposit mix.

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With such a 'departmental' division of the banking firm the meaning of b_g is, empirically, ambiguous.

$$(4.4) \quad C = \sum_{g=2}^L C_g$$

A marginal cost function could be derived from (4.4) only under restrictive assumptions, such as homogeneity of the production processes or, less restrictively, constant costs for each of the different production processes. As there is no reason to believe that these assumptions do hold, each 'department' will have its own marginal cost function.

F.2 The Revenue Function

In the previous chapter (section D) we derived the demand functions for the different types of deposits.

The general form of those functions, according to equations (3.7) and (3.8) is as follows:

$$(4.5) \quad L_g = L_g(\alpha_g, \alpha_z, \rho, r_g, F_B), \quad g, z=2, \dots, l, g \neq z$$

As defined, r_g is the interest rate on deposits, this 'gross' yield can be divided into the service charge on deposit type g and its net yield r_g . In this case the demand function will be as follows²⁷:

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We assume a fixed and given ρ .

$$(4.6) \quad L_g = L_g^1 (\alpha_g, \alpha_s, \bar{r}_g, SC_g, SC_s, SC_{gj}, SC_{sj}), j=1 \dots N-1$$

where SC_{gj} is the service charge on the g th deposit imposed by each bank in the system except the analyzed one, and SC_{sj} is the service on the s th deposit imposed by each bank in the system except the analyzed one.

As shown before, the following relationships hold:

$$\begin{aligned} \partial L_g / \partial \bar{r}_g &> 0 & , & & \partial L_g / \partial \alpha_g &> 0 \\ \partial L_g / \partial r_g &> 0 & , & & \partial L_g / \partial r_s &< 0 \end{aligned}$$

$g, s=2 \dots 1, g \neq s$

By assumption:

$$\partial L_g / \partial SC_g < 0 \quad , \quad \partial L_g / \partial SC_s > 0$$

At this point we have to depart from the traditional micro analysis which identifies the demand function with the average revenue function.

In the case of liquidity production, as was explained, primary as well as secondary deposits are (indistinguishable) components of bank output. The level of secondary deposits is a function of loans and investments activity and thus links the activity on both sides of banks' balance sheet with the level of bank output. This means that revenues from selling bank output should include the revenues from all these

activities. In other words, the banking firm enjoys revenues in the form of service charges from selling primary deposits, and the demand function described by equation (4.6) is the average revenue function for only that part of bank output. At the same time, the banking firm enjoys revenues from its loan and investment activities in the form of service charges on secondary deposits and interest on loans and investments.

As equation (4.6) does not describe the demand for loans and investments, the revenues from this source can not be incorporated into this model via this function.

In what follows a revenue function, which includes all these elements, will be constructed.

The level of bank reserves can be described as follows:

$$(4.7) \quad R = DCB + CV = f\left(\sum_{j=1}^N (DCB + CV)_j + CU, \gamma_{g1}, \dots, \gamma_{gk}\right)$$

where $\gamma_{g1}, \dots, \gamma_{gk}$ are the distribution parameters of final output between the N producers. These parameters are themselves a function of the relative service charges, the level of consumer confidence in the various banks, etc.

By assumption:

$$\frac{\partial (DCB + CV)_k}{\partial \left[\sum_{j=1}^N (DCB + CV)_j + CU\right]} > 0, \quad \frac{\partial (DCB + CV)_k}{\partial \gamma_{gk}} > 0, \quad \frac{\partial (DCB + CV)_k}{\partial \gamma_{gs}} < 0$$

$$j, k = 1, \dots, N, \quad j \neq k$$

By our assumption (7) and the analysis in section E we

get the following relationship between bank reserves and the level of deposits:

$$(4.8) \sum_{g=2}^{\ell} Lg (1/(\bar{R}_q + \bar{R}_e)) = DCB + CV$$

where \bar{R}_q and \bar{R}_e are an average required reserve ratio and an average desired excess reserve ratio $\frac{\sum_{g=2}^{\ell} R_{qg} Lg}{\sum_{g=2}^{\ell} Lg}$ and $\frac{\sum_{g=2}^{\ell} R_{eg} Lg}{\sum_{g=2}^{\ell} Lg}$ respectively).

From our assumption (9) we get the following relationship between bank equity and the level of deposits.

$$(4.9) \quad E = s \sum_{g=2}^{\ell} Lg$$

The Bank's balance - sheet constraint is the following:

$$(4.10) \quad DCB + CV + A = \sum_{g=2}^{\ell} Lg + E$$

From equations (4.8), (4.9) and (4.10) we get:

$$(4.11) \quad A = \sum_{g=2}^{\ell} Lg (1 - \bar{R}_q - \bar{R}_e + s) = \sum_{g=2}^{\ell} Lg (1 - R_{qg} + R_{eg} + s)$$

Thus the level of bank assets is a function of the level of deposits, the required reserve ratio, the excess reserve ratio, and the equity ratio. Since the excess reserve ratio, as explained, is itself a function of bank costs and revenues, of which the service charges are of special importance in our

model, equation (4.11) ceases to be a mechanical relationship but incorporates bank costs into the explanation of the level of bank assets.

The revenues from bank assets are:

$$(4.12) \quad r_L \sum_{g=2}^{\ell} L_g (1 - R_{qg} - R_{eg} + s)$$

The revenues from bank deposits are:

$$(4.13) \quad \sum_{g=2}^{\ell} L_g SC_g$$

Thus, the total revenue function corresponding to the 'single production process' case is:

$$(4.14) \quad RV = r_L \sum_{g=2}^{\ell} L_g (1 - R_{qg} + R_{eg} + s) + \sum_{g=2}^{\ell} L_g SC_g$$

As mentioned in the previous discussion, if we have reason to believe that each deposit is characterized by a unique production process, then the equilibrium of the banking firm should be described as an equilibrium in each (deposit) 'department' by itself.

In this case the revenue function would be:

$$(4.14a) \quad RV_g = r_L L_g (1 - R_{qg} - R_{eg} + s_g) + L_g SC_g$$

As can be seen, the demand function for the various deposits (L_g) will co-determine the equilibrium position of

the banking firm but won't by itself reflect the revenues of the bank.

F.3 Asset Services and Bank Liquidity

As explained in chapter 3, section C.3, if the asset servicing function of the banking firm provides bank customers with liquidity which is not part of the volume of liquidity embodied in bank liabilities, then the production costs of bank assets should be separated from the total costs and attributed to a measure of output which is based on the assets side only. Alternatively, one could still study an aggregate production (cost) function, but the measure of output used should include the asset as well as the liability - side activities of banks.

Such a structure implies that producers (banks) and consumers regard liquidity as being embodied in both bank assets and liabilities. This is illustrated as follows:

$$(4.15) \quad Q^B = f(Lg, Ag)$$

$$(4.16) \quad Q^C = t(Lg, Ag)$$

where Q^B is the level of liquidity supplied by banks which is a function of their liabilities, Lg , and assets, Ag . Q^C is the level of liquidity "produced" by bank customers from

a given vector of bank assets and liabilities²⁸.

These equations imply the following bank cost function:

$$(4.17) \quad C = C\left(\sum_{g=2}^{\ell} Lg, \sum_{j=1}^n Aj\right) + b$$

Comparing this equation with equation (4.2) on page we see that bank costs become, now, a function of the volume of bank liabilities and assets. If liabilities and assets are produced via different production functions, mix variables should be added to equation (4.17).

As mentioned before, when bank assets are assumed to produce "their own" liquidity for bank customers and we still want to refer to bank output as liquidity produced by its liabilities only, we must adjust our cost function to the following form (which corresponds to the Lower Bound approach explained in the text):

$$(4.18) \quad C_D = f_1\left(\sum_{g=2}^{\ell} Lg\right) + b_D$$

where C_D are the production costs of deposits only (compare with equation (4.2) on page 149).

Under the assumption of multiple production processes this equation becomes:

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Equation (4.16) should not be identified with a demand for liquidity function, it is rather a "characteristics" production function.

$$(4.18a) \quad C_g = f_2(L_g) + b_g$$

where C_g includes now only the direct costs of producing any specific type of deposit (compare with equation (4.3) on page 149).

Most of the cost studies in banking (see for example Benston, 1965 and 1972; and Bell and Murphy, 1968), use this Lower Bound approach when estimating the parameters of the production function for the various bank deposits (and assets).

F.4 Equilibrium and the Adjustment Process

As mentioned in our second chapter²⁹, one of the deficiencies of the existing micro models of the banking firm, is the lack of a comprehensive description of this firm's adjustment to changes in the 'givens' and especially to changes in those 'givens' which are unique to banks such as the required reserve ratio and the ~~monetary base~~.

We saw that some models imply that banks may reject any reserve influxes if they already operate at the equilibrium point where $MC=MR$. As this predicted behavior contradicts the daily practice of banks which accept new deposits almost without exception, a different analysis of the nature of the equilibrium position and the adjustment process of the bank,

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See section C for example.

is needed.

In this section we analyze these aspects of banking theory under two alternative assumptions:

(a) All deposits are produced via a single production process (all deposits are homogeneous with respect to costs).

(b) Each deposit has its unique production process.

(a). Equilibrium with a Single Production Process

According to our assumption, service charges are the variable under the control of the banking firm, the gross interest rate on deposits and loans as well as the yield on investments, the wage rate and the rental price of bank capital are all given.

According to this construction the banking firm will maximize its profits (revenues minus costs of production) with respect to these service charges.

The cost function is:

$$(4.2) \quad C = C \left(\sum_{g=2}^{\ell} Lg \right) + b$$

The revenue function is:

$$(4.14) \quad RV = r_L \sum_{g=2}^{\ell} Lg (1 - Rqg - Reg + s) + \sum_{g=2}^{\ell} Lg SCg$$

Thus the bank's profits are:

$$(4.19) \Pi = \left[r_L \sum_{g=2}^{\ell} Lg(1 - Rqg - Reg + s) + \sum_{g=2}^{\ell} LgSCg \right] - \left[c \left(\sum_{g=2}^{\ell} Lg \right) + b \right]$$

Maximizing these profits with respect to the service charges yields the first order conditions for maximum profits³⁰:

$$(4.20) \quad \begin{aligned} \partial \Pi / \partial SCk &= r_L \sum_{g=2}^{\ell} Lg(1 - Rqg - Reg + s) (\partial Lg / \partial SCg) - \\ &- r_L \sum_{g=2}^{\ell} Lg (\partial Reg / \partial SCg) + Lk + \sum_{g=2}^{\ell} SCg (\partial Lg / \partial SCk) - \\ &- \sum_{g=2}^{\ell} (\partial c / \partial Lg) (\partial Lg / \partial SCg) = 0 \end{aligned}$$

Rearranging terms yields:

$$(4.21) \quad \begin{aligned} r_L \sum_{g=2}^{\ell} Lg(1 - Rqg - Reg + s) (\partial Lg / \partial SCg) - \\ - r_L \sum_{g=2}^{\ell} Lg (\partial Reg / \partial SCg) + \sum_{g=2}^{\ell} SCg (\partial Lg / \partial SCk) - \\ - \sum_{g=2}^{\ell} (\partial c / \partial Lg) (\partial Lg / \partial SCg) = Lk \end{aligned}$$

The left hand side of equation (4.21) stands for the bank's marginal revenues while the right represents the bank's marginal costs $(\partial C / \partial L_g)$ and its variation costs³¹.

The term $r_L \sum_{g=2}^L L_g (\partial \text{Reg}) (\partial \text{SC}_g)$ illustrates the role of reserves and their effect on bank revenues as discussed in section E.2. As the service charges increase, the revenues forgone from holding excess reserves go up, thus forcing the bank to economize on excess reserves - issue more deposits. This offsets part of the expected decrease in bank revenues as a result of the decreased demand.

The term L_k represents, according to our assumption (6), a given level of services and thus a given level of costs of providing these services. When we analyze the meaning of equation (4.21) we may note that the behavior of the banking firm can be described in terms of choosing an optimum point along an expansion path even though this firm is not a price taker.

The right hand side of equation (4.21), yields a family of iso-cost curves, each describing different combinations of D and T that can be produced with a given level of inputs, and thus with a given level of costs.

The left hand side of equation (4.21), yields a family of iso - revenue curves. Along each curve total revenues stay constant while the deposit mix changes.

31

For a discussion of the meaning of these costs see chapter 2, section C.2b.

This is illustrated in figure 4-4a.

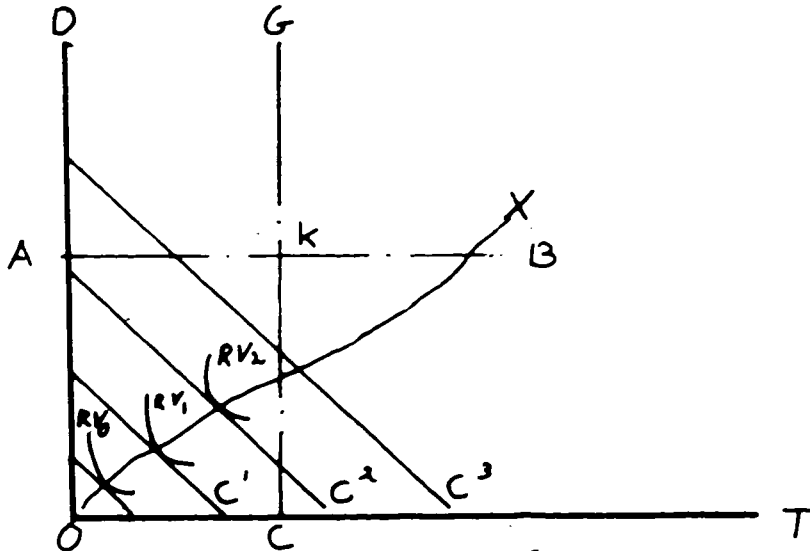


Figure 4-4a: The Bank's Expansion Path

The slope of the iso - cost curve is (in general):

$$(4.22) \quad dD \frac{\partial C}{\partial D} + dT \frac{\partial C}{\partial T} = 0 \Rightarrow - \frac{\partial C / \partial T}{\partial C / \partial D} = \frac{dD}{dT} \Rightarrow$$

$$- \frac{MC_T}{MC_D} = \frac{dD}{dT}$$

In our case the iso - cost functions are straight lines. This follows from the "single production - process" approach, according to which D and T are homogeneous with respect to costs, so that a change in their mix might affect total but not marginal costs.

The slope of the iso - revenue curve is (in general):

$$(4.23) \quad dD \frac{\partial RV}{\partial D} + dT \frac{\partial RV}{\partial T} = 0 \Rightarrow - \frac{\partial RV / \partial T}{\partial RV / \partial D} = \frac{dD}{dT} \Rightarrow$$

$$- \frac{MR_T}{MR_D} = \frac{dD}{dT}$$

The iso - revenue curves are convex, and not linear as in the case of perfect competition, because the bank changes the output price as the relative quantities produced change³².

The bank's expansion path, OX, is a collection of tangency points between the iso - cost and iso - revenue curves.

Along this line the following relationship holds:

$$MC_D/MC_T = MR_D/MR_T .$$

This expansion path corresponds to a unique marginal cost function which describes the efficient combinations of inputs and outputs given the factor prices.

When a similar analysis is used for the case of a perfect competitor³³, the equilibrium level and mix of output are determined by equating the iso - revenue (cost) curves' slope with the products' price - ratio. In our case this price ratio is not given, but is determined by the banking firm as part of the optimizing process itself. Thus the equilibrium level and mix of deposits should be determined differently.

The bank is producing various kinds of deposits which serve as inputs into the consumers' production function of liquidity. The crucial point here is that the bank has a discriminatory power as far as his pricing policy is concerned, because consumers are aware of the income - liquidity trade off

32

They are convex since as D increases SC_D decreases and SC_T increases.

33

See Henderson and Quandt (1971) pp. 89-98.

among the various deposits. This makes arbitrage between these deposit meaningless since the price differential among the various deposits reflects their different liquidity equivalents. In this sense, the explicit price plus a liquidity equivalent (nonpecuniary return) per unit of deposit, should be equal across all deposits, and there is no room for arbitrage. So different prices for different deposits will characterize the market. This analysis resembles Shull's (1963) view of the banking firm as a multiproduct price discriminating producer. He bases this view on Clemens' (1951) study on this subject.

"In his article on price discrimination and multiple production, Clemens sees the firm as producing and selling a number of distinct products to separable groups of customers with different elasticities of demand.... Each market composed of one product sold to one distinct group of customers, has its own demand curve. At the same time the firm sells a homogeneous product with respect to costs - the firm does not sell products but its capacity to produce" (p.354)..

According to this construction the banking firm is, in a unique sense, a discriminating monopolist which equates the marginal revenues in each market to its marginal costs.

As a monopolist, the banking firm will never operate where the demand elasticity for D or T is less than 1, this is illustrated in figure 4-4a by the two ridge lines, AB and CG. The relevant area for our discussion is thus OCKA. The bank will move along the expansion path OX until profits are maximized. The point at which $(RV-C)$ is maximized, determines the level and mix of the bank's liabilities. The demand -

elasticity constraint replaces here the given output - price constraint which is in the center of the analysis when perfect competition is assumed.

The equilibrium point on the expansion path is related to a unique output level and output mix. The pricing policy implied by this level and composition of deposits is illustrated in figure 4-5.

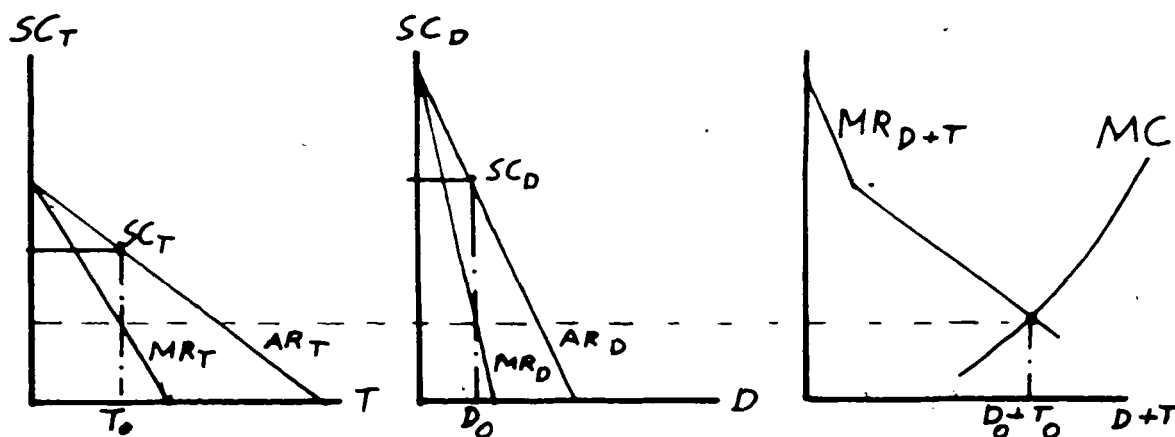


Figure 4-5; Costs Homogeneity and Bank Equilibrium

The deposit mix (D_0, T_0) and the price vector (SC_D, SC_T) are the characteristics of the equilibrium position of the banking firm.

As explained in the previous section, the average revenue functions AR_T and AR_D are not to be identified with the demand functions for these deposits derived in chapter three, but reflect the asset - side activity as well as the demand for the various liabilities. D_0 and T_0 are used by the consumers

(equation 3.1 in chapter three) to produce the 'ultimate output, liquidity. Thus, consumers' preferences and bank costs co-determine the level and composition of bank liabilities. As these liabilities imply a given level of liquidity, we get that consumers' preferences as well as banks' costs determine the level of liquidity in the system. As we support the view that the definition of money is an empirical problem, we hypothesize that at least one such definition is the liquidity aggregate constructed by us. Thus we conclude that the level of money is codetermined by banks' operating costs and consumers' preferences. So, a link is provided between the micro and macro foundations of banking, between the role of costs and efficiency considerations in banks operation and the role of banks' output in the determination of prices and income.

(a.1) The Single Production Process and The Adjustment Mechanism

In this section we describe the bank's adjustment to technological changes, changes in input prices, changes in the monetary base, and changes in the reserve requirements.

In section F.5 we will demonstrate the use of this analysis for describing some current developments in U.S banking.

(a.1.1) Technological changes and changes in input prices:

A cost saving technological change in the banking industry, such as the development of more efficient computer systems or the introduction of credit cards, and a reduction in factor prices will shift the bank's marginal cost function to the right. This is illustrated in figure 4-6.

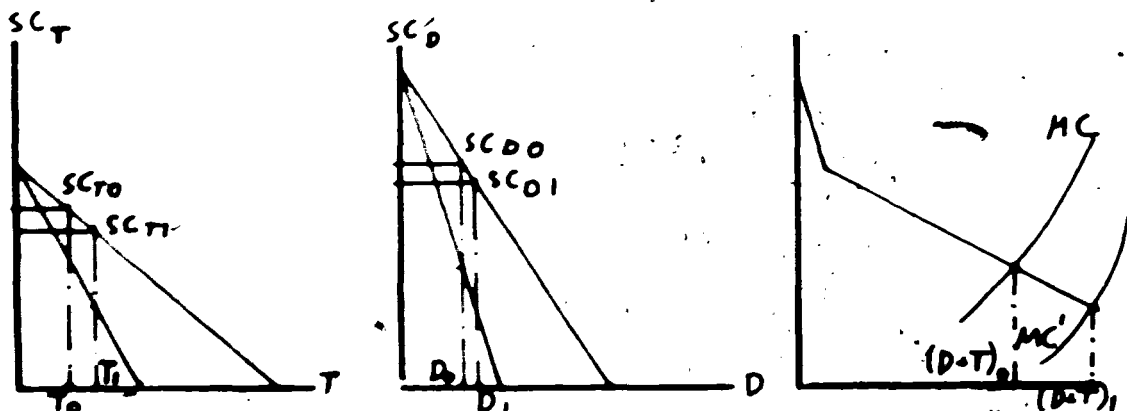


Figure 4-6: Technological changes and Bank Equilibrium

The technological change or the decline in factor prices cause the shift of MC to MC' , this results in an increase in the level of total output from $(T+D)_0$ to $(T+D)_1$. The service charges are reduced, and both T and D increase.

The increase in the level of deposits required an increase in one input - namely, reserves. This is not the case for any other producer for whom a technological change means a higher level of output for a given level of inputs. For the banker, this holds only as far as labor and capital are concerned but not with regard to reserves.

The reserve influx needed to support the increase in output is initiated by the change in the relative yields on bank deposits vs. other investments. As the net yield on bank deposits increases, it brings into operation a substitution effect which shifts reserves from other (financial) institutions to banks. In other words, the consumers' budget

constraint, F_B , changes³⁴. The increase in this budget provides the needed reserves.

(a.1,2) Changes in the Monetary Base : Suppose the central bank expands reserves through purchases of bonds. We assume that this involves no immediate change in r and the cash to deposits ratio. Banks whose customers sold bonds, or who sold bonds on their own behalf, will experience an external economy in the sense that, at the existing prices, they are able to attract more reserves³⁵. The bank's marginal cost function will shift to the right, which again reflects a shift of the expansion path. This is illustrated in figure 4-6, and has the same effect as technological changes discussed above³⁶.

At the previous output level $(D+T)_0$, the bank has 'excess' profits and thus tries to increase output, increasing its marginal costs and decreasing its marginal revenues, until a new equilibrium is reached at $(T+D)_1$.

In contrast to Tovey's (1974) analysis the level and quality of services do not need to change, the price adjustment is all that is needed. In particular, the marginal cost function does not shift to its original position as is

³⁴ This is discussed in chapter three, section C.

³⁵ See equation 4.7.

³⁶ We disregard a possible shift in the demand functions for time and demand deposits as a result of a change in the price of a close substitute (bonds). Throughout the analysis we also disregard shifts in the demand functions for demand and time deposits as a result of changes in SC_T and SC_D respectively.

the case in Towey's model.

The described adjustment process also holds for a reserve influx which is a result of consumers' desire to purchase more deposits at the given prices. The bank would not reject these reserves as suggested by most of the existing bank micro models³⁷ because this influx reflects the same externality as the one described above, thus the shift in the marginal cost function caused by this influx, induces an increase in the level of deposits and probably a change in their mix.

(a.1.3) Changes in the reserve requirements: Suppose the central bank reduces the reserve requirement on time deposits. This reduction affects the banking firm in two ways:—It increases the average revenues from time deposits (equation 4.15) and thus shifts the iso-revenue curve in figure 4-4. At the same time this 'externality' also shifts the iso-cost curves as described in the case of both technological changes and changes in the monetary base. In other words, a change in the reserve requirements shifts both the MC and the MR functions. This is illustrated in figure 4-7.

³⁷

For this point see chapter 2, section C.

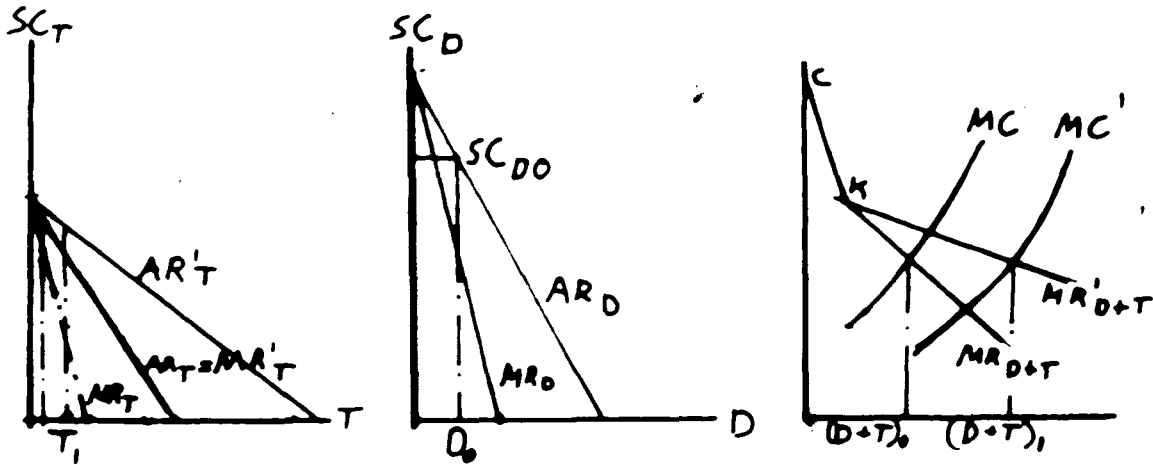


Figure 4-7: Reserve - Requirement Changes and Bank Equilibrium

As R_{RT} decreases the bank's marginal cost function shifts to MC' and AR_T shifts to AR'_T , thus causing MR_{D+T} to shift to MR'_{D+T} . These two effects increase the level of deposits to $(T+D)_1$ ³⁸. As can be seen from figure 4-7 the service charges on time deposits may decrease. This is also the case with SC_D since the 'cost effect' and the 'revenue effect' have opposing impacts on the service charges.

The question arises as to whether the increase in the level of deposits as a result of the changes discussed above,

38

If the MC function intersects the MR function in the segment CK , the increase in the level of deposits will be a result of the 'cost effect' only.

is equal to that implied by the (simple) deposit multiplier theory. As can be seen from figures 4-6 and 4-7, for a given shift in the marginal cost function (AB in figure 4-6) the final equilibrium level of deposits depends on the slopes of MR and MC. Thus the change in the level of deposits is a function of the bank's cost structure as well as the elasticity of its revenue function.

When reserves increase, charges will tend to decrease, this may increase the desired excess reserve ratio and thus the change in the level of deposits will be smaller than the one implied by the deposit - multiplier theory.

For a given change in the reserve requirements, the change in the level of deposits will reflect, in addition to the shift in the cost function, the elasticity of the demand for bank deposits with respect to their price. When bank costs change, holding reserves constant, our model predicts that the level and mix of deposits will change, not by "recalling" existing deposits and thus changing the mix, but by adjusting future production - policy such that the marginal revenues equal the new marginal costs. Such a change in costs results in a shift in the function D_2 in figure 4-3, and in the marginal cost function presented in figure 4-5. Thus we see that the deposit multiplier implied by our model is taking into account the 'mechanical' characteristics, such as the legal reserve requirements, as well as the structural ones such as bank costs.

It is interesting to note, that Tobin's (1963) "Natural

Economic Limit" theory addresses itself only to the banking industry and thus can not explain the behavior of the banking firm. As Tobin (p.414) puts it:

"Clearly then, there is at any moment a natural economic limit to the scale of the commercial banking industry. Given the wealth and the assets preferences of the community, the demand for bank deposits can increase only if the yields of other assets fall. The fall in these yields is bound to restrict the profitable lending and investment opportunities available to the banks themselves. Eventually the marginal returns on lending and investing, account taken of the risk and administrative costs involved, will not exceed the marginal cost to the banks of attracting and holding additional deposits. At this point the window's cruise has run dry."

This theory suggests that as long as the banking industry is producing at a level lower than the one implied by the natural economic limit, the banking industry (and thus each firm) will continue to expand deposits according to some mechanical ratio which is not inherently different from the simple deposit multiplier.

However, according to our model each bank and the industry as a whole, are at each point in time at their 'natural economic limit'. If as a result of banks' activity, relative yields (r_L) change, we get but one additional shift parameter in our model³⁹. This parameter determines a new equilibrium position and as such should be part of our modified deposit multiplier. Thus, in contrast to Tobin's theory, banks do not usually operate at a point where their marginal revenues are higher

than their marginal costs. Equating the two at each point in time is the behavior implied by profit maximization.

To summarize, although the various bank deposits are regarded as homogeneous with respect to their production costs, the bank itself can nevertheless be analyzed as a producer of joint products by assuming that different demand elasticities exist for the various deposits. This permits the complementary assumption that the bank behaves as a discriminating monopoly.

Such a structure enables us to study the equilibrium position and the adjustment process of the banking firm. In contrast to some other theories, (surveyed in chapter 2) our analysis does not predict a behavior which is empirically hard to accept.

(b). Multiple Production Processes, Equilibrium and the Adjustment Mechanism

When it is assumed that bank deposits are not homogeneous with respect to production costs, that is, when the production - process of demand deposits is assumed to be different from that of time and other deposits, the banking firm should be regarded as a quasi 'department store' where each department is a monopolist equating its marginal costs with its marginal revenues.

Thus, instead of an equilibrium position in one market (bank deposits) the bank is characterized by multiple (simultaneous) equilibrium positions, one for each type of

deposit. This is illustrated (for time and demand deposits) in figure 4-8.

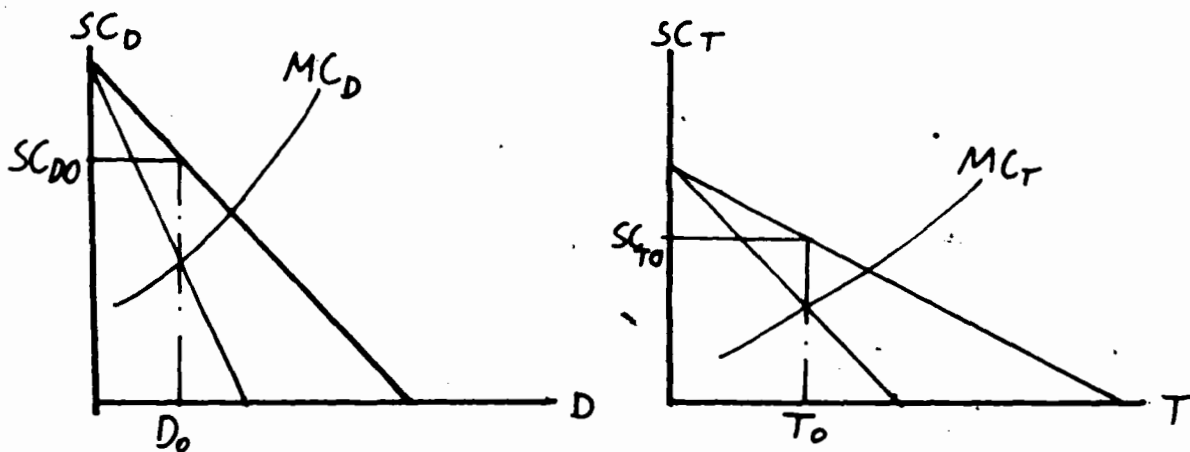


Figure 4-8: Multiple Production-Processes and Bank Equilibrium

The marginal cost and the marginal revenue functions described in figure 4-8 are derived from equation (4.3) and (4.14) respectively. The optimum structure (D_0, T_0) reflects the equilibrium position in the demand deposit 'department' as well as in the time deposits 'department'. According to our assumption here, the marginal costs in one market (department) will differ, with respect to their level and rate of change, from those in the other markets⁴⁰. The bank

⁴⁰

We assume that the production costs of demand deposits are independent of those of time deposits and vice - versa. For an empirical justification for this point see Longbrake and Haslem (1975).

operates as a multiplant monopolist where each plant specializes in one kind of deposit.

(b.1). Technological changes and changes in input prices;

A cost - saving technological change or a decrease in input prices, will shift the marginal cost functions to the right, the relative magnitudes on the shift in each market will depend of the nature of the production process in that market. If, for example, the production of demand deposits is relatively more labor intensive, then the capital - labor substitution arising from the introduction of more sophisticated computer systems, will affect time deposits more than demand deposits, SC_T will drop more than SC_D and ΔT will be greater than ΔD .

(b.2). Changes in the monetary base; An increase in the level of reserves in the system will shift both MC_D and MC_T to the right because this increase represents an external economy for the banking firm in the production of all deposits. The important question here is how do we determine the relative magnitudes of those shifts, how can we determine the change in the quantity produced of each deposit?

The problem we face here is not the one which appears in the micro theory of a "multiplant monopolist", since there we assume that one kind of output is produced and that the cost functions of each firm are identical.

In our case, the bank has to decide the production of which deposit will be increased, given the differences in the

production costs of the various deposits.

The equilibrating process, in this case, works itself out as follows: when the bank experiences a reserve influx, each 'department' will try to increase its output by one unit, only that with the highest marginal profits will actually be allowed to do so. Then the next unit of the additional reserves will be allocated according to the same process and so on.

The final output mix will be such that marginal costs will equal marginal revenues in each department. The new output level and mix (D_1 , T_1) will indicate the relative magnitudes of the shifts in MC_D and MC_T . It has to be noted that the shift in MC_D and MC_T taken together, is constrained by the increase in reserves, as it is under the single production - process case.

(b.3) Changes in the reserve requirements: A decrease in the reserve requirement on time deposits for example, will shift MC_T to the right, since it represents an external economy. The marginal revenue function MR_T will shift to the right (see equation 4.14a) and the quantity produced will increase, even though nothing can be said about the change (if any) in SC_T . If the quantity of the other inputs is fixed then the increase in the level of time deposits has to be accompanied by a decrease in the level of demand deposits produced, the final output mix will be determined according to the process described in section (b.2).

We can see that there are no major differences between the theory of bank equilibrium under the single production - process assumption and under the multiple production - processes assumption. However, the differences are important with respect to the empirical implications of our model.

G. Equilibrium and the Level of Liquidity

Up to this point the equilibrium position of the banking firm has been presented in terms of the level and mix of bank deposits.

In contrast, the central hypothesis presented in chapter three⁴¹ was that consumers' demand for bank deposits is derived according to a liquidity (or utility in terms of moneyness) maximization process, thus we should be able to present the equilibrium of the banking firm in terms of the level of liquidity produced and sold.

One way of doing it is by specifying the banks' production function for liquidity which, together with the consumers' demand function, determines the level of liquidity supplied. For such an approach see section F.3.

We prefer, however, an alternative approach which derives the equilibrium level of liquidity, supplied and demanded, in two stages:

The first stage involves the specification of a model which presents the equilibrium level of the various deposits produced and the net yield of those deposits. This yield, like other prices, is co-determined by consumers' demand and banks' production costs.

The second stage introduces a technique which identifies the level of liquidity supplied based on the equilibrium level of deposits and their (net) yields as derived in the first stage.

41

For this point see equation (3.1) in chapter 3.

This two - stage analysis preserves one of the essential characteristics of our study - namely, that bank costs are most important in explaining the level of liquidity produced. Such analysis thus provides a link between the micro and macro foundation of banking theory. The banks' cost structure explains the level and structure of their liabilities (given the demand side) and, simultaneously, the interest they pay on those liabilities. This interest affects, in turn, the level of liquidity derived from their liabilities. Thus their costs (co) determine the level of liquidity produced.

The relation between yields and the level of liquidity (which is one technique used to relate deposits to liquidity) is analyzed, as explained in chapter 3 section D.1, by Chetty (1969). He tries to identify the moneyness (liquidity) of the various financial assets and the liquidity level implied by them, by examining consumers' preferences and the substitutability between bank deposits as far as the liquidity embodied in them is concerned.

A second technique, presented in chapter two section B.3 and chapter three section C.5, suggests that the moneyness component of each deposit may be found by regressing it against GNP. This method is based on the assumption that there is a positive correlation between liquidity and (nominal) GNP, and that bank deposits, among other things, satisfy the liquidity needs of firms and individuals. This method is

very closely related to that school of thought which claims that the definition of money is an empirical issue more than a theoretical one. If we define 'money' as the sum of all financial assets times their respective moneyness 'weights', we get the liquidity aggregate we are looking for.

Both methods can be used to assign a unique level of liquidity to a given volume and mix of bank deposits provided that in this process the equilibrium level of bank deposits is used. Thus the level and composition of deposits, (D_0, T_0) in figures 4-5 and 4-8, should be described as a function of consumer preferences as well as bank costs and efficiency considerations. This is not the case in the work of Chetty and others, whose models imply that (D_0, T_0) can be explained solely by demand forces and thus that the level of liquidity derived does not involve suppliers costs and their behavior.

Empirically, the bias in such a method will be greater the larger is the instability of the demand for deposits. Thus in order to have an accurate transformation of deposits into liquidity, a system of simultaneous equations should be specified.

At the same time it has to be noted that the demand for money function is among the few functions whose stability is almost undisputed. As a result single and simultaneous equations models yield similar results⁴².

When such a transformation is completed we have a model which explains not only the equilibrium level and composition of bank deposits, but also the equilibrium level of liquidity supplied by the banking sector. It is possible then to attribute banks' production costs not to the level of deposits but to the level of liquidity produced.

This enables us to analyze the micro aspects, production and cost characteristics, of a variable which has major macro significance as far as prices and income are concerned.

In such a way the micro and macro aspects of the behavior of the banking firm are integrated.

H. The Behavior of the Banking Firm - An Application

In this section we use our suggested model of the banking firm to explain the phenomenon known as "bank liability management".

A very recent and comprehensive documentation of the development of this phenomenon provided in Kane (1978), will serve as the empirical background for this discussion.

We limit our analysis to one aspect of government intervention in the free operation of the banking firm - namely deposit - rate ceilings. Other aspects such as reserve requirements, and the structure of the deposits insurance premiums can be incorporated into the suggested framework in a similar manner.

Let us assume that banks were never allowed to pay interest on demand deposits so that a zero pecuniary return (r) is the existing 'equilibrium' return in the demand deposits market. It is an equilibrium rate since an incentive to hold demand deposits is created by their nonpecuniary returns⁴³. In the 1960s as the market interest rate (r_L) rose under the impact of accelerating inflation, this interest prohibition led to a disequilibrium in the demand - deposits market. Banks were pressured to increase the level of loans

43

The results of this analysis will stay the same had we, alternatively, assumed that banks were permitted to pay interest on demand deposits, but that this rate is now decreased to zero by a government regulation.

(so as to at least supply the customers with the same real quantity as before), but were unable to adjust their pricing policy so as to encourage a reserve influx. This is described in figure 4-9 which is based on the analysis in section E (see figure 4-3).

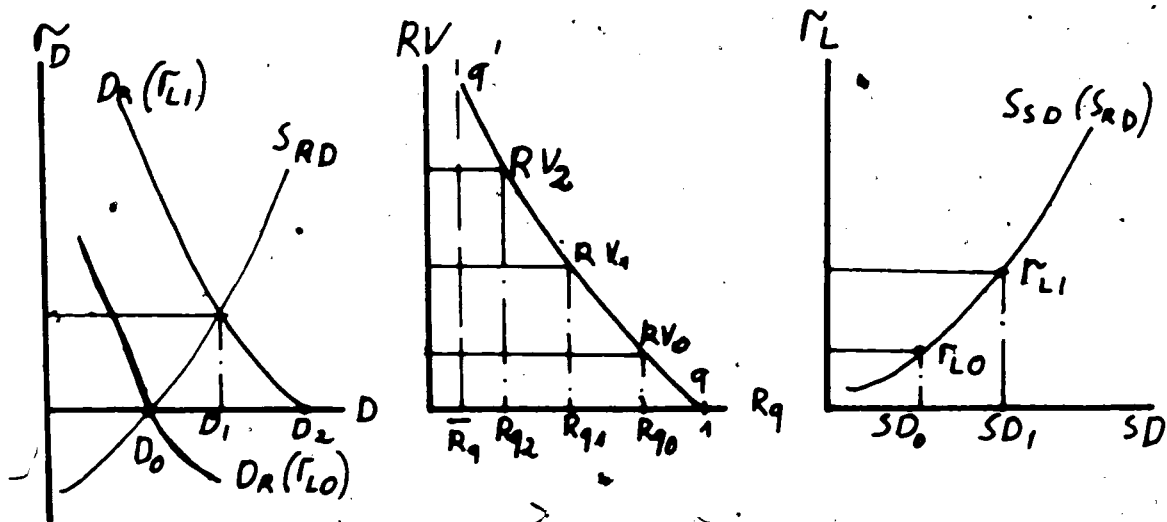


Figure 4-9: Deposit-Rate Ceiling and Bank Disequilibrium

The demand deposits (demand) function (S_{RD}) implies a positive demand even when $r_D < 0$ because the derived non-pecuniary returns are positive. The bank's supply of these deposits is not infinite as $r_D = 0$ because it incurs real costs in providing the nonpecuniary services attached to any given level of demand deposits.

The initial equilibrium level of demand deposits is D_0 , this supports SD_0 of loans given the desired reserve ratio of R_{q0} .

As a result of the inflationary pressures mentioned, the loan rate increases to r_{L1} , which shifts the demand function for reserves from $D_R(r_{L0})$ to $D_R(r_{L1})$. Without government intervention D_1 would be the new equilibrium level of deposits which in combination with the desired reserve ratio R_{q1} (lower than R_{q0} on the assumption that $r_1 < r_{L1} - r_{L0}$), supports the new higher level of loans SD_1 .

However, as the government sets the rate - ceiling ($r_D=0$), disregarding market forces, an excess demand will characterize the demand deposit market. As a result the bank will economize on "excess" reserves (decreasing their desired reserve ratio from R_{q0} to R_{q2}) thus trying to satisfy the increased demand for loans.

This adjustment is however, insignificant since the excess reserve ratio held by U.S banks is very low (.03 percent in 1977). Thus the banks are forced to satisfy their own excess demand, $D_2 - D_0$ in figure 4-8, by means of nonprice competition. Banks begin to offer various services which are intended to compensate their customers for the lack of pecuniary returns.

When service charges are used as the control variable as is suggested in our model, nonprice competition would imply that the service charges on demand deposits would be lower than the marginal cost of producing them⁴⁴. This is illustrated in figure 4-10.

⁴⁴

Excluding from other reasons which might explain that gap.

The "extra" services offered as a result of nonprice competition have two effects; (i) they shift the demand function to the right and probably make it less elastic, (ii) they shift the MC function to the left. These effects resemble the impact of advertising on firms engaged in monopolistic competition.

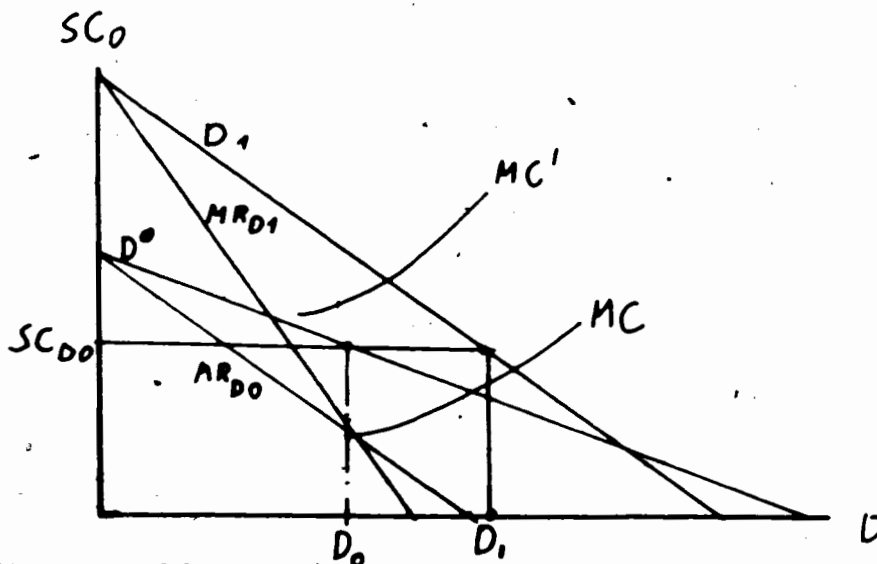


Figure 4-10: Disequilibrium Pricing of Demand Deposits

The bank would not increase its service charges (in the face of interest - rate ceilings) and thus, given the existing price, SC_{D0} , it would attract more deposits ($D_1 - D_0$). The bank will continue these 'nonprice competition' practices until $D_1 - D_0$ (in figure 4-10) equals $D_2 - D_0$ (in figure 4-9). This will enable it to satisfy the loan demand, but yields a misallocation of resources⁴⁵.

⁴⁵

This phenomenon of $MR < MC$ in the demand - deposits market is what most empirical studies point at. (See Bell and Murphy, 1968, for example).

In the case of interest - rate ceilings on time deposits, the banks' reaction was different. In response to regulation Q the banks tried to develop fund - raising instruments which are exempt from it, the most important of which are of course the CD's (among other are the NOW accounts and repurchase agreements) which carried a higher interest rate than regular time deposits.

"Since the large CD ceilings were suspended (partially in 1970 and completely in 1973), CD growth has conformed positively with changes in open market interest rates" (Kane, 1978, p.18)

Without going into the issue of the welfare implications of deposit - rate ceilings and their effects on the structure and nature of operation of the banking firm, it is interesting to note that the so called 'disintermediation' trend is directly connected to interest ceilings and can be explained within the previously discussed framework:

"The greater the differential between market rates and deposits rates and the longer an attractive differential persists, the more depositors become aware of the advantages of placing at least some of their funds elsewhere" (Kane, 1978, p.11).

As the interest rate on open market securities (r_L in figure 4-9) rises above the ceiling, the demand - deposits demand function, S_{RD} , shifts to the left as a result of bank customers shifting to institutions (and instruments) exempt from the ceiling. Bank customers will try to get the same (or close) level of nonpecuniary services from their deposits and an explicit interest rate. If successful - the banks'

problem of loans demand pressures will be aggravated.

Today in the U.S.⁴⁶, credit unions, money market mutual funds, and real estate investment trusts, account for the institutions which attract previously held bank deposits. NOW accounts, drafts payable against money - market mutual funds, brokerage accounts, and written and telephonic thrift - institution payment orders, account for instruments which offer payment services and a pecuniary return.

Thus, rate ceilings, like a maximum price facing any producer, cause misallocation of resources within the different 'departments' of the banking firm and between banks and other financial intermediaries.

⁴⁶

For this point see Kane, 1978, p.14.

I. Summary

In this chapter we analyzed the liquidity supply function of banks while focusing the discussion around the single money producer, the banking firm, its operation and adjustment to changes in the "givens".

Our main propositions, following this discussion, are:

(a) In the absence of government monopoly over the supply of dominant money and in the absence of a deposit - insurance scheme, banks are, almost by necessity, monopolistic competitors. If these conditions do not hold there is still a high probability that some type of monopolistic competition is the more appropriate description of this industry's market structure.

(b) When banks are analyzed as producers of money, capacity limits, real factor costs, competitive considerations etc., determine the shape of their cost function. Under the usual assumptions this function is upward sloping, and thus the size of the bank is determinate.

(c) Bank reserves are an input in the production of liquidity. Such a view implies that interest payments made by the bank as a factor payment. This is not the common practice in empirical cost studies.

(d) Bank costs co-determine the quantity supplied as in the case of any other good.

(e) Banks will never reject reserve influxes (deposits). They might be in a state of "passive" equilibrium where they

do not seek (liability management) new deposits but they will nevertheless adjust to any reserve influx.

(f) Banks, like most other producers, react to price fixing in the market for their output by developing close substitutes, the price of which is unregulated. Rationing, which is the expected reaction to maximum - price setting, is not applicable here since the banks create the excess demand.

CHAPTER 5

THE PRODUCTION PROCESS OF BANKS -
SOME EMPIRICAL ESTIMATES

A. Introduction

In this chapter we present the empirical results of our bank cost study. This study is based on the model presented in chapter three and four and differs substantially from previous studies. This difference concerns the definition of bank output as well as the classification and aggregation of bank costs.

Our analysis is a cross - section study based on 2669 banks for the three data-years: 1973, 1975 and 1977. These banks, from all parts of the United States, voluntarily participated in the Functional Cost Analysis (FCA) program during the years surveyed. The data was collected by the Federal Reserve Bank of New York. These banks range from 3 to over 800 million dollars in total assets, indicating a significant dispersion in the scale of operation. Table 5 - 1 shows the distribution of the sample banks by asset size.

Comparing our sample distribution to that reported in Bell and Murphy (1968) who used 772 banks, (1963, 1964 and 1965) located in the Federal Reserve Districts of Boston, New York and Philadelphia, we find that the share of larger banks in our study is somewhat bigger. Table 5 - 1 also indicates that the share of large banks, over 100 million dollars in total assets, increased from 21.4% in 1973 to 27.7% in 1977.

Bell and Murphy's comprehensive cost study serves as a means to insolate the impact on the empirical results of the differences between our theoretical model and other, more

Table 5 - 1 Banks Distribution By Asset Classes

Asset Classes (millions \$)	1973		1975		1977	
	no. of Banks	%	no. of Banks	%	no. of Banks	%
0 - 2.4	0	0	0	0	0	0
2.5 - 4.9	10	1.0	7	0.8	2	.2
5.0 - 7.4	19	2.0	15	1.7	11	1.3
7.5 - 9.9	23	2.4	19	2.2	14	1.7
10.0 - 12.4	36	3.7	28	3.2	12	1.4
12.5 - 14.9	41	4.3	19	2.2	21	2.5
15.0 - 17.4	47	4.9	36	4.2	24	2.8
17.5 - 19.9	45	4.7	30	3.5	21	2.5
20 - 24.9	74	7.7	61	7.1	46	5.5
25 - 29.9	61	6.3	60	6.9	50	5.9
30 - 39.9	95	9.9	80	9.3	110	13.0
40 - 49.9	84	8.7	77	8.9	66	7.8
50 - 59.9	68	7.1	60	6.9	63	7.5
60 - 79.9	100	10.4	111	12.8	101	12.0
80 - 99.9	52	5.4	48	5.6	69	8.2
100 - 139.9	68	7.1	59	6.8	66	7.8
140 - 199.9	35	3.6	45	5.2	64	7.6
200 - 499.9	81	8.4	83	9.6	76	9.0
500 - 699.9	8	0.8	15	1.7	18	2.1
700 -	14	1.5	11	1.3	10	1.2
Total	961	100.0	864	100.0	844	100

Source: Functional Cost Analysis Program.

'conventional' theories; Thus the structure of our statistical model stays close to the one suggested by them.

Our cross - section study is aimed at measuring the level of bank output, exploring the relationship between bank costs and output, and isolating the importance of labor in banks' production process. Johnston (1960 pp. 186-192) discusses two problems arising from the use of a cross - section data base, both

of which should be taken into account in interpreting the results:

(i) The variability of conditions between firms of different size at any given point in time (due to age, type and cost of equipment, executive quality etc.) may yield an L shaped cost function that provides evidence not that big firms are efficient, i.e. economies of scale but that the efficient firms grow big. One can only hope that the observations are chosen in such a way as to minimize the variations mentioned above.

(ii) The observed output of a firm at a given point in time may depart from the 'normal' output for which its capacity has been designed because of random factors particular to the firms in question. This "regression fallacy" may be avoided by the incorporation of 'capacity' as an additional independent variable. However, it is hard to think of a meaningful definition of 'capacity' for the banking firm.

B. Measuring of the Level of Bank Output

This section is aimed at identifying and measuring the level of bank output. This step is superfluous in cost studies related to most producers. In the case of banks, however, more than one output - definition is used. Since we suggest liquidity as the measure for bank output (in the context of this study), this section presents the model according to which this measure is calculated, and the empirical results obtained. The level of liquidity as measured here serves as the dependent variable in the cost function estimates in the next section.

The definitions used here are as follows:

- D - The level of demand deposits.
- DA - The average size of a demand deposit account.
- DPI - Weighted items per account. The processing of checks (debits on own accounts), deposit and transit items (checks) represent sources of activity. A weighted index for these factors was constructed using the weights developed by Benston (1964)¹.

¹ These weights were chosen over more recent ones (see Longbrake, 1973), so as to stay close to Bell and Murphy's (1968) structure.

Item	Weight
X_1 - Check processing (own demand deposits)	1.0000
X_2 - Deposit items	.9475
X_3 - Transit items	.1660

The above weights indicate the relative time used in processing.

- DRP - Ratio of regular to total checking deposits.
- DWA - The yearly wage rate of demand deposits employees.
- TDWA - The yearly wage rate of demand and time deposits employees(average).
- TR - The level of regular savings.
- TO - The level of other time deposits.
- TONINR - The interest rate (net of service charges) on time deposits other than regular savings.
- TRNINR - The interest rate (net of service charges) on regular savings.
- TRA - The average size of a regular savings account.
- TRP - Ratio of regular savings to total time deposits.
- U - Liquidity, our measure for bank output.
- WA - The yearly wage rate per bank employee.
- TWA - The yearly wage rate of time deposits employees.

B.1 The Statistical Model

As discussed in chapter 3 (see section C), we define bank output as the level of liquidity (services) produced by the banking firm. This level itself can be revealed by using Lancaster's (1966) characteristics approach to consumer theory.

Reproducing the utility or "Liquidity" function and the budget constraint as derived in chapter 3 we get:

$$(3.1) \quad U = \left[\alpha_D (D)^{-\rho} + \alpha_T (T/(1+r_T))^{-\rho} \right]^{-1/\rho}$$

$$(3.2) \quad F_B = D + T$$

where D and T are demand and time deposits respectively. T itself is subdivided into regular savings (TR) and other time deposits. The interest rate on time deposits (r_T) is equal, in our case, to TRNIR for regular savings and to TONIR for other time deposits. The sum the consumer wants to invest in banks is F_B , and ρ is the elasticity of substitution (between the various deposits) parameter. The distribution parameters, α_D and α_T are closely related to 'consumer tastes', a change in tastes as to the ordering of D and T in U will affect α_D and α_T by changing the marginal products of these deposits in the production of liquidity².

Maximizing (3.1) subject to (3.2) yields the following equilibrium condition (in logarithmic form):

$$(5.1) \quad \text{Log} \frac{D}{T/(1+r_T)} = -\frac{1}{1+\rho} \text{Log} \frac{\alpha_T}{\alpha_D} + \frac{1}{1+\rho} \text{Log}(1+r_T)$$

2

For a more thorough discussion of these parameters see chapter 3, section D.1.

When more than two financial assets, as in our study, appear in the utility function, equation (5.1) becomes³:

$$(5.2) \quad \text{Log} L_i = -\frac{1}{1+\rho} \text{Log} \frac{\alpha_D \rho}{\alpha_i \rho_i} - \frac{1}{1+\rho_i} \text{Log}(1+r_i) + \\ + \frac{\rho + 1}{\rho_i + 1} \text{Log} D$$

where L_i , ($i=1\dots n$) are the various types of bank deposits.

In our study, the explicit form of equation (5.2) is:

$$(5.2a) \quad \text{Log} \frac{TR}{1 + TRNINR} = -\frac{1}{1+\rho_{TR}} \text{Log} \frac{\alpha_D \rho}{\alpha_{TR} \rho_{TR}} - \\ - \frac{1}{1+\rho_{TR}} \text{Log}(r + TRNINR) + \frac{\rho + 1}{\rho_{TR} + 1} \text{Log} D$$

³ This equation is a result of maximizing the following utility function: $U = [\alpha_D D^{-\rho} + \alpha_1 L_1^{-\rho_1} + \dots + \alpha_n L_n^{-\rho_n}]^{-1/\rho}$

subject to the constraint: $F_D = D + \sum L_i$. For an analysis of this "generalized CES production function" see Dhrymes and Kurz (1964).

and

$$(5.2b) \quad \text{Log} \frac{T_0}{1 + T_0 \text{NINR}} = - \frac{1}{1 + \rho_{T_0}} \text{Log} \frac{\alpha_D \rho}{\alpha_{T_0} \rho_{T_0}} - \\ - \frac{1}{1 + \rho_{T_0}} \text{Log} (1 + T_0 \text{NINR}) + \frac{\rho}{\rho_T + 1} \text{Log} D$$

Using the normalization rule that $\alpha_D = 1$, (see Chetty, 1969), based on the notion that demand deposits are the most liquid financial asset produced by banks, we are able to estimate $\rho_{TR}, \rho_{T_0}, \rho, \alpha_{TR}$, and α_{T_0} . These parameters, in turn, determine the level of liquidity implied by a given level and mix of bank deposits. The regression results of equations (5.2a) and (5.2b) are reported in tables 5 - 2 and 5 - 3 respectively. The derived parameter ($\rho, \rho_{TR}, \rho_{T_0}, \alpha_{TR}, \alpha_{T_0}$) are presented in table 5 - 4.

Table 5 - 2 Regression Results - Saving Accounts Liquidity

Function

$$\text{Log} \frac{\text{TR}}{1+\text{TRNINR}} = - \frac{1}{1+\rho_{\text{TR}}} \text{Log} \frac{\alpha_{\text{TR}} \rho}{\alpha_{\text{TR}} \beta_{\text{TR}}} - \frac{1}{1+\rho_{\text{TR}}} \text{Log}(1+\text{TRNINR}) +$$

$$+ \frac{\rho + 1}{\rho_{\text{TR}} + 1} \text{Log} D$$

Independent Variables (log. form)*		1973	1975	1977
(1+TRNINR)	Parameter	115.3452	127.8150	81.9600
	St. Error	(6.6023)+	(6.6328)+	(5.9767)+
D	Parameter	.9107	.8934	.8872
	St. Error	(.0308)+	(.0288)+	(.0239)+
Constant		-4.2149	-4.6697	-2.2319
\bar{R}^2		.5666	.5982	.6491
St. Error Estimate		1.0587	.9530	.7434
F		626.19	643.53	780.34
N		961	864	844
D.F		958	861	841

* No significant problem of heteroscedasticity was detected unless so specified.

+ Significantly different from 0 at the 5 percent level.

Table 5 - 3 Regression Results - Other Time Deposits Liquidity Function

$$\text{Log } \frac{TO}{1+TONINR} = - \frac{1}{1+\rho_{TO}} \text{Log } \frac{\alpha_D \rho}{\alpha_{TO} \rho_{TO}} - \frac{1}{1+\rho_{TO}} \text{Log}(1+TONINR) + \frac{\rho + 1}{\rho_{TO} + 1} \text{Log}D$$

Independent Variables (log. form)		1973	1975	1977
1+TONINR	Parameter	47.9734	10.3508	52.5144
	St. Error	(5.0339)+	(4.3050)+	(4.6407)+
D	Parameter	.7372	.8592	.8814
	St. Error	(.0260)+	(.0189)+	(.0194)+
Constant		1.3802	1.6372	-1.2022
\bar{R}^2		.5846	.7152	.7123
St. Error Estimate		.8157	.6176	.5988
F		674.16	1084.80	1044.96
N		961	864	844
D.F		958	861	841

+ Significantly different from zero at the 5 percent level.

As can be seen from table 5-4, all the parameters of the liquidity (utility) function have the expected sign. The share parameters ($\alpha_D, \alpha_{TR}, \alpha_{TO}$) must be positive (in order for the inputs to take part in the production process). The elasticity parameters ($\rho, \rho_{TR}, \rho_{TO}$) are all negative and greater than -1 (perfect substitutability between bank deposits

Table 5 - 4

The Elasticity and Share Parameters of the Liquidity Function (derived via equations (5.2a) and (5.2b) from Tables 5-2 and 5-3).

The Parameter	1973	1975	1977
αD^*	1	1	1
αTR	.9711	.9647	.9731
αTO	1.0297	1.1889	.9796
ρTR	-.9913	-.9921	-.9877
ρTO	-.9791	-.9034	-.9809
ρ	-.9795	-.9169	-.9832
$\sigma_{D,TR}$	73.56	17.06	69.93
$\sigma_{D,TO}$	48.31	11.08	55.55

* By normalization

would imply that $\rho_1 = -1$, a positive elasticity parameter implies concave isoproduct curves). The parameters of regular savings are stable over time; However, significant instability exists with respect to the elasticity parameter of "other" time deposits (ρ_{TO}) which has the value of $-.90$ in 1975 compared with $-.98$ in 1973 and 1977⁴. It is our view that this

Since ρ_{re} is not estimated directly but is related to an estimated coefficient, a direct hypothesis - testing on the various elasticity parameters was impossible. Instead, the means and variances of these parameters were estimated via expanding the random variable (the regression coefficient) in a Taylor series around its expected value. This procedure enabled us to conclude whether the various parameters in different years were significantly different from each other.

result demonstrates the short run instability of the demand for money function since the parameters discussed enter the demand for money (in the broad sense) in the form of "consumer tastes". Our estimates of α_{T0} and ρ_{T0} for 1973 and 1977 are close to those reported by Chetty (1969); However, in his study there is no differentiation between regular savings and other time deposits.

Table 5-4 also presents the partial elasticity of substitution (σ) between demand deposits and the other two financial assets. This elasticity, first derived by Allen and Hicks (1934), is defined as follows:

$$(5.3) \quad \sigma_{D,L1} = \left\{ (1+\rho) + \rho_i - \rho \left[1 + \frac{\alpha_i \rho_i (L_i)^{-\rho_i}}{\alpha_0 \rho_D (D)^{-\rho}} \right] \right\}^{-1}$$

As can be seen from the table, regular savings are a better substitute for demand deposits⁵. Since the level of liquidity of demand deposits is assumed to be the highest, we conclude that the liquidity of regular savings is higher than that of other time deposits (including CD's). The empirical counterpart of this argument is the higher interest rate paid on CD's and other time deposits.

⁵

The relatively low values in 1975 reflect the changes in ρ and ρ_{T0} .

The parameters presented in table 5-4 are then used to measure the level of liquidity (output) produced by each bank. This is done via the following equation (an extension of the general model presented by equation (3.1)).

$$(5.4) U = \left[\alpha_D (D)^{-\rho} + \alpha_{TR} \left(\frac{TR}{1+TR/NIR} \right)^{-\rho} + \alpha_{TO} \left(\frac{TO}{1+TO/NIR} \right)^{-\rho} \right]^{-1/\rho}$$

The level of liquidity (U) produced by each bank is the output proxy that best describes the role of banks in the monetary process, and is also directly related to the production activity of banks via the level and mix of deposits outstanding. Thus, this proxy enables us to link the micro and macro aspects of the banking firm, which was one of the purposes of this study⁶. The empirical counterpart of equation (5.4), for a small sample of banks, is presented in table 5-5.

Table 5-5 Bank Deposits and Liquidity - 1977*
(Based on the parameters presented in table 5.4)

Demand Deposits (D)	Regular Savings (TR)	Other time deposits (TO)	Liquidity (U)
1224	466	1826	3363
36838	33507	32216	100891
10557	16771	14061	40494
135206	99863	151489	376364
15772	75060	25214	74681
1907	2101	2143	6005
91429	18602	107305	208077
8009	20045	26956	52818
127872	196675	213302	524976
5383	3732	7925	16454

* Sample banks, thousands of dollars.

⁶ For a broader discussion see Chapter 3, Section C.

C. The Cost - Output Relationship

In this section we present the theoretical model which is similar to the one used by Bell and Murphy (1968), and the empirical structure of bank cost functions using liquidity (as measured in the previous section) for bank output, as well as an alternative, more conventional, definition.

C.1 The Model

The most commonly used function in bank cost studies is the Cobb - Douglas type production function (see Bell and Murphy, 1968; Benston, 1965 and 1972; Daniel, Longbrake and Murphy, 1973; and Longbrake and Haslem, 1975).

This function is of the following form:

$$(5.5) \quad U = AK^{\alpha} L^{\beta} M^{\gamma}$$

where U is bank output, K, L and M are capital, labor and materials respectively, α , β and γ are the distribution parameters and A is a constant.

The cost identity is:

$$(5.6) \quad C = wL + rK + nM$$

where w , r and n are wages, rent and the price of materials respectively.

Minimizing (5.6) subject to (5.5) and substituting for the equilibrium relationship between prices and marginal products,

we get the following Cobb - Douglas cost function⁷:

$$(5.7) C = v(A^{1/v} \alpha^{\alpha/v} \beta^{\beta/v} \delta^{\delta/v})^{-1} U^{1/v} r^{\alpha/v} w^{\beta/v} n^{\delta/v}$$

where $v = \alpha + \beta + \delta$

For complete identification of the system devised in (5.5) and (5.6) we must have $\alpha/v + \beta/v + \delta/v = 1$. To achieve this we may divide the costs and any two prices by the remaining price, or as we have chosen to do, assume that r and n are constant across all firms.

Thus the theoretical cost function becomes:

$$(5.8) C = GU^{1/v} w^{\beta/v}$$

where $G = v(A^{1/v} \alpha^{\alpha/v} \beta^{\beta/v} \delta^{\delta/v})^{-1} r^{\alpha/v} n^{\delta/v} = \text{constant}$

Equation (5.8) is the cost function⁸ that we are estimating.

This structure corresponds to the single production process approach developed in chapter four (see section F.1).

The nature of the data⁸ prevented us from estimating the level of liquidity embodied in deposits which differ with respect to size, mix and turnover. As argued previously (see chapter 3, section D.4), each of these characteristics affects the degree of liquidity attached to a specific demand or time

7

For a detailed derivation see Bell and Murphy (1968) pp. 15 - 19.

8

The lack of a break-down of deposits, costs, and revenues according to the various characteristics mentioned above.

deposit. Thus our measure of output, U, may differ from the "true" level of liquidity produced by the banking firm. To overcome this problem we use various output homogeneity variables such as the account size, the turnover of demand deposit accounts etc. These variables are expected to correct for the output - measure bias and are used frequently in bank cost studies. However, in our study the use of such variables is a result of the lack of sufficient information and not a result of what looks to be a theoretical misspecification of the level of bank output. Such a misspecification problem seems to characterize all bank cost studies which use the number of accounts as a proxy for bank output (such as Benston, 1965 and 1972; and Bell and Murphy, 1968; for example).

Using the homogeneity variables discussed above, equation (5.8) becomes:

$$(5.9) \quad C = CU^{1/v_w} \delta^{1/v} \prod_{j=1}^Z X_j^{z_j}$$

where the X's stand for the size, mix and turnover characteristics of demand and time deposits (DA, DPX, DRP, TRA and TRP respectively). We do not use the organizational structure (number of branches) as an additional homogeneity variable because of lack of the relevant data.

G.2 Banks Costs - A General Description

The three factors of production used in our model are

labor, capital and materials. Thus the three prices in our system are wages, rent and the price of materials. An important component of banks' capital expenses are computer service fees ("off - and - on - premise") as well as computer software expenses.

The major component of materials expenses, in our model, are interest payments on time deposits. To the best of our knowledge, interest payments have never before been used as a direct cost of production for the banking firm. As discussed in chapter 3 (see section C.4), reserves are regarded as an input into the production process of banks. Thus interest payments on deposits are regarded as a direct cost of production, since deposits are necessary to acquire reserves.

Banks are required to provide a detailed breakdown of overhead costs (advertising, administration, etc.) according to the various deposits produced by them. Thus the amount of imputation done is minimal.

Almost all bank cost studies adopt the "perfect certainty" assumption (see Bell and Murphy, 1968; Benston, 1965 and 1972; Daniel, Longbrake and Murphy, 1973; Greenbaum, 1966; Longbrake and Haslem, 1975; and Longbrake and Merrill, 1976), an assumption which is retained in our study. It is, however, interesting to note that with regard to banks' expenses there exists an important interaction between risk and operating costs. Baltenspreger (1972, p.596) discusses this as follows:

"...a financial firm has possibilities to trade off risk and the costs associated with it for

more 'operating costs'... One way to achieve this is by spending resources in order to acquire information about its customers and thus reduce uncertainty... Another possibility for the bank is to change the average size of its loans deposits accounts. By giving more loans... of smaller average size, the firm can reduce risk and the associated costs... but it will increase its operating costs..."

This aspect of bank activity should be born in mind when the empirical results are analyzed.

In table 5-6 we present the distribution of the banks' major cost components for 1977.

As can be seen from this table, labor is the most important factor in the production of demand deposits. Wages constitute more than 55 percent of the total costs of producing this type of financial asset. Bell and Murphy's (1968, p.145) figure is close to 70 percent. Since their analysis was conducted in 1965, we can conclude that the technological change in banking between 1965 and 1977 has been substantial. The substitution of computer technology for labor is also reflected in the share of capital costs in our study (14 percent) as compared with that share in 1965 (9 percent). The major cost component in the production of time deposits is interest payments (near 90 percent) and the importance of other factors of production is relatively small. If interest payments are not considered as a direct cost, so as to compare the 1977 structure directly with that of 1965, we find that in 1977 the share of wages in total costs is about 44 percent, and that of capital is about 13 percent. The corresponding

figures for 1965 are 60 percent and 4 percent respectively. This again indicates the intensive substitution of computer technology for labor.

Table 5 - 6 The Distribution of Bank Costs - 1977*
(Percentages)

Costs items	Demand Deposits	Time Deposits	Assets ¹	Total
Wages	55.13	3.47	46.29	23.86
Capital Exp ²	14.10	.97	9.27	5.29
Supplies ³	12.27	.57	6.60	3.96
Advertisement	2.06	.45	2.95	1.48
Deposits Insurance	1.55	.61	-	.51
Administration ⁴	1.20	.11	5.84	2.15
Interest on Deposits	-	92.06	-	50.45
Other Costs ⁵	13.68	1.76	29.04	12.28
Total ⁶	100.00	100.00	100.00	100.00

* The distribution is based on the mean values of the variables.

1 Including liabilities other than demand and time deposits.

2 Computer service fees ("off - and on * premise"), and furniture and equipment.

3 Office supplies, printing, etc.

4 Legal fees, information services, etc.

5 Interest on borrowed money, service departments expenses, net loan losses, etc.

6 Not including occupancy expenses (about 4% of total costs).

Source: Functional Cost Analysis Program.

C.3 Empirical Results - Liquidity Production

Ordinary least - squares was applied after logarithmic transformation of the model presented in equation (5.9). As mentioned before, our model identifies the existence of returns to scale in the production of bank output⁹ ($\frac{1}{V} < 1$ implies increasing returns to scale), the importance of labor in the production process and the impact of the homogeneity variables on banks' costs. This last impact is, however, of secondary importance in our study.

In section B we presented the theoretical structure as well as the empirical results of our measure of bank output--namely, liquidity, this measure is based solely on the level and mix of bank deposits. When analyzing the production of liquidity, one could attribute all bank costs to output so measured only if the asset activity contributes nothing to it. However, when this is not the case, i.e. when asset activity also contributes output, then this additional output should be related to asset - production costs and liquidity (U) should be related to deposit - production costs¹⁰. A test concerning this issue might examine the dependence between the asset (structure) activity and the structure and mix of bank

9

Given the assumption that rent and the price of materials are not subject to regional variation in the U.S.

10

For this point see also chapter 3, section C.3.

deposits. High dependence would imply that asset activity is reflected in the structure and mix of deposits, and thus deposits provide the basis for an unbiased measure of bank output. This, in turn, means that all costs should be attributed to the level of liquidity - this will be defined as the Upper Bound approach. Independence, on the other hand, would imply that asset activity is not reflected in the level and composition of bank deposits; It produces an output of its own, and thus only deposit production costs should be attributed to the level of liquidity measured here. This will be defined as the Lower Bound approach. To the extent that the Lower Bound approach is correct, the Upper Bound approach underestimates output or, equivalently, overestimates the production costs of liquidity.

Table 5-7 and 5-8 summarize the cost - output relationship reflecting the Lower and Upper Bound approaches respectively.

Table 5 - 7

Regression Results for the Cobb - Douglas Production Function
(Liquidity - Lower Bound)

$$\text{LogC} = \text{LogG} + \frac{1}{V} \text{LogU} + \frac{\beta}{V} \text{LogTDWA} + z_1 \text{LogDA} + z_2 \text{LogTRA} + \\ + z_3 \text{LogDPI} + z_4 \text{LogDRP} + z_5 \text{LogTRP}$$

Independent Variables (log. forms)		1973	1975	1977
U	Parameter	1.0303	.9461	1.0016
	St. Error	(.0065)+	(.0031)+	(.0043)+
TDWA(-w)	Parameter	.0360	.0789	.0823
	St. Error	(.0191)	(.0197)+	(.0239)+
DA	Parameter	-.0101	.0144	-.0113
	St. Error	(.0045)+	(.0025)+	(.0029)+
TRA	Parameter	.0138	-.0103	.0168
	St. Error	(.0046)+	(.0026)+	(.0029)+
DPI	Parameter	.1449	.1065	.1410
	St. Error	(.0183)+	(.0104)+	(.0121)+
DRP	Parameter	-.3225	-.0254	-.2545
	St. Error	(.0949)+	(.0505)	(.0596)+
TRP	Parameter	-.0763	.0511	-.0626
	St. Error	(.0129)+	(.0075)+	(.0094)+
Constant (-G)		-3.8829	-3.6524	-3.5812
\bar{R}^2		.9685	.9921	.9868
S.E.E.		.1945	.0965	.1165
F		4217.11	15350.21	8928.25
N		961	864	844
D.F		953	856	836

+ Significantly different from zero at the 5 percent level.

Table 5 - 8

Regression Results for the Cobb - Douglas Production Function
(Liquidity - Upper Bound)

$$\text{LogC} = \text{LogG} + \frac{1}{V} \text{LogU} + \frac{\beta}{V} \text{LogWA} + z_1 \text{LogDA} + z_2 \text{LogTRA} + z_3 \text{LogDPIX} + z_4 \text{LogDRP} + z_5 \text{LogTRP}$$

Independent Variables (log, forms)		1973	1975	1977
U	Parameter	1.0312	.9371	1.0084
	St. Error	(.0048)+	(.0058)+	(.0041)+
WA(=w)	Parameter	-.1482	-.2003	-.0204
	St. Error	(.0307)+	(.0418)+	(.0268)
DA	Parameter	.0008	.0352	.0068
	St. Error	(.0033)	(.0047)+	(.0028)
TRA	Parameter	-.0093	-.3918	.0014
	St. Error	(.0033)+	(.0048)+	(.0028)
DPIX	Parameter	.0898	.0649	.1082
	St. Error	(.0136)+	(.0145)+	(.0118)+
DRP	Parameter	-.3196	.0041	-.1122
	St. Error	(.0693)+	(.0930)	(.0572)+
TRP	Parameter	-.0510	.0760	-.0309
	St. Error	(.0094)+	(.0138)+	(.0090)+
Constant(=G)		-1.8398	-.5471	-2.3416
\bar{R}^2		.9830	.9728	.9878
S.E.E		.1420	.1780	.1119
F		7931.46	4424.90	1994.56
N		961	864	844
D.F		953	856	836

+ Significantly different from zero at the 5 percent level.

Two interesting results show up in tables 5-7 and 5-8:

(1) We do not find conclusive evidence for the existence of economies of scale in the production of liquidity¹¹ (in contrast to Greenbaum who also used a single output measure and found returns to scale in bank operations in 1961). We find that the production of liquidity was characterized by decreasing returns to scale in 1973, increasing returns to scale in 1975, and again decreasing returns to scale in 1977 (constant returns in 1977 according to the Lower Bound approach). A more intense use of computers over the period analyzed would support the suggestion of increasing returns to scale in 1977. However, the marginal contribution of this technological change is offset by decreasing returns in the use of materials. Since interest payments are regarded here as a 'material' expense, this result may point to a relative decrease in the monopolistic power of banks in 1977. We do not have any support for this hypothesis from any other source. These arguments are discussed again following tables 5-9 and 5-10.

(2) The coefficient of the wage rate, between 3 and 8 percent according to the Lower Bound approach¹², is significantly lower than that found in previous studies (which

II

All the conclusions with respect to the existence of returns to scale are based on testing whether $(1/v)-1$ is significantly different from zero at the 5 percent level.

¹²

Which implies that a 10 percent increase in the wage rate will increase banks' total costs by less than 1 percent.

excluded interest payments from the definition of costs). According to the Upper Bound approach, the coefficient of the wage rate is significantly less than zero in two years, implying that an increase in the wage rate will result in a decrease in total costs. There may be several explanations for this peculiar result:

(i) The Upper Bound approach is wrong. Asset activity is not fully reflected in the mix and structure of bank liabilities and thus the costs of producing liquidity should exclude 'asset production' costs.

As will be later demonstrated, (using a version of the Lower Bound approach), the negative wage coefficient also characterizes, to a certain degree, the production of time deposits, which are more frequently used as a proxy for bank output. It also appears in at least one other cost study¹³. Thus a misspecification of our proxy for bank output (liquidity) can not explain the above result.

(ii) The assumption made about the price of reserves (the net interest rate) being constant is wrong and thus creates a bias in the wage coefficient. To test this argument we estimate the liquidity cost function (Upper Bound) with the wage rate and the interest rate serving as explicit independent variables, while only the price of capital is

¹³

See Bell and Murphy (1968), pp. 241-242.

assumed to be constant. The results are as follows (for 1977);

$$\begin{aligned} \text{LnC} = & -1.7640 + 1.0083 \text{ LnU} - .0263 \text{ LnWA} - .0061 \text{ LnDA} + .0006 \text{ LnTRA} + \\ & (.0041)+ \quad (.0269) \quad (.0028)+ \quad (.0028) \\ & .1031 \text{ LnDPX} - .1336 \text{ LnDRP} - .0180 \text{ LnTRP} + .1799 \text{ LnTNINR} \\ & (.0118)+ \quad (.0575)+ \quad (.0101) \quad (.0640)+ \end{aligned}$$

where C are total operating costs and TNINE is the interest rate on time deposits. We see that the coefficient of the wage rate is still negative and thus it can not be explained by a misspecification of our original estimating equation.

(iii) The Cobb - Douglas production function can not describe the production process of banks. If this is the case then none of the estimated coefficients, including the wage - rate coefficient, can be viewed as describing the "true" production process of banks. This point will be further discussed when we present a test for the appropriateness of this production function in the case of banks.

(iv) Bank costs are minimized subject to factor prices, given the level of output, and an additional constraint which is, most probably, a time constraint preventing quick and full adjustment in the short run. This constraint prevents them from using as much capital as they would like. In other words, banks are inefficient producers according to the standard neoclassical model. In this model, an increase in the wage rate implies the substitution of capital for labor which,

when leading to a reduction in total costs, means that the initial allocation of resources was inefficient. In our case, banks can produce the existing level of output more efficiently by using less labor and more capital (computer technology). The adjustment to this new technology is not yet complete and thus banks currently employ "too much" labor. This hypothesized inefficiency in the production process of banks may also be linked to the fact that this industry is regulated and thus there is interference with the optimizing process of banks¹⁴.

In addition to the two main results stated above we also find:

(a) An inverse relationship between bank costs and the proportion of regular checking accounts out of total demand deposits (DRP). The result with respect to the proportion of regular saving accounts out of total time deposits (TRP) is less conclusive.

(b) A certain degree of multicollinearity between the average account size of demand (DA) and regular saving (TRA) deposits. However, using the Lower Bound approach, the coefficients of both variables are significantly different from zero and thus none of them is omitted from the estimated cost function. This was not the case for 1973 and 1977 using the Upper Bound approach where one of the account size variables

¹⁴

Since regulations take more than one form (interest ceilings, barriers to entry, reserve requirements, etc.), we can not point to a well defined relationship between them and the kind of inefficiency found.

was found to be not significantly different from zero; Thus TRA has been omitted and the cost function was re-estimated. The results show that DA is inversely related to the level of costs. This confirms the often reported result that larger accounts are associated with lower costs per unit of output produced.

(c) A positive correlation between the activity (turn-over) of demand deposits accounts as measured by the number of home debits, deposit items and transit items per account (DPX) and banks' production costs.

The Cobb - Douglas production function, used here, implies in theory that factor shares are invariant to scale. The validity of this assumption may be checked by disaggregating the cost function into its three components: wages, rents, and material costs, and comparing the point estimates of the scale parameter for each component of total costs. Such a disaggregation will also enable us to observe how the various factors of production are economized as the scale of production changes, and explain the results discussed before with regard to liquidity production (tables 5-7 and 5-8).

The results of such a disaggregation of total costs for 1975 and 1977 (the Lower Bound approach only¹⁵) are presented in tables 5-9 and 5-10.

These two tables indicate that the point estimates of

the scale parameters are not equal to each other, at the 5 percent level of significance. Thus, holding factor prices constant, factor shares are invariant to scale. Such a result raises doubts concerning the validity of the use of the Cobb - Douglas function for the banking industry and may explain results such as the negative wage coefficients discussed before. However, it has to be remembered that our theoretical model (see chapter four, section B) suggests that banks are not price takers as far as the net interest on deposits is concerned. Thus factor prices are not constant and different point estimates of the scale parameter of the various costs components would not necessarily imply that factor shares will change with scale, nor that the use of the Cobb - Douglas production function is invalid.

Tables 5-9 and 5-10 also indicate a result already discussed - namely, that in both 1975 and 1977, wages and capital costs exhibited increasing returns to scale (capital costs exhibited decreasing returns to scale in 1973). Thus an increase of 10 percent in scale was accompanied in 1977 by a 9.2 percent increase in wages and 8.5 percent ~~increase~~ increase in capital costs. However, in 1977 material costs exhibited decreasing returns to scale, while in 1975 (and 1973) they exhibited increasing returns to scale. This accounts for the overall decreasing returns to scale in the production of liquidity found in 1977 (see tables 5-7 and 5-8). As explained before, the major component of material costs in the (net)

Table 5 - 9

Regression Results For the Components of Total Costs - 1975
(Liquidity Production)

$$\text{Log}C_i = \text{Log}G + \frac{1}{v} \text{Log}U + \frac{1}{v} \text{LogTDWA} + z_1 \text{LogDA} + z_2 \text{LogTRA} + z_3 \text{LogDPX} + z_4 \text{LogDRP} + z_5 \text{LogTRP}, i=1...3$$

C₁ = Wages, C₂ = Capital ex., C₃ = Material ex.

Independent Variables (log. form)		Dependent Variables (log. form)		
		Wages	Capital	Materials
U	Parameter	.8518	.7316	.9828
	St. Error	(.0129)+	(.0310)+	(.0061)+
TDWA(-w)	Parameter	.7086	-.0388	.0083
	St. Error	(.0307)+	(.1942)	(.0386)
DA*	Parameter	.0581	.0540	.0294
	St. Error	(.0106)+	(.0255)+	(.0050)+
TRA*	Parameter	-.5988	.0249	.0366
	St. Error	(.0106)+	(.9421)	(.0051)+
DPX*	Parameter	.2192	.6873	.0444
	St. Error	(.0429)+	(.1032)+	(.0205)+
DRP*	Parameter	.0095	.0051	.0907
	St. Error	(.2069)	(.4976)	(.0989)
TRP*	Parameter	.3526	.5480	.8061
	St. Error	(.0307)+	(.0739)+	(.0146)+
Constant(-G)		-9.0629	-.6710	.9075
\bar{R}^2		.8648	.4536	.9728
S.E.E		.3956	.9514	.1891
F		788.44	103.36	4423.35
N		864	864	864
D.F		856	856	856

+ Significantly different from zero at the 5 percent level.

* Irrelevant for our discussion.

Table 5 - 10

Regression Results for the Components of Total Costs - 1977
(Liquidity Production)

$$\text{Log}C_i = \text{Log}G + \frac{1}{v}\text{Log}U + \frac{\beta}{v}\text{LogTDWA} + z_1\text{LogDA} + z_2\text{LogTRA} + z_3\text{LogDPI} + z_4\text{LogDRP} + z_5\text{LogTRP}, i=1...3$$

C_1 = Wages, C_2 = Capital ex., C_3 = Material ex.

Independent Variables (log. form)		Dependent Variables (log. form)		
		Wages	Capital	Materials
U	Parameter	.9278	.8501	1.0214
	St. Error	(.0124)+	(.0428)+	(.0093)+
TDWA(=w)	Parameter	.6994	.0610	-.1316
	St. Error	(.0692)+	(.2375)	(.0518)+
DA*	Parameter	.0099	.0702	-.0238
	St. Error	(.0086)	(.0296)+	(.0064)+
TRA*	Parameter	-.0144	-.0592	.0331
	St. Error	(.0085)	(.0292)+	(.0063)+
DPI*	Parameter	.2263	.3551	.0318
	St. Error	(.0351)+	(.1203)+	(.0262)
DRP*	Parameter	-.3462	-.0181	-.0653
	St. Error	(.1727)+	(.5921)	(.1291)
TRP*	Parameter	.2183	.2776	-.0144
	St. Error	(.0272)+	(.0934)	(.0203)+
Constant(=G)		-9.4971	-3.5809	-2.6677
\bar{R}^2		.8907	.3576	.9430
S.E.E		.3375	1.1574	.2524
F		973.77	68.05	1994.56
N		844	844	844
D.F		836	836	836

+ Significantly different from zero at the 5 percent level.

* Irrelevant for our discussion.

interest payments on time deposits. Thus one may claim that 1977 is characterized by a change in banks' monopolistic power in the market for deposits. The explanation for the decreasing returns to scale exhibited by this cost item in 1977 may also be based on the "other" material costs (supplies, etc.). Further investigation with respect to the nature of these inputs is necessary in order to have a complete explanation.

C.4 Empirical Results - The Production of Demand and Time Deposits.

There are three basic differences between our analysis and most of the (bank) cost studies done in the past (Baltenspreger, 1972; Benston, 1965 and 1972; Bell and Murphy, 1968; Daniel, Longbrake and Murphy, 1973; Longbrake and Haslem, 1975; and Longbrake and Merrill, 1976):

(i) Our definition of bank output is based on the single - output concept of liquidity, to which various components of bank portfolios (assets and liabilities) contribute, whereas the above studies argue that each bank department (demand deposits department, business loans department, etc.) produces a unique product.

(ii) All the above studies use the number of accounts as a measure for the physical quantity of output. In our analysis the dollar volume (of liquidity) stands for the physical level of bank output.

(iii) None of the above studies considers interest payments on time deposits as a factor payment (and thus reserves are not explicitly treated as an input). However, we regard interest payments as a direct cost of production.

In order to isolate the impact of the first of these differences on the empirical results, we analyze the relationship between bank costs (our classification) and a more conventional definition of bank output - namely, demand and time deposits separately. The results are summarized in tables 5-11 and 5-12.

Returns to Scale - we find decreasing returns to scale in the production of demand deposits in both 1973 and 1975, and constant returns to scale in 1977. Since no explicit interest is paid on demand deposits, the only difference between our analysis and previous ones is with respect to the output measure used. When the number of accounts serves as such a measure, Benston (1972), Bell and Murphy (1968), and Longbrake and Haslem (1975), find increasing returns to scale in the production of demand deposits. Constant returns to scale is the finding of Daniel, Longbrake and Haslem (1973).

As far as time deposits are concerned, constant returns to scale are found in 1973 and 1975, while for 1977 we find increasing returns to scale. Constant returns to scale in the production of time deposits are also found by Benston (1972) and Bell and Murphy (1968, table iv - 5). Based on this information it is hard to conclude whether the different results in

Table 5 - 11

Regression Results for the Cobb - Douglas Production Function
(Demand Deposits Production)

$$\text{LogC} = \text{LogG} + \frac{1}{v}\text{LogD} + \frac{\beta}{v}\text{LogDWA} + z_1\text{LogDA} + z_2\text{LogDPX} + z_3\text{LogDRP}$$

Independent Variables (log. Form)		1973	1975	1977
D	Parameter	1.0327	1.0440	1.0193
	St. Error	(.0097)+	(.0102)+	(.0116)+
DWA(-w)	Parameter	.2867	.4178	.4279
	St. Error	(.0300)+	(.0617)+	(.0661)+
DA	Parameter	.0101	.0182	.0166
	St. Error	(.0034)+	(.0035)+	(.0037)+
DPX	Parameter	.3882	.5129	.4163
	St. Error	(.0289)+	(.0325)+	(.0336)+
DRP	Parameter	-.8187	-.8680	-.7741
	St. Error	(.1451)+	(.1549)+	(.1659)+
Constant(=G)		-6.2916	-7.3255	-7.1466
\bar{R}^2		.9316	.9367	.9175
S.E.E		.3068	.3040	.3270
F		2619.50	2557.96	1865.19
N		961	864	844
D.F		955	858	838

+ Significantly different from zero at the 5 percent level.

1977 are due to the treatment of interest as a factor payment or to the use of the dollar value as representing the level of bank output (rather than the number of accounts).

Employment of Labor - the coefficient of the wage rate in the

Table 5 - 12

Regression Results for the Cobb - Douglas Production Function
(Time Deposits Production)

$$\text{LogC} = \text{LogG} + \frac{1}{V} \text{LogT} + \frac{\beta}{V} \text{LogTWA} + z_1 \text{LogTRA} + z_2 \text{LogTRP}$$

Independent Variables (log. form)		1973	1975	1977
T(-TR+TO)	Parameter	.9914	1.0040	.9914
	St. Error	(.0052)+	(.0022)+	(.0025)+
TWA(-w)	Parameter	-.1132	-.0166	.0204
	St. Error	(.0133)+	(.0104)	(.0106)
TRA	Parameter	.0033	.0005	.1750
	St. Error	(.0020)	(.0007)	(.0007)+
TRP	Parameter	-.0424	-.0559	-.0346
	St. Error	(.0118)+	(.0050)+	(.0051)+
Constant(-G)		-1.7714	-2.7566	-2.8750
\bar{R}^2		.9769	.9961	.9959
S.E.E		.1851	.0675	.0651
F*		10155.81	85997.08	51680.68
N		961	864	844
D.F		956	859	839

+ Significantly different from zero at the 5 percent level.

* The hypothesis that the variance of the residuals is homoscedastic is rejected at the 5 percent level of significance.

production of demand deposits (DWA) is in accordance with the results reported in previous studies. However, the coefficient of the wage rate in the production of time deposits (TWA) is found to be negative or very close to zero (in contrast with a coefficient of .4 found by Bell and Murphy for

example). This illustrates again the hypothesized inefficiency of banks' production process whether liquidity or time deposits represent their output. The fact that such an inefficiency is found with respect to time deposits and not with respect to the production of demand deposits may point to the fact that any further research in this direction will have to establish a link between the existence of interest ceilings and the suboptimal resource allocation in the banking industry.

Homogeneity Variables - we find that deposit mix has a significant impact on the level of bank costs. Costs of producing time and demand deposits are inversely related to the level of regular savings deposits (TRP) and the level of regular checking deposits (DRP). The result with respect to regular checking deposits is in accordance with the one reported by Daniel, Longbrake and Murphy (1973), and by Longbrake and Haslem (1975), but in contrast to Bell and Murphy's (1968) finding.

In accordance with the findings of previous studies, we find that the average demand and time deposit account size (DA and TRA respectively) are positively related to the cost of producing these two types of deposits.

To conclude our analysis, we disaggregated the total cost functions of demand and time deposits into wages, capital expenditures and materials expenditures. The findings are summarized in tables 5-13 and 5-14 (for 1977 only since there is no significant variation).

Comparing the point estimate of the scale parameter of the three components, we see (again) that factor shares in the production of time and demand deposits are not invariant to scale. In other words, assuming constant factor prices, capital, labor, and materials will not increase proportionally with the increase in the scale of operation. However, as discussed before, the assumption that banks are price takers is in violation with our theoretical model according to which they are monopolistic competitors at least in the reserves market, Thus the unequal factor elasticities do not necessarily imply that the Cobb - Douglas production function can not describe the production process of banks.

Table 5-13 illustrates that banks enjoy considerable returns to scale with respect to the employment of labor and capital in the production of demand deposits. The decreasing returns to scale with respect to the employment of materials accounts for the overall constant returns to scale in the production of demand deposits.

Table 5-14 indicates that increasing returns to scale in the employment of labor and capital explains the overall increasing returns to scale in the production of time deposits. Materials expenditures exhibited constant returns to scale in 1977 (increasing returns to scale in 1973, and decreasing returns to scale in 1975)

Table 5 - 13

Regression Results for the Components of Total Costs - 1977
(Demand Deposits Production)

$$\text{Log}C_i = \text{Log}G + \frac{1}{v}\text{Log}D + \frac{\beta}{v}\text{Log}DWA + z_1\text{Log}DA + z_2\text{Log}DPX + z_3\text{Log}DRP, \quad i=1\dots3$$

C_1 = Wages, C_2 = Capital ex., C_3 = Material ex.

Independent Variables (log. form)		Dependent Variables (log. form)		
		Wages	Capital	Materials
D	Parameter	.9268	.8589	1.3415
	St. Error	(.0103)+	(.0446)+	(.1112)+
DWA(=w)	Parameter	.5419	.0508	.4703
	St. Error	(.0591)+	(.2544)	(.6338)
DA*	Parameter	.0016	.0176	.5745
	St. Error	(.0033)	(.0143)	(.0357)+
DPX*	Parameter	.3906	.5465	.1014
	St. Error	(.0301)+	(.1296)+	(.3228)
DRP*	Parameter	-.7429	-.5821	5.6959
	St. Error	(.1464)+	(.6386)	(1.5908)+
Constant(=G)		-7.2394	-2.9753	-20.9109
\bar{R}^2		.9188	.3324	.4143
S.E.E		.2925	1.2584	3.1347
F		1911.10	84.94	120.27
N		961	961	961
D.F		955	955	955

+ Significantly different from zero at the 5 percent level.

* Irrelevant for our discussion.

Table 5 - 14

Regression Results for The Components of Total Costs - 1977

(Time Deposits Production)

$$\text{Log}C_i = \text{Log}G + \frac{1}{v}\text{Log}T + \frac{\beta}{v}\text{Log}TWA + z_1\text{Log}TRA + z_2\text{Log}TRP,$$

$i=1\dots3$, C_1 =Wages, C_2 =Capital ex. C_3 =Material ex.

Independent Variables (log. form)		Dependent Variables (log. form)		
		Wages	Capital	Materials
T(=TR+T0)	Parameter	.8835	.8181	.9998
	St. Error	(.0200)+	(.0397)+	(.0020)+
TWA(=w)	Parameter	.3477	-.0337	-.0177
	St. Error	(.0966)+	(.1918)	(.0099)
TRA*	Parameter	-.0137	-.0033	.0017
	St. Error	(.0064)+	(.0128)	(.0006)+
TRP*	Parameter	.5186	.3746	-.0691
	St. Error	(.0457)+	(.0907)+	(.0047)
Constant(=G)		-6.8780	-3.7378	-2.7872
\bar{R}^2		.7239	.3540	.9966
S.E.E		.5792	1.1494	.0596
F		553.74	116.48	62607.25
N		844	844	844
D.F		839	839	839

+ Significantly different from zero at the 5 percent level.

* Irrelevant for our discussion.

C.5 The Production Of Liquidity - Some Final Remarks

a. The Cross - Section Variation of Interest Rates and Service Charges

As discussed in chapter four (see sections B and F.4), the control variable in our model of the banking firm is the service charge and not the (gross) interest rate. As explained, this assumption, although not crucial for the (theoretical and empirical) results derived, subsumes the case of interest ceilings and represents our feeling that the variation in the service charge rate among banks is higher than the cross - section variation of the interest rates on time deposits, at a given point in time.

Table 5-15 presents a crude test of this hypothesis

Table 5 - 15

The Variability of Interest Rates and Service Charges

	Service Charges			Interest Rates		
	DE	DO	D	TR	TO	T
1973						
Mean	.006	.019	.007	.044	.060	.054
St. dev.	.005	.014	.005	.005	.006	.005
1975						
Mean	.006	.019	.007	.048	.064	.067
St. dev.	.006	.006	.006	.005	.005	.004
1977						
Mean	.006	.017	.017	.048	.062	.056
St. dev.	.007	.015	.006	.004	.005	.004

From the above table it can be seen that for almost

each type of demand deposits, during the three years surveyed, the standard deviation of the service charge yield is significantly higher than the standard deviation of the interest rate on the various types of time deposits. Thus, for example, in 1977 the variation in service charges paid on demand deposits is 50 percent higher than the variation of the interest rate on time deposits. This result becomes even more apparent when we consider the fact that the service charge per dollar of demand deposits is much smaller than the interest rate on time deposits. Thus we see that the standard deviation of the service charges is almost as high as the mean value, while the standard deviation of the interest rate is approximately 13 times smaller than its mean value. These findings may not constitute a solid proof of our hypothesis but at least point to the fact that service charges are an important control variable in banks' operation.

b. Average Production Costs of Liquidity and Deposits.

Our producer approach towards the production of liquidity (bank money) enables us to present some (average) cost figures with respect to the production of liquidity and demand and time deposits as an alternative measure for bank output. These figures, for 1973 and 1977 are presented in table 5-16.

This table indicates that when total costs of production are attributed to liquidity, as we define it, the costs per dollar produced in 1977 are 7.59 cents. If only demand and time deposit costs of production are used, the corresponding

Table 5 - 16 Banks' Average Production Costs*

(Cents per dollar produced)

	1973	1977
Demand Deposits	1.81	2.32
Time Deposits	5.87	6.03
Liquidity ¹	3.99	5.29 ³
Liquidity ²	6.41	7.59 ³

* Based on the mean values of costs and output.

1 The Lower Bound approach.

2 The Upper Bound approach.

3 Average and marginal costs.

figure is 5.29 cents. It has to be noted that, here, the dollar dimension of liquidity becomes a dimension of the physical quantity produced and should not be confused with the bank's total revenues. This point is illustrated in figure 5-1.

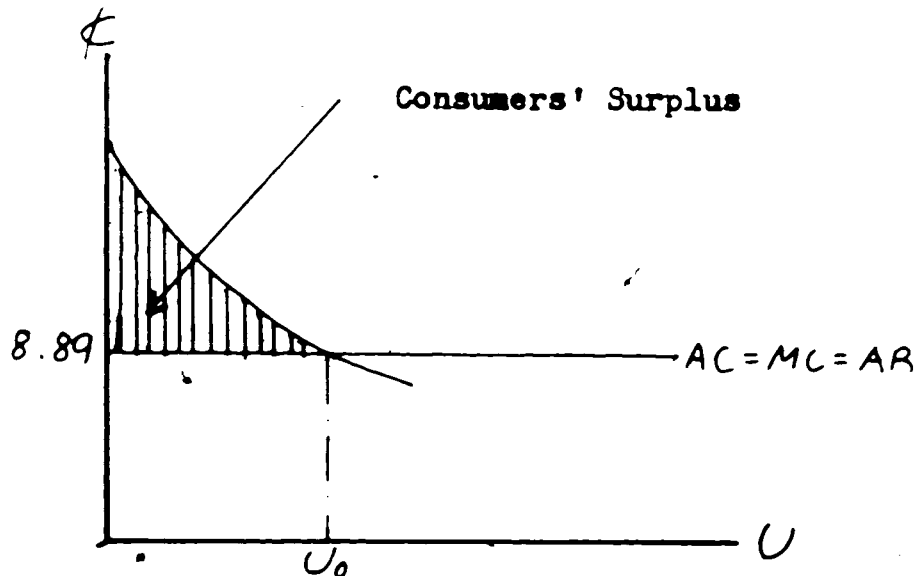


Figure 5 - 1 Liquidity production - 1977

The above described banking firm produced U_0 units (dollars) of liquidity, costs of production (including profits) were 8.89 cents per unit produced¹⁶, and total revenues were $8.89U_0$.

When we use demand or time deposits as a proxy for bank output, the average costs of production are approximately 2 and 6 cents respectively.

From the discussion presented in chapter three (see sections C and D) it should be clear that we are not interested in incorporating banks' costs of production into the most frequently used money supply equation (the money stock equals the multiplier times the monetary base). We are rather incorporating the impact of bank costs on the supply of liquidity through their effect on the net interest rates paid by banks¹⁷ and thus the level of liquidity embodied in the various bank liabilities. It is our view that bank costs are significant enough not to be disregarded in the analysis of banks as a vehicle for the implementation of monetary policy as well as in any micro model of the banking firm.

16

The profit margin in 1977, as implied by the mean values of costs and revenues, was 17.14 percent. Thus the average "selling price" of a unit of liquidity was $7.59 \times 1.1714 = 8.89$ cents.

17

See equations (3.1), (5.2a), and (5.2b). The interest rate which appears there is a function, among other things, of bank costs and thus we get the relationship: costs \longrightarrow interest rate \longrightarrow liquidity.

D. Summary

This cost study of almost 3000 U.S. banks¹⁸ in the years 1973, 1975 and 1977, is aimed, first and foremost, at reflecting the ideas put forward in our theoretical model. We challenge some of the conventional definitions and behavioral assumptions used to describe the operation of the banking firm. Thus the results reported here should be examined in light of the alternative structure suggested.

D.1 Main Results and Policy Implications

(a) Our approach towards the definition of bank output can be used to find the "liquidity" equivalent of changes in bank liabilities and determine the amount by which the monetary base should be changed so as to maintain a given overall level of liquidity¹⁹. On the assumption that this level of liquidity is consistent with stable prices, such an approach will ensure the continuation of this stability. However, as the liquidity function is found to be unstable (at least in the short run, see table 5-5), a frequent revision of the parameters used is needed in order to make the above policy efficient. Such an approach adds a practical dimension to the long discussed issue of the definition of money.

¹⁸

For a discussion whether these (FCA) banks can represent the whole population see Heggstad and Mingo (1978).

¹⁹

For this point see also Chetty (1969).

(b) We do not find any conclusive evidence for the existence of (consistent) economies of scale in bank operations. This holds whether liquidity is used as a measure of bank output or whether bank deposits serve this function. Thus it is our view that banks' supervisory agencies should encourage more intense competition in the banking sector²⁰. The existence of administrative barriers to entry may result in the operation of banks which are "too big" and thus are characterized by higher costs. The only benefits of these barriers seem to be in terms of 'supervisory convenience'.

(c) The high degree of government intervention in the operation of banks (one aspect of which is the above mentioned barriers to entry) is suspected of causing resource misallocation in this industry. It is shown that banks may employ too much labor relative to capital, a result which is partially supported by other studies.

(d) Banks are found to have significant economies of scale in the employment of labor as well as in the employment of capital (computer technology). Thus it is hard to determine whether future developments in this industry will involve further use of a labor - saving technology such as Electronic Fund Transfer Systems, or whether the gains from such a trend

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Bell and Murphy (1968, p.244) reach a different conclusion: "It was demonstrated that the existence of economies of scale could present a dilemma to the regulatory agency. That is, the encouragement of both vigorous competition and low cost banking services might not always be mutually consistent."

are close to being fully exploited.

(e) Finally our study raises some doubts with respect to the validity of using the Cobb - Douglas production function in order to describe the production process of banks.

D.2 Some Suggestions For Further Research

(a) The fact that decreasing returns to scale in the employment of materials was found in 1977 (in contrast to the structure of the cost function in 1975) calls for some further investigation. More explicitly: as interest payments (as well as other costs) are included in 'material expenditures', one should test the hypothesis that there were significant changes in the elasticity of the demand function(s) facing the banking firm, between 1975 and 1977. Such a change in the monopolistic power of banks would be reflected in their service charges and thus, in the net interest rate they pay.

(b) With respect to the suggested inefficiency of banks (the employment of 'too much' labor), some further research must be done in order to establish whether there exists a well defined relationship between that inefficiency and a specific form of government intervention. It is also possible that this inefficiency reflects a less than full adjustment to recent technological changes in banking and will thus be eliminated as time passes.

(c) Some further research is also needed to determine whether a linear and homogeneous production function can or

cannot describe the production process of banks.

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