The Influence of Current and Potential Competition on a Commercial Bank's Operating Efficiency

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The Influence of Current and Potential Competition on a Commercial Bank's Operating Efficiency

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THE INFLUENCE OF CURRENT AND POTENTIAL COMPETITION ON A COMMERCIAL BANK'S OPERATING EFFICIENCY

by

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TABLE OF CONTENTS

Page

CHAPTER

LIST OF TABLES

LIST OF CHARTS

CHAPTER I

INTRODUCTION

This study analyzes the relationship between a bank's market structure and its level of operating efficiency. The elements of market structure considered are the degree of current competition and the ease of entry of potential competitors.

The methodology employed consists of two parts. First, a managerial efficiency index is constructed by a "frontier" statistical technique. The index is equal to the difference in cost per unit of output between a particular bank and the most efficient bank of the same size and organizational form.[1] Second, the influence of market structure variables on the efficiency index is tested by multiple regression analysis.

The major goal of this study is to provide bank regulators with evidence concerning the bank market structure most conducive to efficient production. It is not meant to imply what bank structure is optimal for promoting the social welfare. Although different regulators might denote different desiderata of this optimal structure, probably most regulators would accept the following five.[2]

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[1]A bank's organizational form refers to whether it operates as a unit, a branch system or a holding company subsidiary.

[2]The first three goals are defined explicitly and the fourth alluded to in Stuart I. Greenbaum's "Competition and Efficiency in the Banking System - Empirical Research and Its Policy Implications," Journal of Political Economy, LXXV (August, 1967, Part II), 461-81.

1. Efficient production of bank output.
2. Competitive pricing of bank inputs and outputs.
3. Responsiveness to the implementation of technological innovations in production techniques.
4. Rapid transmission of monetary policy influences through the economy.
5. Promotion of public confidence in the stability of the banking system.

If one bank structure leads to the attainment of all these goals the bank regulator's job would be relatively simple, and the results of this study could be taken to have direct implications for the optimal bank structure. However, it is much more likely that bank structures consistent with each of these goals are not consistent with each other. For example, attainment of the most efficient banking system might require a few large banks that can take advantage of economies of scale while, conversely, the best structure for attaining competitive price performance might be a large number of small banks.

Nonetheless, whether or not the ultimate goals of bank regulatory policy are consistent, if bank regulators are to make decisions that lead to the attainment of their goals, they must have complete and accurate information on the influence which different market structures have on these goals. Of course, if regulators are unaware or unconcerned with such information, then the provision of it is not so important, except from an academic point of view. However, this is not the case. Bank regulators are aware of such information and do use it for formulating policy. For example, in a recent report by a bank regulatory agency (the Board of Governors of the Federal Reserve System) the existence of economies of scale is used to justify the prohibition of interest payments on demand deposits.

> There appear to be significant economies of scale in banking, at least over some range, so that it would be difficult for relatively small banks to compete for funds effectively with large banks.[3]

From this statement it is not clear whether the existence of economies of scale was the basis for the regulatory decision, or was used "ex post" to justify a decision which was already made. But this distinction is unimportant, for the significant point is that if regulators use economic studies, it is the economist's responsibility to provide the regulator with as much accurate information as possible.

Current evidence available to bank regulators on what bank structure leads to efficient production is scanty. The studies which have been done in this field concentrated solely on the relationship between a bank's level of efficiency and that bank's size and choice of organizational form.[4] These particular variables were chosen for

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[3]Report to the Presidential Commission on Financial Structure and Regulation, Report of the Staff of the Board of Governors of the Federal Reserve System, November 6, 1970, p. I-1.

[4]The most significant of these studies are as follows: David A. Alhadeff, Monopoly and Competition in Banking (Berkley: University of California Press, 1954); Lyle E. Gramley, A Study of Scale Economies in Commercial Banking (Kansas City, Mo.: Federal Reserve Bank of Kansas City, 1962); George Benston, "Branch Banking and Economies of Scale," The Journal of Finance, XX (May, 1965), pp. 312-331; Paul M. Horvitz, "Economies of Scale in Banking in Commission on Money and Credit," Private Financial Institutions (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1963), pp. 1-54; Irving Schweiger and John S. McGee, "Chicago Banking," The Journal of Business, XXXIV (July, 1961), pp. 203-366; Stuart Greenbaum, "Banking Structure and Costs: A Statistical Study of the Costs-Output Relationship in Commercial Banking" (unpublished Ph.D. dissertation, John Hopkins University, Baltimore, 1964); Frederick W. Bell and Neil B. Murphy, Costs in Commercial Banking: A Quantitative Analysis of Bank Behavior and Its Relation to Bank Regulation. Research Report No. 41 to the Federal Reserve Bank of Boston, April 1968. (Boston: Federal Reserve Bank of Boston, 1968); Stuart A. Schweitzer, "Costs and

scrutiny for two reasons. First, they were considered, to a large extent, to be under the control of bank regulatory agencies. Bank regulators must approve or disapprove any bank's choice of organizational form, and can control size by adjusting the number of banks operating in any given market. Second, these variables were looked on as representing different techniques of bank production, and thus were viewed as arguments of banking's production function, which theoretically defines maximum efficiency.

Although it is recognized that how a bank's efficiency is related to its size and organizational form is important to regulators for making effective decisions and continued research on these topics is desirable, this study raises a new question. Do the market structural variables of current competition and potential competition affect a bank's level of operating efficiency? Studying these particular variables is also important for two reasons. First, they are also variables which regulatory authorities can adjust to attain desired banking goals. Second, these variables may be empirically related to the production function arguments already discussed, and thus may have biased the results of these past studies. For example, it is quite possible that, in general, small banks face less competition than large banks, and that the lower degree of competition induces small banks to operate inefficiently. If this were the case, studies which infer "economies of scale" would be incorrect and policy based on this premise would be misguided.

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[4](Continued) Production in Banking: The Case of the Ninth Federal Reserve District" (unpublished dissertation, University of Minnesota, Minneapolis, August 1970).

The remainder of this paper is divided into six chapters. Chapter II develops a theoretical model of a bank which relates the current and potential competition a bank faces to how efficiently the bank's management chooses to operate. Chapter III and Chapter IV define and formulate procedures for measuring the key concepts necessary for testing the hypotheses formulated in Chapter II. The concepts discussed in Chapter III are efficiency, bank output, and bank costs. Chapter IV concentrates on the theoretical concepts of current competition and potential competition. Chapter V defines and measures certain environmental and other constraints which are outside the control of the bank management and set a limit to how efficiently a bank can be operated. Examples of such constraints are factor prices and input quality. Chapter VI describes the sample of banks used to test the hypotheses formulated in Chapter II, and gives the results of those tests. Chapter VII summarizes the paper, and presents implications which the results of the tests in Chapter VI have for bank regulatory policy.

CHAPTER II

THEORETICAL RELATIONSHIP BETWEEN A BANK'S MARKET STRUCTURE AND ITS OPERATING EFFICIENCY

Current Competition

Previous studies of banks' operating costs accepted, explicitly or implicitly, the classical microeconomic assumption that a firm's management minimizes the cost of producing any given level of output in an effort to maximize the owners' (or stockholders) net wealth. This assumption was crucial for it allowed researchers to concentrate solely on how efficiency was related to size and organizational form and disregard the possibility that efficiency might be related to management choice.

In recent years, however, the classical theory of the firm has come under increasing attack as being an inappropriate model for explaining the internal behavior of a modern firm. The criticism has taken two forms:

> First, the motivational and cognitive assumptions of the theory appear unrealistic. Profit maximization, it is commonly alledged, is either only one among many goals of business firms or not a goal at all.
>
> Second, the "firm" of the theory of the firm has few of the characteristics we have come to identify with actual business firms. It has no complex organization, no problems

> of control, no standard operating procedures, no budget, no controller, no aspiring "middle" management.[1]

Concurrent with the criticism of the classical model have come suggestions for and the development of many alternative models of the firm. For example, as early as 1952 Papandreau suggested that profit maximization was an unnecessary assumption of the theory of the firm, and a more fruitful theory would employ a general preference function.[2] More recently others such as Baumol,[3] and Margolis[4] have also developed theories of the firm in which profit maximization was not the sole goal of management. Baumol's model maintained that managements' goal was maximizing sales revenue and some minimum level of profits was a constraint on their behavior; along the same lines, Margolis' model replaced the goal of profit maximization with the goal of making satisfactory profits. He defined a level of profits as satisfactory:

> . . .if it earns the firm a return at least equal to its aspiration level . . . which might be considered pathological from the perspective of the

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[1]R. M. Cyert and J. G. March, A Behavioral Theory of the Firm (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1963), p. 8.

[2]A. G. Papandreau, "Some Basic Problems in the Theory of the Firm," A Survey of Contemporary Economics, ed. B. F. Haley (Homewood, Illinois: Richard D. Irwin, 1952).

[3]William J. Baumol, Business Behavior, Value and Growth (New York: Macmillan, 1959).

[4]Julius Margolis, "The Analysis of the Firm: Rationalism, Conventionalism, and Behaviorism," Journal of Business, XXXI, (July, 1958), pp. 187-200.

> traditional model. For example, the entrepreneurs may be satisfied with profits which enable him to maintain a specific level of living while being his own boss.[5]

Rather than describe all the different alternative models which have been suggested to replace the classical model, a simplified version of a model developed by O. E. Williamson will be presented. This model has two desirable characteristics. First, it is a fair representation of the structure characterizing this whole class of models. Second, it was developed, in particular, to explain the behavior of firms in the same industry which operate in different market environments, which happens to be a good description of the commercial banking industry today. Since some banks have no other banks close enough to be considered as alternative sources of bank services (or competitors), while others are located in markets with numerous other banks and other financial institutions offering substitute services, this model may be very helpful in explaining the internal behavior of commercial banks.[6]

> More fundamental, perhaps, have been criticisms that challenge the propriety of treating profit maximization as being the entire objective of the firm without regard for the conditions of competition in which the firm operates.

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[5]Margolis, p. 190.

[6]This study is not the first to recognize the need to view bank efficiency in terms of a behavioral model. Stuart A. Schweitzer commented in his previously noted dissertation:

> . . .it is probably true that bankers maximize expected utility, and that expected profit is just one argument entering into their utility function.

> Thus, whereas the assumption of profit maximization may lead to accurate predictions of behavior where competition is vigorous, it is not clear that this assumption should be carried over uncritically to firms for which the conditions of competition are weak.[7]

The basic framework of Williamson's model is that managements' goal is to maximize a personal utility function subject to the constraints imposed by other forces operating in the firm. The specific assumptions of the model are as follows:

1. The firm is treated as a coalition (managers, workers, stockholders, suppliers, customers) whose members have conflicting demands that must be reconciled if the firm is to survive.

2. Where survival of the firm is not a current concern, management is assumed to be the chief member of the coalition. The demands of other members (for wages, profits, products, and so forth) are taken as given, and the operation of the firm is left to the discretion of the management.

3. The management's preference function has as its principal arguments:[8]

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[7]O. E. Williamson, "A Model of Rational Behavior," A Behavioral Theory of the Firm, eds. R. M. Cyert and J. G. March (Englewood Cliffs, N.J.: Prentice-Hall 1963), p. 238.

[8]These particular utility function arguments are not the only ones which could have been used, but I do think these three can be reasonably interpreted to encompass most management behavior. One possible type of management behavior that might not fit into these three utility arguments is what Harvey Leibenstein in his article, "Allocation Efficiency vs. X-Efficiency" in the June 1966, American Economic Review, described as the desire not to spend the time or energy to be a good manager.

> In situations where competitive pressure is light, many people will trade

a. staff (S)

b. discretionary spending for investment (I_D)

c. management slack absorbed as cost (MS)

A brief description of each of these utility arguments will help clarify the difference between this type of model of the firm and the classical one. The staff component represents a manager's desire to have people responsible to him in the firm's organization over and above what is necessary for the good of the company as a whole. It can be interpreted to include management salaries, since it has been demonstrated that management can obtain both of them simultaneously.

> A perceptive management can obtain its salary objectives indirectly (and less ostentatiously) by building pressure from below through staffing rather than by operating on the salary goal directly. Moreover, managers may find staff attractive for reasons other than the relation it bears to salaries: staff is a source of job security, prestige and flexibility as well.[9]

Discretionary spending for investment represents the difference between reported profits and minimum profits demanded by stockholders. It reflects investment decisions of the firm that are made less on the basis of economic necessity than on the successful influence of managers in diverting resources to their area. An example of one type of discretionary investment might be money spent on research projects not

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[8](Continued) the disutility of greater efforts, of search, and the control of other peoples' activities for the utility of feeling less pressures and of better interpersonal relations.

[9]Williamson, p. 242.

directly related to the firms current production. Another example of such investment, more closely related to banking, might be a bank's management deciding to operate in such nonbanking fields as travel agents or equipment leasing.

Managerial expenses absorbed as costs include such items as enlarged expense accounts or office improvements. Alchian and Kessel point out very perceptively another type of managerial behavior that would fall in this category.

> Employment policies will also reflect the maximization of utility. Assume that an employer prefers clean-cut, friendly, sociable employees. If two available employees are equally productive, but only one is white, native born, and Christian, and attractive, the other will not get the job . . . What this means is that the wages paid must be high enough to attract the "right" kind of employees.[10]

<u>The Model</u>

The following three identities provide the mathematical framework of Williamson's model.

1a) $\pi_A = \pi^* - S$

1b) $\pi_R = \pi_A - MS$

1c) $I_D = \pi_R - \pi_o$

where:

π^* = Profits that the strictly profit maximizing firm would obtain by equating marginal revenue and marginal cost.

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[10]A. A. Alchian and R. A. Kessel, "Competition Monopoly and the Pursuit of Money," <u>Aspects of Labor Economics</u> (Princeton: Princeton University Press, 1962), p. 165.

π_A = Actual profits earned by the firm whose objective function is augmented to include a staff component.

π_R = Profits that firms report and are actual profits reduced by the amount of management slack absorbed as cost.

π_o = Minimum profits negotiated by other members of the coalition that are just sufficient to satisfy their demands. Investments made out of necessary economic considerations are included.

S = Management slack absorbed as staffs.

MS = Management slack absorbed as cost.

To derive rigorous implications from his model Williamson also posited the following definitions and behavioral relationship.

R = revenue = $P \cdot X$

$P = P(X, S; e); \frac{\partial P}{\partial X} < 0; \frac{\partial P}{\partial S} \geq 0; \frac{\partial P}{\partial \varepsilon} > 0$

X = output

S = "staff" (in money terms). This term is essential because in this model the staff and production decisions, contrary to the standard theory of the firm are no longer made symmetrically.[11]

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[11]Williamson points out that the argument for neglecting the staff term in the standard treatment of the theory of the firm is

C = production cost = $C(X)$

ρ = the fraction of actual profits reported, (and $(1 - \rho)$ is the fraction of the actual profits absorbed as cost)

ε = the condition of the environment, a demand parameter. For use in this paper an increase in ε will mean a decrease in the competitive environment, and an increase in π^* (potential profits) which a bank could earn.

Williamson also assumed second order (stability) conditions are satisfied by assuming both well behaved cost and revenue functions and diminishing marginal utility characteristics in the utility function.

Now if U represents the utility function, management's objective becomes:

maximize $\quad U = U(S, \pi_A - \pi_R, \pi_R - \pi_0)$

subject to $\quad$ (i) $\pi_R \geq \pi_0$

(ii) $0 \leq \rho \leq 1$

where $MS = \pi_A - \pi_R$

$\pi_A = R - C - S$

$\pi_R = \rho\pi_A$

$I_D = \pi_R - (\pi_0)$

It so happens that both constraints are redundant, and therefore, can be ignored in the subsequent analysis. Thus the problem becomes one

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[11](Continued) that the manufacturing and staff decisions are symmetrical. And indeed they are -- for the standard theory. See G. J. Stigler, The Theory of Price (New York: Macmillan, 1949), p. 251.

of finding an unconstrained maximum.[12] The first constraint redundancy is due to the fact that it takes exactly the same form as the last term in the utility function. Thus, whenever the constraint becomes binding (i.e., satisfied as an equality), the third term in the utility function goes to zero and, with diminishing marginal utility characteristics (and assuming no corner solutions), the marginal utility becomes infinite. Given this property, the firm will so long as it is possible, choose values for its decision variables that maintain positive values for I_D (i.e., satisfy the constraint as an inequality). Thus, as the condition of the environment becomes increasingly more severe, the firm will converge to profit-maximizing behavior independent of the constraint. The second constraint is redundant because first-order conditions require that the second and third terms in the utility function bear positive proportional relationships to one another.

Thus, the problem is to

maximize $U = U[S,\ (1-\rho)(R-C-S),\ \rho(R-C-S)-\pi_0]$

The following first-order results are obtained by taking partial derivatives of U with respect to X, S, and ρ.[13]

$$\frac{\partial R}{\partial X} = \frac{\partial C}{\partial X} \qquad (1)$$

$$\frac{\partial R}{\partial S} = \frac{-U_1 + U_2(1-\rho) + U_3\rho}{U_2(1-\rho) + U_3\rho} \qquad (2)$$

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[12] The analysis, however, is not dependent on the fact that both constraints are redundant. Had this not been true, the resulting inequality-constrained maximization problem could have been handled by making use of the Kuhn-Tucker theorem. All of the results would be preserved as long as the constraints were not binding.

[13] In these expressions, U_1 is the first partial of the utility function with respect to S, U_2 is the first partial with respect to $\pi_A - \pi_R$, and U_3 is the first partial with respect to I_D.

$$U_2 = U_3 \qquad (3)$$

From equation (3) it follows that ρ will be chosen so as to preserve a positive proportional relationship between the amounts of management slack absorbed as cost and discretionary spending on investments. Thus, only in the limiting case when the environment is so severe as to drive both these slack type activities to zero will ρ be chosen equal to one. Otherwise, values less than unity will be selected. Substituting Eq. (3) into Eq. (2) yields

$$\frac{\partial R}{\partial S} = \frac{-U_1 + U_2}{U_2}$$

The corresponding profit-maximizing relationships are

$$\frac{\partial R}{\partial X} = \frac{\partial C}{\partial X}, \text{ and } \frac{\partial R}{\partial S} = 1$$

and ρ chosen identically equal to unity. Hence, only for the production decision do we obtain results for the behavioral model that are consistent with cost-minimizing or profit maximization behavior. That is, whereas the cost-minimizing firm employs staff at the level where the marginal value product equals the marginal cost of the factor (i.e., $\partial R/\partial S = 1$), the behavioral firm ordinarily employs staff in the region where the marginal value product is less than the marginal cost (i.e., $\partial M/\partial S<1$).

The fact that the behavioral model shows the production decision being made along lines consistent with profit maximization while the staff decision is not warrants further examintion. This result follows directly from the assumption that staff is valued by the managers for reasons apart from productivity whereas (by implication) the only satisfaction that management derives from employing labor is that associated with the productive value of this input. By introducing a staff term into the utility function, this result follows deductively.

Williamson proceeds further in his analysis by demonstrating what effect a change in ε (the competitive environment) would have on the management decisions of $\underline{S}$ and $\underline{\rho}$ (i.e., the staff and the per cent of actual profits reported). He demonstrates that an increase in ε will cause staff to increase and the fraction of profits reported (ρ) to diminish.

> Thus the management slack absorbed as cost will increase not only absolutely but also relatively as the [firm's competitive environment improves] . . . The behavioral model therefore predicts that expenditures for travel, expense accounts, office improvements, and so forth will be very much a function of business conditions. Implicitly, the profit-maximizing model denies that such a relationship should exist.[14]

<u>Hypothesis</u> An hypothesis to be tested in this paper is that a positive relationship exists between the degree of competition in a bank's market and that banks level of operating efficiency. That is, a bank is expected to operate more efficiently the more competitive the market in which it operates.

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[14]Williamson, p. 249.

Potential Competition

The relationship between the ease of entry of potential banks and the performance of existing banks in that market has been touched upon in some of the bank performance literature. In his 1954 study, Alhadeff made the following comment about the price behavior of banks:

> The reason such a (bank) does not try beyond limits to increase his profits is that . . . high profits would attract new bankers into the town. A new entry would mean that the first banker would have to share his demand curve, and so his profit prospects in the long-run are not thereby enhanced.[15]

Similarly, in a more recent discussion of banking structure and behavior, Bernard Shull and Paul Horvitz discuss the possible influence which barriers to entry might have on price behavior:

> In assessing the competitiveness of market structure in banking, we must consider not only actual competition among existing banks, but also potential competition from new entrants . . . Fear of new entry can lead existing banks to charge less than their market power would allow.[16]

Furthermore in another study Shull and Horvitz also mention the possibility of an influence on operating efficiency.

> The profits of a bank or a group of banks that is not faced with

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[15] David A. Alhadeff, Monopoly and Competition in Banking (Berkeley: University of California Press, 1954), p. 18

[16] Bernard Shull and Paul Horvitz, "Branch Banking and the Structure of Competition," National Banking Review, II, (March, 1964), p. 303.

> effective competition may not appear abnormally high, even over the long run, if management is deficient, or has decided to reap some of the benefits of its market position in the form of a "quiet life."[17]

Although Shull and Horvitz recognized this latter line of influence they never empirically tested it.[18] In fact, this is the only mention of the relationship between entry barriers and operational efficiency in the banking literature; aside from this, the literature has concentrated solely on the discussion and testing of the influence that entry barriers have on performance in terms of price and output behavior.

It is not surprising that researchers have not analyzed the influence of entry barriers on operating efficiency. First, their studies embodied an acceptance of the classical theory of the firm, which as was mentioned before, assumes management's sole concern is the maximization of stockholder's net wealth, and does not imply efficiency changes with changes in market conditions.[19] Second, there was a lack of

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[17] Bernard Shull and Paul Horvitz, "The Impact of Branch Banking on Performance," National Banking Review, II, (December, 1964), p. 143.

[18] It is interesting to note that although Shull and Horvitz recognized the possible relationship between entry barriers and operating efficiency, it did not enter their latter discussion of economies of scale and organizational form. In this discussion, they criticize studies of bank cost for a variety of reasons, but their criticisms did not include the fact that these studies did not account for possible differences in entry barriers.

[19] This is not absolutely true. W. S. Commanor and T. A. Wilson in "Advertising Market Structure and Performance," in Review of Economics and Statistics, November 1967 describe one type of behavior in which a firm behaving according to the classical tradition might make changes in response to entry barriers that would effect its operating efficiency. They hypothesize that low barriers to entry might cause firms to increase their advertising expenditures in order to differentiate their products and by doing so raise the effective barriers to entry.

understanding of the particular form which barriers to entry take in the banking industry.

The most important barrier to entry in banking is regulatory policy and procedure.[20] All bank entry is regulated by some government agency whether it is in the form of a totally new bank or just a branch of an already existing bank. When barriers to entry are "natural" (for example, economies of scale) the rational behavior of a firm is to lower its prices to the forestalling level, as Bain suggests,[21] to discourage new entry into its market. It would not be reasonable for a bank to try to discourage future entrepreneurs by hiding profits in excessive costs. In fact, this would be completely irrational, for it would be giving up the firm's natural advantage of low cost, and if there were enough profits to keep the existing firm's stockholders satisfied, there would be enough for others. However, hiding profits in excessive costs is reasonable behavior for a firm in an industry in which the entry barriers are artifically established by a regulatory authority. In the following paragraph, Alchian and Kessel describe the atmosphere in which firms given market power by government regulation (they call such firms monopolies) operate.

> Stigler and others have pointed out that monopolies. . .are creatures of the state in a sense which is

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[20]Even if natural barriers to entry do exist, regulatory barriers are so predominant that we can for practical purposes characterize this whole dimension of market structure as "regulatory barriers."

[21]Joe S. Bain, Industrial Organization (New York: John Wiley and Sons, 1968), p. 253.

> not true of competitive enterprises. Monopolies typically are protected against the hazards of competition, not simply by their ability to compete, but by the state's policy of not permitting competitors to enter monopolized markets.... Monopolies so created are beholden to the state for their existence - the state giveth, the state taketh away. Accordingly, they constrain their business policies by satisfying the requirements that they shall do what is necessary to maintain the monopoly status.... The cardinal sin of a monopolist, to repeat, is to be too profitable.[22]

The reason that such firms will lower profits by raising costs rather than lowering price follows partially from the limited perspective which regulatory agencies have, and partially from management's desire to maximize personal preferences.

> But (managers) do have relatively strong incentives to use the resources of the (protected firm) for their own personal interest, but in ways that will count as company costs. Nor does the public regulatory body readily detect such activities, because its incentives to do so are even weaker than those of stockholders. The regulatory body's survival function is the elimination of publicly detectable inefficiencies. Furthermore, (regulatory agencies) have a poor criteria of efficiency because it lacks competitive standards....

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[22]Alchian and Kessel, pp. 159-163.

> Management will be rational if it uses company funds to hire pleasant and congenial employees...office furniture and equipment will be of higher quality. Fringe benefits will be greater and working conditions more pleasant.... They cost more, of course, but how does the regulatory agency decide that these are unjustifiable expenditures.[23]

The concern for non-excessive profits and a lack of concern for internal efficiency is particularly true of bank regulatory agencies. Historically there has always been a populist distaste for the powerful banker in this country, and the visible evidence of such power, large profits.

> From the beginning, a general behavior for banking on the one hand had been paralleled on the other by a powerful political opposition to it as, monopolistic, undemocratic, and hostile to farms. Abuses fostered this opposition to such an extent that in several western states banking was outlawed.[24]

The fact that such a mood still exists today is evident in the popular dialogue of Representative Wright Patman who is continually condemning the power of today's banks. For example, in a recent

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[23]Alchian and Kessel, p. 167.

[24]Bray Hammond," "Banking Before the Civil War" in Banking and Monetary Studies, edited by Deane Carson (Homewood, Illinois, Richard D. Irwin, Inc., 1963), p. 9.

speech he referred to the business practices of large banks as "predatory" and referred to them as the "strong armed tactics of the Wall Street Financial Complexes."[25]

Regulatory authorities are not immune to such popular sentiment. Also, although current banking legislation states as one goal of bank regulatory decisions "the fostering of competition," it also states that the agency should consider the conveniences and needs of the public. Currently, the latter criteria seems to have the most influence on regulators, and seems to have been interpreted as meaning the needs of the community can be served best by insuring the survival of all existing banks.[26] This can be seen clearly in actual statements by bank regulators.

> The function of limits to entry, then is not to set the number of banks at the optimum, but to prevent bank failure, through protecting the inefficient.... A Comptroller of the Currency was

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[25] New York Times, June 4, 1971, Sec. III, p. 21, Col. 3.

[26] This definition follows from how bank regulators view a bank failure. As Paul Horvitz points out in The Role of Mergers in Fostering a Viable Banking System in a New York Institute Paper, 1966.

> The problem of avoiding failure is not so serious in other industries, where failure is part of the game, as it is in banking when failures are generally considered a community disaster.... The banking agencies are well aware of the controversy and unpleasantness that results when a bank fails.

Moreover, causal observation of the national news coverage reveals the calamitious nature of such an incident to the public.

> quoted as saying, 'We believe thoroughly in competition in the field of banking and endeavor to provide it whenever possible <u>without jeapordizing existing</u> institutions;' and a state banking supervisor was quoted similarly as saying 'Sound and ethical competition...is a healthy thing, of course, not to the extent of hazard to existing banking institutions.'[27]

<u>The Model</u>

Williamson's model can also be used to rigorously derive implications on how differing degrees of the threat of potential entry influence a bank's operating efficiency if the following two assumptions are made.

1. Bank regulators desire to restrict bank profits to less than or equal to some fixed level denoted π_M, and they are unconcerned with bank efficiency.

2. Bank management and stockholders wish to maintain profits below π_M in order to prevent entry into their market which might be allowed by regulators if their profits were higher.

Given such assumptions, Williamson's model thus becomes:

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[27] Dale A. Taussig, "The Case for Bank Failure," <u>The Journal of Law and Economics</u>, X, (April, 1967), p. 139.

$$\text{maximize} \qquad U[S, \pi_A - \pi_R, \pi_R - \pi_0]$$

$$\text{subject to} \qquad \text{(i)} \quad \pi_R \geq \pi_0$$

$$\text{(ii)} \quad \pi_R \leq \pi_M$$

where π_M = maximum safe level of profits to report.

Since we are interested in the effect of π_M constraint it is assumed the minimum profit constraint is ineffective, but the maximum profit constraint may be encountered. When this occurs, $\pi_R = \pi_M$ and this can be handled by substituting π_M for π_R in the objective function. The problem then is reduced to

$$\text{maximize} \qquad U[S, R - C - S - \pi_M, \pi_M - \pi_0]$$

but the last term in this expression is a constant. Hence, the only terms that are relevant for maximization purposes are the staff and management slack absorbed as cost terms. Thus, the effect of encountering a safe-level profit constraint shifts the firm all the more into excessive staff expenditures and excessive managerial accommodations.[28]

<u>Hypothesis</u>

An hypothesis to be tested in this paper is that the lower the barriers to entry in a bank's market (or the lower the profit constraint) the less efficient that bank will be, and the higher the barriers to entry (or the higher the profit constraint) the more efficient that bank will be.

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[28]Williamson, p. 249.

CHAPTER III

DEFINITION AND MEASUREMENT OF EFFICIENCY, BANK OUTPUT, and BANK COSTS

Economic concepts mentioned earlier in this paper, such as "efficiency" and "current competition," have straightforward definitions in economic textbooks. However, when these concepts are applied to real life problems their meanings are far from unambiguous. Moreover, with existing data, exact measurement of many of these concepts is virtually impossible, and one has to accept approximations or proxies in empirical studies. Therefore, the purpose of this chapter and the next is to define and measure the key concepts in the hypotheses formulated in Chapter II. In addition, if a relevant literature exist on these concepts, it is presented and the definitions and measurements used in this paper are compared and contrasted to those which were used in the previous studies. The concepts discussed in this chapter are "efficiency", "output", and "costs". The concepts discussed in Chapter IV are "current competition", and "potential competition".

Efficiency

Definition of Operating Efficiency

The concept of efficiency generally refers to a comparison of the uses made of productive resources. Three broad categories can be defined: allocation, technical, and operational efficiency. Bain defines allocational efficiency as a comparison of the rate of output of an industry, or the amount of scarce productive resources used producing an industry's output - relative to the outputs produced and resources committed in other industries.[1] He defines technical efficiency as referring to a comparison between industries of the number of firms or plants that operate at optimum size.[2] That is, a more efficient industry would have a greater proportion of its total output produced in firms of optimum size (meaning lowest average cost) than a less efficient industry would have. Finally, operational efficiency refers to a comparison of the cost of resources utilized in the production of a given output between firms, plants, or managements all in the same industry.

This paper deals, for the most part, with this third concept of efficiency, and thus, a more thorough examination of its meaning is warranted. An operationally efficient firm is one that produces a given output as cheaply as technology and factor prices allow. This is illustrated in Chart 1 which assumes that firms have normally shaped isoquants, two inputs (F_1, F_2), one output (Q), and constant returns to scale. If these conditions hold the production function can be specified in the form of a unit isoquant (curve SS'). This curve represents the locus of points indicating the minimum quantities of the factors of production required to produce one unit of output with varying factor proportions. Factor requirements for higher levels of output can be determined by monotonic transformations of this function. The dots on the chart represent observations of different firms producing the same output. Given factor prices an efficient firm will

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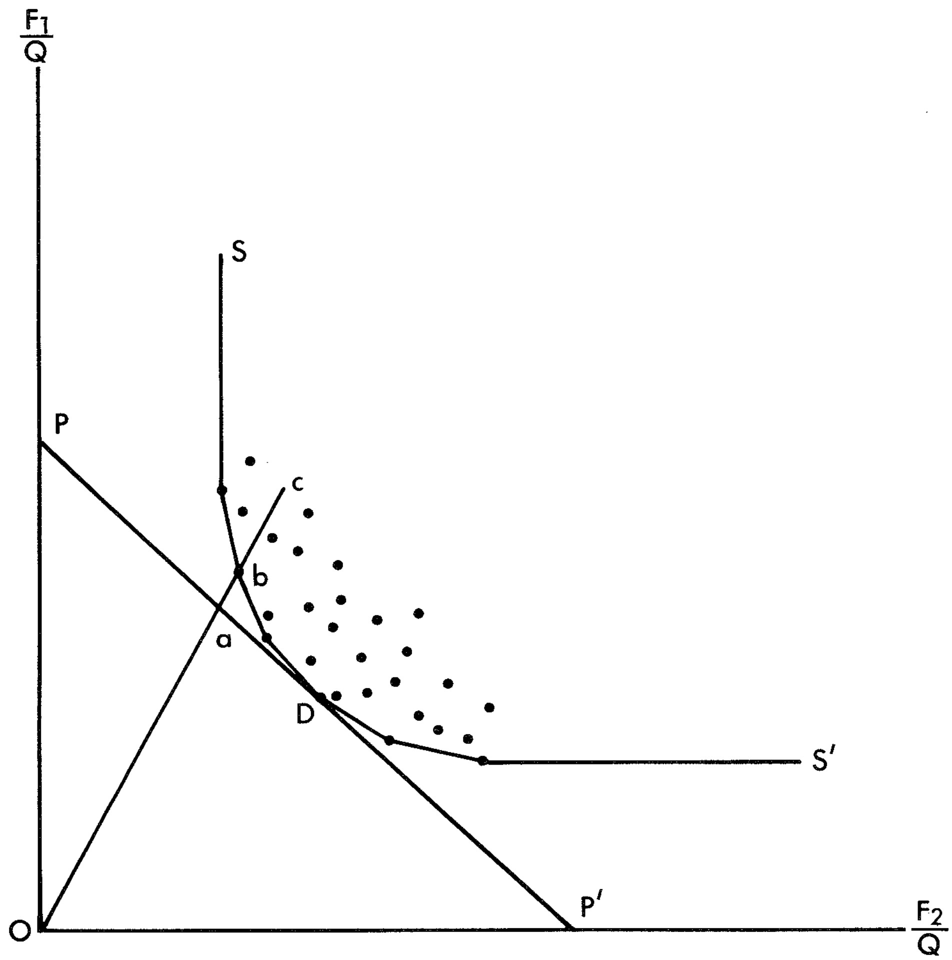
[1] Joe Bain, Industrial Organization (New York: John Wiley and Sons, 1968), p. 374.

[2] Bain, p. 385.

Chart 1

A Unit Isoquant



choose that combination of inputs which allows production at the cheapest overall cost. Assuming line PP' represents the isocost line incorporating the relative prices of inputs F_1 and F_2, then the operationally efficient firm will operate at point D, and thus, other firms are operationally inefficient relative to D. Even a firm that is efficient in that it is operating on the isoquant, like B, is operationally inefficient relative to D. Even though B's management produces as much output as is possible out of the combination of inputs, they have operated inefficiently because they did not choose that combination of inputs which would allow them to produce the same amount of output at minimum cost. The operationally efficient bank, D, can be described as producing output at the lowest possible cost allowed by current technology and factor prices.

Measurement of Efficiency

In their discussion of the "Ambiguous Notion of Efficiency," Hall and Winsten point out that the proper measurement of efficiency depends, to a large extent, on the purpose of that measurement.[3] If the problem being considered is which firm or industry is most efficient, then simply measuring and comparing average costs would be appropriate. On the other hand, if the problem is to compare the efficiency of different management teams, measurement is a bit more difficult. Hall and Winsten insisted that in cases in which the efficiency of managements is being compared extreme care must be taken. They maintained that allowance must be made for differences in physical environment facing each manager. If different managers face different constraints

[3]Lady Hall and C. B. Winsten, "The Ambiguous Notion of Efficiency," Economic Journal, LXIX, (March, 1959), pp. 71-87.

on their maximizing behavior, even though all face the same general production function, judgments about their relative performance will be invalid unless these constraints are recognized. The extent to which operational efficiency depends on management can only be determined after correction for environmental differences have been made.

The efficiency comparison being made in this paper is one between management teams. The question being asked is not whether a given size or organizational form of a bank is more efficient than another, but how do certain market structure elements influence the operating efficiency of different managements given the production constraints like size and organizational form. Although management could vary the size and organizational form of a bank over time, these variables are considered outside the control of management in this study since this is a cross-section study and incorporates data on each bank's operations at only one point in time. Therefore the procedure for measuring efficiency in this paper must allow for differences in production constraints which individual management teams might face.

The frontier technique: One procedure, which measures managerial efficiency without being sensitive to certain production constraints, was developed by M. J. Farrell.[4] The Farrell index was initially constructed to adjust for different factor prices firms might face,

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[4] M. J. Farrell, "The Measurement of Productive Efficiency," Journal of the Royal Statistical Society, CXX, Part III (1957), pp. 253-81.

and was further developed by Farrell and Fieldhouse[5] and Seitz[6] to adjust for differences in efficiency related to a firm's size.

The measures of efficiency which Farrell suggested are also indicated on Chart 1. "Productive" efficiency of observation C is defined as the ratio of the distance between the origin and point b to the distance between the origin and point c ($\frac{ob}{oc}$). An index of "productive" efficiency demonstrates the relative success of different firms in maximizing output given that each firm has the same relative proportion of inputs. Price efficiency of c is estimated by defining the lowest possible isocost line touching the efficient unit isoquant, in this case PP' and finding the ratio of the cost of point b ($\frac{oa}{ob}$). The measure of price efficiency is, therefore, determined as the ratio of the minimum cost given factor proportions utilized to the minimum cost given efficient utilization of the optimum factor proportions. The product of "productive" efficiency $\frac{ob}{oc}$ and price efficiency $\frac{oa}{ob}$ is an estimate of operating efficiency $\frac{oa}{oc}$, the ratio of minimum to actual costs. In order to desensitize this index to factor prices varing between firms, the measure of price efficiency is made independently for each firm, so a firm's management is not penalized with a low efficiency rating for being in a market with nonoptimal factor prices.[7]

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[5] M. J. Farrell and M. Fieldhouse, "Estimating Efficient Production Functions Under Increasing Returns to Scale," Journal of The Royal Statistical Society, Series A, 1962, p. 252-67.

[6] W. D. Seitz, "The Measurement of Efficiency Relative to a Frontier Production Function," American Journal of Agricultural Economics, LII (November, 1970), pp. 505-11.

[7] The assumption of constant returns to scale was made to simplify the presentation. However, if constant returns to scale was not the case, then Farrell's procedure could be revised slightly in one of two ways. Either the observations could be grouped in size categories, and isoquants

To measure this index empirically Farrell made a further suggestion. Accepting the fact that there is little knowledge of engineering production functions, which is what curve SS' theoretically is on Chart 1, he suggested that an appropriate way to estimate this frontier is to allow the most efficient actual observation to form the isoquants while maintaining some theoretical conditions such as convexity. This estimation can be easily done by linear or quadratic programming.

> Although there are many possibilities, two at once suggest themselves-a theoretical function specified by engineers and an empirical function based on the best results observed in practice. The former would be a very natural concept to choose-after all, should not a postulated standard of perfect efficiency represent the best that is theoretically attainable? Certainly it is the concept used by engineers themselves when they discuss the efficiency of a machine or a process. However, although it is a reasonable and perhaps the best concept for the efficiency of a single production process, there are considerable objections to its application to anything so complex as a typical manufacturing firm, let alone an industry.
>
> In the first place, it is very difficult to specify a theoretical efficient function for a very complex process. Even the best engineer is likely to overlook some problems, and it must be very difficult indeed to estimate, a priori, a plant's need of, say, indirect labour. Thus, the

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[7] (Continued) and indexes estimated for each group, or size could be defined as an input and put on a third axis. Both these procedures prohibit the operational efficiency indexes reflecting efficiency due to size since firms are only compared to firms of their own size.

> more complex the process, the less accurate is the theoretical function likely to be. Also, partly because of this, and partly because the more complex a process, the more scope it allows to human frailty, the theoretical function is likely to be wildly optimistic. If the measures are to be used as some sort of yardstick for judging the success of individual plants, firms, or industries, this is likely to have unfortunate psychological effects; it is far better to compare performances with the best actually achieved than with some unattainable ideal.[8]

In this study Farrell's technique is used to construct a managerial index of operational efficiency which is insensitive to differences in efficiency related to a bank's size or organizational form. However, rather than applying it to the isoquant as Farrell did, it is applied to banking's long run average cost curve. The long run average cost curve defines the minimum average cost at which firms could produce at each output level given optimum technology. Factor prices are assumed to be the same for firms of any size class, but the long run average cost curve can vary with factor prices changing if the change is due strictly to the change in the size of the firm.

The reason Farrell's "frontier technique" is applied to the long run average cost curve and not to isoquants is because applying it to the latter necessitates measuring all input services and their prices independently. Measuring input services is difficult in any industry, but is particularly so in banking due to some special characteristics of that business. For example, banks allow other banks

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[8]Farrell, p. 255.

to pay for capital and labor services by compensating balances. This practice creates an input measurement problem not only because current data sources do not identify compensating balances, but, even if the data did, this would not reveal whether it was labor or capital services that were utilized. Since application of the frontier to the long run average cost curve does not require identifying and measuring each input service separately, this procedure was chosen.

Chart 2 illustrates this approach to measuring efficiency in banking. Line II is the long run average cost curve estimated by the frontier technique. A bank's (or its management's) measure of efficiency is its vertical deviation from line II. For example, the efficiency index for observation A is AB. It is equal to the extra absolute cost per unit of output that bank A spends more than has been demonstrated necessary for a bank of that size (bank B).[9] The production function arguments of organizational form are held constant by dividing the observations into those three types of banks, and fitting a frontier long run average cost curve to each, and thus each bank's efficiency index is relative only to banks of the same size and organizational form. This is displayed in Chart 3 on the assumption that the technology of branch banking is less efficient than that of unit banking.[10]

This measure of efficiency differs from Farrell's in one other way. His measures are ratios whereas the one in this paper are absolute

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[9] This index of efficiency does not differentiate production efficiency from overall efficiency as was done in Williamson's model.

[10] The ideal way to separate branch banks would be grouping them by the number of offices each has, but if this were done there would not be enough observations in each group to interpolate a meaningful long run average cost curve. Therefore, in the empirical section the number of branches a bank has will be held constant by an independent variable in the multiple regression analysis.

Chart 2

A Frontier Long Run Average Cost
Curve and Measures of
Manigerial Efficiency

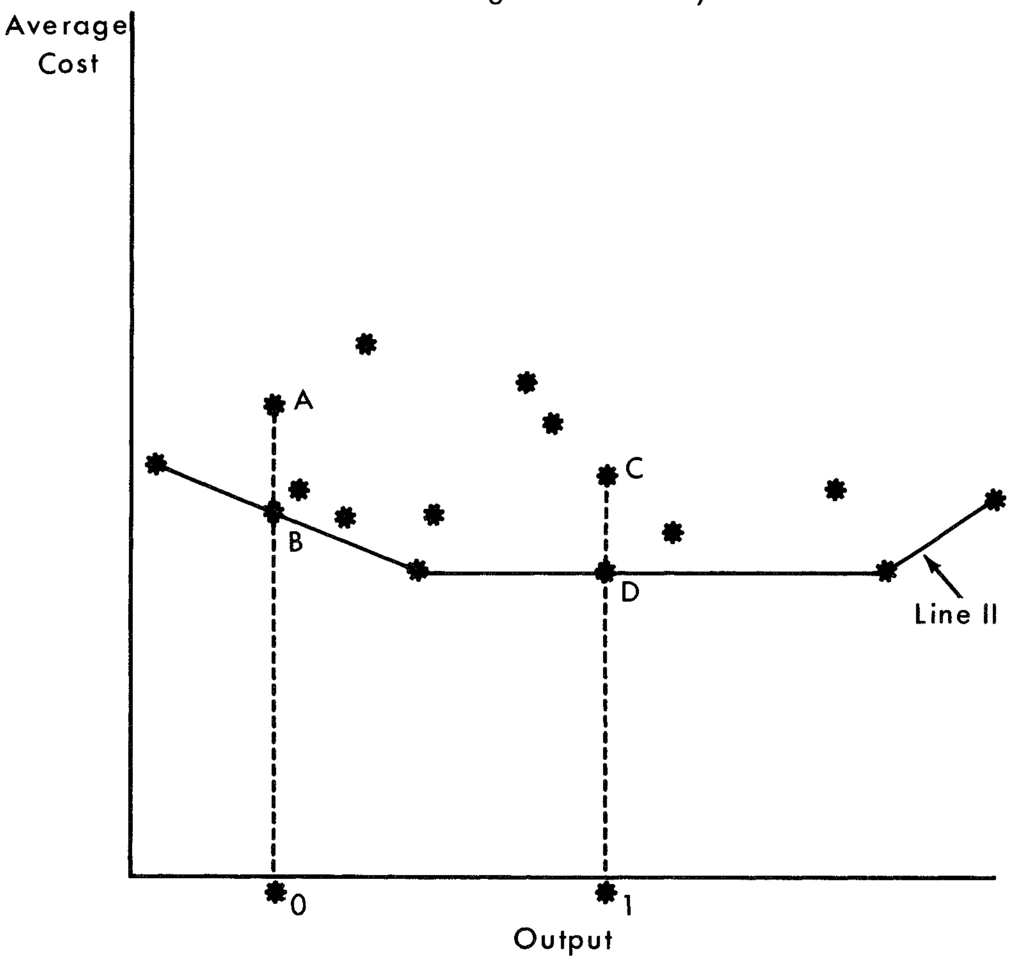
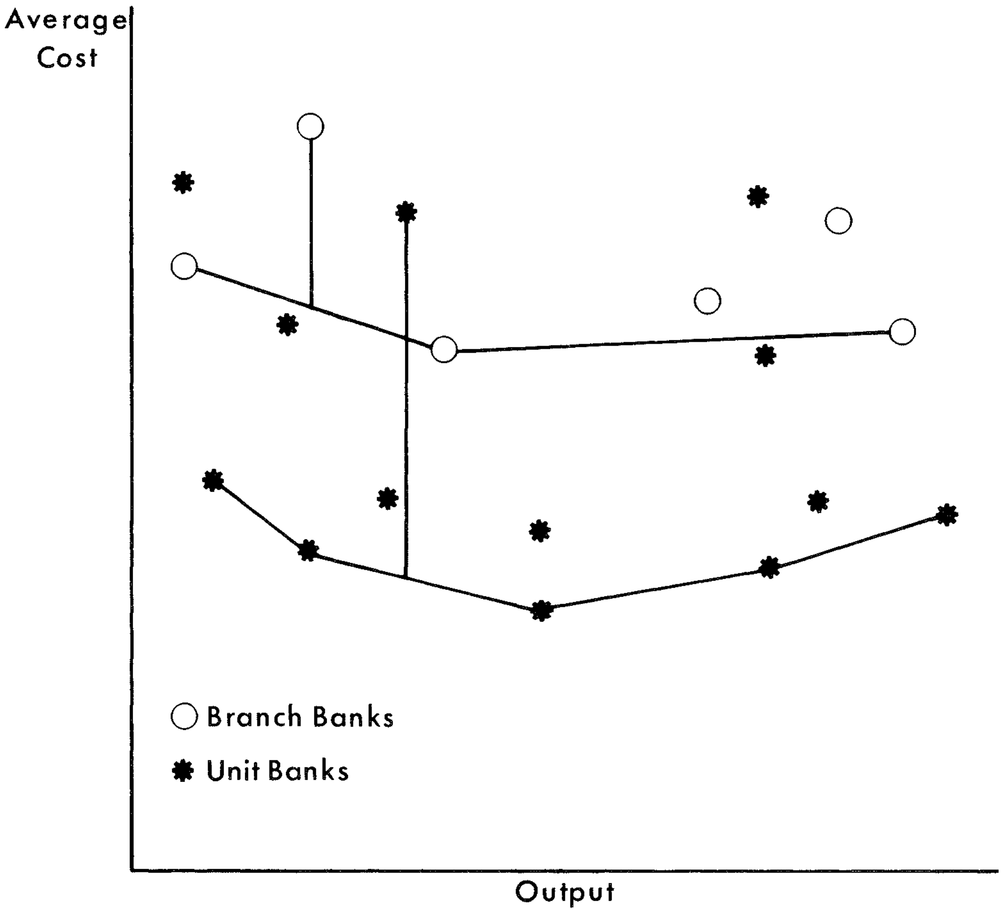


Chart 3

Frontier Long Run Average Cost Curves: Unit Banks Assumed More Efficient than Branch Banks



deviations. The disadvantage of ratios is that if size or organizational form do affect efficiency then using a ratio would bias the managerial efficiency index. For example, in Chart 2, which assumes economies of scale exist in banking, if bank A used the same amount of extra resources per unit of output over the best bank of its size, B, as did Bank C over Bank D, (AB = CD) this equal inefficiency would not be reflected in a ratio index. The ratio index for each bank would be $\frac{X_oA}{X_oB}$ and $\frac{X_1C}{X_1D}$ respectively, and these do not equal each other since the denominators are different. Absolute deviations are chosen in this paper because management is not held responsible for the current size or organizational form of their bank.

A comparison of the frontier and averaging techniques: To put the frontier technique in clearer perspective it may be helpful to compare and contrast it to the techniques which were used in other bank costs studies to hold constant or measure the influence on efficiency of banks' size and organizational form. As in this study, most previous ones used average cost as the basic measure of efficiency.[11] However, rather than using the frontier technique to measure or hold constant the influence of production function arguments on efficiency these studies either averaged data in different size or organizational groups or used multiple regression analysis.

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[11] Two time series studies of banks' operating efficiencies did use the average productivity. Since this measure ignores all inputs except labor, it is as a result an inferior measure of efficiency.

David Alhadeff's study is a prime example of the first technique. In order to make inferences about economies of scale he averaged the annual cost per unit of output of California unit banks and compared these average among discrete size classes. Table I displays his findings for the year 1950:

Table I

Total Expenses as a Per Cent of Loans and Investments (Output) by Different Size Banks in 1950

Unit Bank Size (Millions of Dollars of Deposits	Average Cost
Under 2	4.38
2-5	2.89
5-15	2.56
15-50	2.82
50-150	2.55
Over 150	1.99

Alhadeff drew the following conclusiong from this evidence.

> As far as unit banks alone are concerned . . . with (roughly) constant proportions of the components of expenses at all size of plant (bank), there are initially increasing returns to scale (decreasing cost), then a fairly wide range of fairly constant returns to scale (constant cost), and finally, a range of further increasing returns to scale (decreasing cost).12

[12] David A. Alhadeff, Monopoly and Competition in Banking (Berkeley: University of California Press, 1954), p. 85.

It should be noted that although Alhadeff made no statistical adjustments for the many possible biases in such a study, he did recognize them, discuss them, and qualify his results accordingly.

Lyle Gramley's study of scale economies of unit member banks in the Tenth Federal Reserve District is an example of a study that used multiple regression analysis.[13] The main difference between his type of analysis and Alhadeff's is that a larger number of factors influencing efficiency levels can be held constant than can be by the cross classification procedure, and sample statistics are developed. For example, Gramley not only related efficiency to banks' sizes, but also held constant the ratio of time to total deposits, the ratio of total loans to total assets, the ratio of securities other than U. S. Government issues to total assets, the ratio of consumer loans to total loans, and the percentage growth of assets between 1956-1959.[14] Holding constant these variables, Gramley's finding were consistent with Alhadeff. He found significant economies of scale in the lower size ranges (less than $10 million) and a flattening out thereafter.

The reason these statistical tools are rejected in this study for estimating the long run average cost curve is that their use for such purposes imply an "economic inconsistency." These two statistical procedures both use some form of averages to estimate the curve, but the long run average cost curve is defined as being the

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[13] Lyle E. Gramley, A Study of Scale Economies in Commercial Banking, (Kansas City, Mo.: Federal Reserve Bank of Kansas City, 1962).

[14] Gramley, p. 12.

lowest average cost possible at each level of output. Therefore, how can an average bank represent the maximum level of efficiency if we observe, (and actually use in the calculation of the average), banks that are more productive.[15]

Aigner and Chu examined this inconsistency fully.[16] They described three major reasons why a firm's output might not lie on the production surface:

1. Due to pure random shocks. For example, some products might be defective.
2. Due to difference in technology. Perhaps, a firm is not using the latest model machinery.
3. Due to differences in economic efficiency. For example, one management's goal might be profit maximization, whereas another's might be staff maximazation.

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[15]The recognition of this inconsistency is not new. In fact, Alhadeff pointed it out in his 1954 study.

> If unit costs for different size banks were plotted on a scatter diagram with unit cost on the ordinate, and size of bank (or level of output) on the abscissa, a curve drawn by least squares . . . Although it would not be technically precise to call such a curve an envelop cost curve . . .

[16]D. J. Aigner, and S. F. Chu, "On Estimating the Industry Production Function," American Economic Review, LVIII (September, 1968), pp. 826-39.

They then pointed out that all errors must conceptually lie below the true production surface, "since had there been any level of output obtained with a given combination of inputs higher than that allowed by the production function, a new state of arts should have been defined."[17] Therefore, since all errors must be on one side of the production surface, they questioned estimates of production function based on averages:

> Average in the sense of what? A conditional mean? A mean? Or a mode? More importantly, average about what? About output? About some input? About technology or about something[18]

Next they examined arguments that have developed to defend "averaging." For example, some have interpreted the average production function as some sort of "average technology," but they rebutted this argument as follows:

> But it would be infeasible to assume that a firm which possesses "average technology" with respect to capital also has an average technology with respect to labor.[19]

Moreover, the theoretical definition of the production and cost function assumes optimum technology and not average. A more appealing argument to them was that "true" productive capacity only makes sense as an output level which can be sustained. They answered

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[17] Aigner and Chu, p. 828.

[18] Aigner and Chu, p. 829.

[19] Aigner and Chu, p. 830.

this argument with a slight concession. They admitted that if the industry is one which is influenced by many random events completely outside of the control of the managers, even in the long run, (like sunspots), these averages might have some justification. But, if not, the sustainable output argument has no merit. For the average production today with only few firms incorporating the most up to date technology is not the average production of the future when more firms will have adopted the innovations.

Although they gave no ground on the theoretical issue, Aigner and Chu concluded their argument by saying each technique has its practical purposes. Their opinion was "averaging" might be a reasonable approach to use to predict a given firm's efficiency, but they maintained the frontier measurement is the better estimator of the theoretical production or cost function.

Two other points should be mentioned concerning the use of the frontier measure. First, its susceptibility to measurement error, and second, the lack of any sample statistics, such as the t-value or F-value, which allow one to test the reliability of the estimated curve.

It is well recognized that the frontier measure will give erroneous estimates of the production or cost function if the variables are measured incorrectly.[20] Even in Farrell's original discussion of this technique he emphasized this point:

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[20]The data used in this paper was chosen with this in mind. Its source is the Functional Cost Program which banks voluntarily join. The purpose of the program is to aid each bank improve its own operation, and, therefore, one can presume that there is a greater incentive for producing accurate data than when data comes from reports that are required. Also there is much less averaging in the Functional Cost Data than in other bank data sources.

> A more important qualification arises with respect to the measurement of inputs . . . These problems remain and are formidable[21]

While such errors could bias the frontier in an optimistic fashion, lowering the cost curve, there is an offsetting bias. Since the frontier depends only on actual observations contained in the sample, a larger sample cannot raise it, but it can lower it. This bias is analagous to that of a sample maximum as an estimator of a population maximum.[22]

These two biases will tend to be offsetting, but the extent to which either is dominant is unknown. It should also be noted that such errors also bias studies which use "averaging" or multiple regression. Only when such errors exist only in the dependent variable, or when the distribution of such errors are known exactly can one be free of bias using these other techniques. Neither of these conditions are very reasonable ones to assume in this or past studies of bank costs, given the nature of the data.

A major criticism which has been levelled at the frontier estimation procedure is that it produces no sample statistics such as the t-test or the F-test by which the reliability of the parameters or the curve as a whole can be determined. Although it is true that these statistics are not available, there are alternative statistics which could be utilized to test the acceptability of the frontier estimate of the long run average cost curve. If, for example, it

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[21] Farrell, p. 260.

[22] C. P. Timmer, "On Measuring Technical Efficiency," (unpublished doctoral dissertation, Harvard University, 1969), p. 22.

were assumed that firms fall on or above the long run average cost curve through a stochastic process which produces the same distribution of observations all along the curve, then the validity of this assumption can be tested by nonparametric tests. The null hypothesis of such a test would be that the distribution of observations all along the curve come from the same over-all population. A statistic value greater than a predetermined critical value would call for rejection of the null hypothesis and the estimate of the long run average cost curve being the true curve. Nonrejection of this statistic would mean the estimated curve cannot be rejected as the true one. Appendix I gives a brief description of one such test, the Kruskal-Wallis One Way Analysis of Variance by Rank, and applies it to the estimates of the long run average cost curves made in this paper.

Bank Output

Although most previous studies of bank operating efficiencies agreed on cost per unit of output as being the proper operating efficiency concept, their measures still differed substantially due to different definitions of a bank's output. Joel Dean observed that the " . . . measurement of output is usually the hardest problem in the statistical determination of costs,"[23] and it will become evident that this is particularly true of "bank output".

The historical development of the concept of bank output in bank cost studies is interesting to follow, and also develops a background by which the output concept(s) employed in this paper can be compared and contrasted.

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[23] Joel Dean, Managerial Economics (New York: Prentice-Hall, 1951), p. 284.

An Historical Sketch of the Concept of Bank Output

Early statistical studies of bank cost used various balance sheet items to act as proxies for bank output. Alhadeff, Horvitz and Schweigher and McGee used total deposits and Gramley used total assets to act as a proxy for bank output.[24] The primary justifications for these "stock" measures were that they were conveniently available data, and that most people already tended to think of bank size in those terms. However, the economists, who used these measures, were aware of the shortcomings, and qualified their results accordingly. Probably the most critical was Lyle Gramley who made the following comment about his own study:

> If weights could be assigned to types of banking output according to the relative value of those services to the public, an index could be constructed to represent the social value of the services provided . . . The amount of resources needed to provide a given quantity of banking services, evaluated in terms of its social value, would then provide a measured social efficiency with which resources were employed . . .
>
> This study then will have to be content with a discussion of scale economies that is narrower in its scope and implications . . . The study is concerned with efficiency at individual banks, and does not seek to determine whether, from the standpoint of maximum social

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[24] David A. Alhadeff, Monopoly and Competition in Banking (Berkeley: University of California Press, 1954); Paul M. Horvitz, "Economies of Scale in Banking in Commission on Money and Credit," Private Financial Institutions (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1963), pp. 1-54; George Benston, "Branch Banking and Economies of Scale," The Journal of Finance, XX (May, 1965), pp. 312-331; Lyle E. Gramley, A Study of Scale Economies in Commercial Banking (Kansas City, Mo.: Federal Reserve Bank of Kansas City, 1962).

> efficiency, the banking system should be composed of small or large units.[25]

Taking the lead from Gramley, Greenbaum, Schweitzer, and Powers used an estimate of the "real" or "social" value of output in their examination of efficiency in commercial banking.[26] Greenbaum justified this concept of output as follows:

> . . . if it is accepted that the ultimate goal of economic activity is to satisfy the wants of consumers, then the concept of output must be defined in terms of social welfare.[27]

Their estimates of social output were simply variants of a bank's gross income, based on the belief that a bank's services are worth what its customers are willing to pay.

It is interesting that all three of these researchers used different estimates of this social output concept. Greenbaum realized that a bank's gross income does not necessarily reflect only the amount of services provided, but may also reflect the degree of competition in a bank's market. That is, some banks may have "market power" and voluntarily be cutting down their output, raising their prices, and as a result, exagerating the volume of services provided as measured by their gross income. Therefore, in an attempt to remove this influence from a

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[25] Gramley, pp. 3-4.

[26] Stuart I. Greenbaum, "Banking Structure and Costs: A Statistical Study of the Costs-Output Relationship in Commercial Banking" (unpublished Ph.D. dissertation, John Hopkins University, Baltimore, 1964); Stuart A. Schweitzer, "Costs and Production in Banking: The Case of the Ninth Federal Reserve District," (unpublished dissertation, University of Minnesota, Minneapolis, August, 1970); John A. Powers, "The Existence of Economies of Scale in Commercial Banking," Federal Reserve Bank of Chicago, Research Department, 1967.

[27] Greenbaum, p. 23.

bank's output, Greenbaum assumed that the flow of each financial service a bank provides is proportional to the volume of that type of financial asset it holds. He them computed an average "yield" (b_j) from the following regression for each of sixteen types of earning assets.

$$\frac{Y_i}{A_i} = b_0 + \sum_{j=1}^{16} b_j \frac{Z_{ij}}{A_i} + \sum_{k=1}^{3} b_k X_{ik} \tag{1}$$

where:

Y_i = loan income of the i^{th} bank

A_i = total assets

Z_{ij} = j type of earnings assets, j=1,2...16. The sixteen categories of earning assets were determined by statistical experimentation on different combinations of earning assets. The groups chosen were those for which significant, and *a priori* "sensible" coefficients were found.

X_{ik} = k bank structure variables used to capture the influence of market powers. The ones he used were 1.) the population in a bank's area 2.) dummy variables for state 3.) and a dummy variable to differentiate those banks in one bank towns, those in two bank towns, and others.

The computed b_j's were then multiplied by the year-end amounts of the sixteen types of assets, and the products were added to non-lending gross operating income for bank i to determine that bank's *output*.

Schweitzer's measurement of the social value of a bank's output differed from Greenbaum's only slightly.[28] He subtracted a bank's service charges on deposits from its output because he assumed that

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[28] Schweitzer's procedure comes closest to that which is used in this paper to compute an adjusted revenue of output.

these were merely reductions in factor payments. Also he did not calculate weights for investment services, as Greenbaum did, because he felt that individual banks could do little to influence the yields on securities.

Power's rejection of raw gross income was for an entirely different reason than Greenbaum's or Schweitzer's. He believed that interbank differences in yields reflected differences in social productivity in different communities, and as a result, he did not adjust gross operating income for this reason.[29] Moreover, Power's procedure differed because he felt that gross income did not accurately account for the value of savings deposits to the community, and therefore, he multiplied a bank's time deposits by an opportunity cost and added it to gross operating income to obtain "output".

Benston and Bell and Murphy[30] used a third approach to the measurement of bank output. They divided commercial banks output into six relatively homogeneous services: demand deposits, time deposits, real estate loans, installment loans, business loans and securities. The direct cost of each was analyzed separately. Their measure of output for each service was defined in terms of what part of the service produced operating costs, and since most bank operations consist of

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[29] Powers is right in as much as differences in yields reflect differences in the specific assets which make up the broader category of assets at each bank for which we have data, but he is wrong in not recognizing the fact that if a bank does use market power to raise price above marginal cost that this represents a social welfare loss from a reduction in consumer surplus.

[30] George J. Benston, The Cost of Banking Operations: A Statistical Study, (unpublished doctrinal dissertation, University of Chicago, 1963); Frederick W. Bell and Neil B. Murphy, Costs in Commercial Banking: A Quantitative Analysis of Bank Behavior and Its Relation to Bank Regulation. Research Report No. 41 to the Federal Reserve Bank of Boston, April 1968. (Boston: Federal Reserve Bank of Boston, 1968).

handling documents and dealing with people, these researchers measured output in terms of the number of deposits, accounts and loans produced. These measures were computed as the average number serviced per year, and, therefore, are a flow variable consistent with the theoretical output concept.

Definition of Bank Output

To develop a definition of a bank's output, (and later its costs) necessitates having a conceptual model of a bank, or a description of what it is that banks do. The model bank in this paper holds assets consisting of cash, loan, and securities. The bank produces financial output, which consist of the service of holding interest bearing debt. Each type of debt represents a different service produced; that is, holding a Treasury bill represents a different service than holding a mortgage. The inputs needed in the production of financial services include labor, physical capital, and materials, along with demand deposit funds, time deposit funds, and other borrowings (such as federal funds and borrowings from a Federal Reserve Bank).

This extremely simple view of banking has two very important implications. First, the return which banks obtain through their demand deposit functions are not considered as revenue from service produced, but merely a reduction in the cost of the demand deposit input. Second, differences in deposits, such as the number of checks cleared or the number of the accounts which make up a dollar volume of deposit funds, does not change a bank's output, but represents merely differences in the quality of a bank's inputs.

Stuart Greenbaum in his excellent analysis of the definition and measurement of bank output asserted "that the nature of the hypotheses to be tested must influence one's selection of an (output) measure."[31] He presented the following example to compare the use of a unidimensional bank output concept with a multidimensional one.[32]

> If one is concerned with management decision-making, the partial derivatives of cost with respect to changes in the output of particular products may be of primary importance. However, if one wishes to answer the question of whether regulatory authorities should foster increased bank size by permitting wider branching and merger privileges, the partial derivatives mentioned above are, by themselves, of little help. Consider the following hypothetical finding. A two dimensional output measure is employed and cost parameters are estimated indicating that firms are producing under falling cost conditions with respect to one product and rising costs with respect to the second type of output.
>
> If one were to ask to evaluate the advisability of encouraging increased firm size, the result would prove ambiguous . . . It was because our special interest lies in making generalized interfirm comparisons of this

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[31]Greenbaum, p. 25. He is the only researcher to systematically approach defining and measuring bank output. Others, it seems, realizing the complexity of the problem were guided at least partially by the availability of data.

[32]A unidimensional measure of a bank's output incorporates all bank operations; examples of such are "loans and investments" or gross income. A multidimensional measure breaks down a bank's output into functions and measures each separately as Bell and Murphy did.

> type that the unidimensional type of measure was selected.[33]

In this paper a unidimensional measure of output is used for two reasons. First, the purpose of this paper is to provide bank regulators with useful information about "bank operations as a whole"; second, the only data available which breaks down costs by functions is extremely unreliable. Benston, one of the economists who actually used the data for this purpose, pointed out:

> A single officer in a small bank might serve as demand or time deposit teller, mortgage loan, consumer loan or commercial loan officer, and even sweep out the building at night. It would be ridiculous to have him fill in some time sheet that purported to 'allocate' his time to each of these functions. Therefore, your procedure of 'explaining' costs as a whole is a necessary one for these smaller banks.[34]

The hypotheses being tested in this paper are that elements of a bank's market structure influence its level of operating efficiency. Therefore, a major desideratum of the output measure chosen should be an insensitivity to market structure. An equally important concern is that the measure reflect the real resources needed to produce a given amount of services as dictated by banking's production function.

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[33] Greenbaum, p. 30.

[34] This quote came from a letter written by Benston, and appears in Irving Plotkin's, "The Determinants of Commercial Bank Operating Costs: An Econometric Analysis of Activities and Services," (unpublished paper for Management Science Division, Arthur D. Little Corporation, 1967).

Given these two desiderata we are in somewhat of a dilemma. Adjusted revenue measures of bank output have the desirable qualities of being a flow measure, which is consistent with the theoretical meaning of output, and of reflecting to a certain extent the different amount of resources needed to produce different output mixes. That is, if it assumed that loan yields are not sensitive to market power, then higher price loans should reflect higher marginal costs of production.[35] However, measurement of this output concept is very difficult. Benston makes this clear in the following comment he made about Greenbaum's measure of a bank's output:

> Greenbaum adjusts for differences in the elasticities faced by individual banks by his use of average yields, but he ignores the non-homogeneity within asset types about which Powers is concerned. Moreover, neither researcher adjusts the yields for differences in risk among assets and so they consider, say, consumer loans to be of greater social value than mortgage loans. The gross yields on assets also is affected by transactions costs. The yields on large loans and securities is lower than the yields on small loans, cet. par. because the small loans cost a bank more, per dollar, to make, process, etc. Therefore, wholesale banks or those with few loans will appear to be more efficient than retail, consumer oriented banks. In addition, measuring output by earning assets neglects

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[35] It will be shown later that this is not a perfect measure of the resources needed to produce different output mixes.

> differences in operating costs due to differences in deposit structure.[36]

Unfortunately there is no way known to this author to adjust the output measure for all these possible biases noted by Benston. On the other hand, whereas a stock measure such as the dollar volumes of loans and investments implicitly weights each service a bank provides by 1 and is, therefore, not sensitive to variations in product mix, it does have the nice feature of being completely insensitive to market structure.

Rather than trying to choose between these two measures, or developing a new one which fulfills both desired attributes, this paper uses both measures. This decision allows this paper's results to be compared and contrasted with results in past studies that used either measure.

Measurement of Output

Earning assets are used as the balance sheet measure of a bank's output. The procedure for calculating it is quite straightforward. A bank's (L + I) is found by simply summing the dollar amounts of each of its loan and security holdings. It is important in terms of later comparisons with other studies to note that the Functional Cost data, which is the data source used in this study, better approximates a bank's holdings of earning assets over a year than the Call Report data,[37] which was the data source utilized in most prior studies. This is so because Functional Cost asset values are annual averages of monthly

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[36] George J. Benston, "Economies of Scale of Financial Institutions," Working Paper No. 7019A for University of Rochester, College of Business Administration, October, 1970, p. 14.

[37] The annual period is important because all cost figures are annual.

figures, whereas Call Report asset values are only mid-year or end of year values. The possible biases in these Call Report figures are described by Greenbaum:

> The year-end values may be thought of as estimates of the average of all instantaneous rates of output throughout the year. The estimates may be biased as a result of differences in patterns of seasonal variation among earning-asset categories and the alleged practice of "window dressing" year-end balance sheets.[38]

The adjusted revenue measure of bank output[39] is calculated with the following formula:

$$RA_i = \sum_{j=1}^{j=8} b_j A_i^j + NLI_i - SC_i$$

where:

RA_i = the i^{th} bank's output

b_j = estimated yields of the j loan categories defined in the Functional Cost data

NLI_i = i^{th} bank's nonlending income

SC_i = i^{th} bank's revenue received as service charges on deposits

The procedure for estimating the financial asset weights (b_j's) is very much like Schweitzer's and Greenbaum's models,which were described

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[38]Stuart I. Greenbaum, "A Study of Bank Costs," National Banking Review, IV (June, 1967), p. 420.

[39]Henceforth, the revenue adjusted measure of bank output will be referred to as (RA).

in the preceding section. It is assumed the amount of a certain type of financial service provided by a bank is proportional to its dollar holdings of that financial asset. It is further assumed that banks' incomes from a given type of financial asset vary only as their volume of holdings vary or as their "market power" vary. Furthermore, it is assumed the relationship between the yield a bank receives on a given financial asset and its "market power" is linear.

Given these assumptions the yield on a financial asset can be specified as:

$$\frac{R_i^j}{A_i^j} = B_0 + B_1 X_i \qquad (2)$$

where:

R_i^j is the i^{th}'s bank revenue from asset j

A_i^j is the i^{th}'s bank dollar holdings of asset j

B_0 is the intercept and its estimate is the weight used in the formation of the i^{th}'s bank's output

X_i is the i^{th}'s bank degree of "market power"

The b_j's used in the formulation of (RA) are meant to be yields on financial assets if banks had no "market power." To estimate these b_j's equation (2) was estimated by regression analysis for each of the loan categories specified independently on the Functional Cost data. The measures of "market power" which were used were concentration ratios which take on a value of 1 in the case of a pure monopoly and approach zero as the number of banks in a given market increase in the case of one measure or the size distribution decreases in the case of the other measure. Given the characteristics of these "market power" variables an estimate of b_j can be attained by taking the estimated regression equation and assuming that "market power" is equal to zero. This is the same as accepting the estimated intercept as the estimate of b_j.

One obvious difference between Greenbaum's and Schweitzer's procedure and the one utilized in this paper is the former two ran their output regression equations in an aggregate form. That is, Schweitzer and Greenbaum's regression equation for finding the b_j's had the aggregate income from a number of financial assets as a dependent variable, and the proportion which these financial assets were of total assets as independent variables. On the other hand, the regression equation used in this paper to find the b_j's has only one financial asset's yield as a dependent variable and one concentration variable as an independent variable. The procedure used in this paper necessitates running an independent regression for finding each b_j. The fact the aggregate procedure has inherent many possible biases is made clear by Greenbaum:

> . . . the banking-structure variables . . . in the output-regression equation were introduced to isolate the effects of imperfect markets, and thereby expunge monopoly elements from the rate-of-return estimates. It is probably unreasonable to expect the earning-assets coefficients to have been completely purified. To the extent that some coefficients contain greater monopoly elements than others, banks with relatively large amounts of the corresponding earning assets will have overstated output.[40]

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[40] Greenbaum, "A Study of Bank Costs," p. 420.

Another difference is that Greenbaum and Schweitzer used a greater number of financial asset categories than was used in this paper. That is they estimated a greater number of b_j's. This difference also results from different data sources -- The Report of Condition gives a greater breakdown of loan and securities than the Functional Cost data does. Unfortunately this greater breakdown is desirable for estimating (RA). The ideal for purposes of estimating (RA) would be the disaggreggation of earning assets be determined by all those characteristics which distinguish financial assets. These include class of borrower, payment method, maturity, and loan size.[41] This type of breakdown is desirable because it eliminates the possibility of differences in yields on a given financial asset being the result of an aggregation of many different types of financial assets, each which would be expected to have a different market yield and real return to the community. Tables II and III show the respective breakdown of financial assets given on the two sources of data.[42]

Although the characteristics of the sample of banks utilized in this study have not yet been discussed (they will be in the first section of Chapter VI), it still seems appropriate to give the estimates of the weights (b_j's) which are used in the formulation of (RA). Table IV presents these results for the eight financial asset categories specified

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[41] Schweitzer, p. 39.

[42] The breakdown of securities is shown because Greenbaum used them in his analysis. In this paper revenue from securities will be accepted unadjusted on the assumption that banks have little, if any, influence on security prices. This same assumption was made by Schweitzer in his dissertation.

TABLE II

BREAKDOWN OF FINANCIAL ASSET VARIABLES
REPORT OF CONDITION

Number	
1	Real Estate Loans - Farm
2	Real Estate Loans - Residential - FHA-Insured
3	Real Estate Loans - Residential - VA-Insured
4	Real Estate Loans - Residential - Conventional
5	Real Estate Loans - Nonfarm, Nonresidential
6	Loans to Farmers - Not Guaranteed by CCC
7	Commercial and Industrial Loans
8	Loans to Individuals - Auto Installment
9	Loans to Individuals - Other Retail Installment
10	Loans to Individuals - Repair and Modernization Installment
11	Loans to Individuals - Other Installment
12	Loans to Individuals - Single Payment Loans
13	All Other Loans
14	Loans to Domestic Commercial and Foreign Banks
15	Loans to Other Financial Institutions
16	Loans for Purchasing or Carrying Securities - to Brokers and Dealers in Securities
17	Loans for Purchasing or Carrying Securities - Other
18	United States Government Obligations
19	Obligations of State and Political Subdivisions
20	Other Bonds, Notes, and Debentures (Including Farm Loans Guaranteed by CCC)
21	Corporate Stocks

TABLE III

BREAKDOWN OF FINANCIAL ASSET VARIABLES
FUNCTIONAL COST DATA[43]

Number	
1	Real Estate Loans
2	Agriculture Loans (Excluding Mortgages)
3	Commercial and Other Loans
4	Direct and Indirect Consumer Installment (Includes Check Credit Loans)
5	Commercial Installment
6	Charge Plan
7	Floor Plan
8	Municipal
9	Federal Funds Sold
10	Commercial Paper
11	Liquidity and Broker Loans
12	U. S. Securities
13	Tax-Exempt Securities
14	Federal Reserve Stock - Taxable
15	Federal Reserve Stock - Tax Exempt
16	Other Bonds and Stocks

[43]This breakdown is not copied exactly off functional cost data sheets, but is reorganized somewhat so income allocation and balance sheet items correspond. Furthermore, direct and indirect consumer installment loans were combined on the adivce of Functional Cost official at the St. Louis Federal Reserve Bank.

TABLE IV

RESULTS OF REGRESSIONS TO DETERMINE ASSET WEIGHTS IN OUTPUT FORMULATION

Asset	Intercept	PC5B	Intercept	Herf
1. Commercial Loans	.063	.003 (2.97)	.064*	.008 (4.41)
2. Real Estate Loans	.062	.0004 (.335)	.061*	.002 (1.18)
3. Agriculture Loans	.068	-.00122 (-.509)	.067*	.002 (.651)
4. Municipal Loans	.032	.013 (3.00)	.037*	.022 (3.14)
5. Consumer Installments (Direct and Indirect)	.083*	.007 (3.35)	.087	.004 (3.00)
6. Floor Plan Loans	.069	-.002 (-.31)	.067*	.004 (.425)
7. Consumer Installment (Business)	.076*	.004 (1.12)	.078	.007 (.856)
8. Charge Plan Loans	.121*	.057 (1.47)	.146	.089 (1.19)

in the Functional Cost data. For each financial asset two regression equations were run using two different measures of market power (PC5B and Herf).[44] The figure in parantheses in each case are t-values. The estimated b_j's are the intercepts denoted by asterisks. The criteria for choosing which intercept to use was that the concentration variable have the appropriate sign (positive) and then the highest t-values.

It is reassuring that the weights chosen pretty much fit preconceived ideas of what they should be. The charge plan loan has the highest yield and municipal loan yield the lowest, and also the t-values seem to be highest in those markets which it seems intuitively to this author to be most open to local monopoly pricing.

This procedure for measuring (RA) is subject to many biases. Although no adjustment is made for them, they should be noted.[45]

1. Differences in the average acquisition dates among classes of earning assets can cause a bias. If the secular rate of increase in yields is the same for all classes of earning assets, there will be a tendency to underestimate current rates of return on those assets with the greatest portfolio age.

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[44] PC5B refers to the percentage of deposits held by the five largest banks in a given market. Herf refers to the Herfindahl Index which is a relative size dispersion concentration ratio. As the size of banks in a given market become more nearly the same Herf approaches zero, and as they become more disperse Herf approaches one. Herf is also negatively related to the number of banks in a given market. The exact procedure for measuring these concentration ratios are given in the next section. Although seven concentration ratios are developed in this paper, these two were used for calculation (RA), because early experimentation showed these two gave the best results.

[45] Greenbaum, "A Study of Bank Costs," pp. 420-22.

If the interest-rate trend varies among asset classes -- estimates may be biased even in the absence of differential portfolio age.

2. Another source of bias may result because differences between asset purchase and sale prices are treated as capital gains or losses and are excluded from current operating revenue.

3. The fact that some banks will accept business's compensating balances in place of a higher nominal yield can also bias the output measure.[46] This payment practice might lower the yield on business loans relative to the yields on other loans. However, in this case there is an offsetting bias. Banks accept compensating balances rather than higher yields because these balances represent a cheap way of attaining deposits. They are cheap with regard to the cost of procurement, and because they are relatively riskless. Therefore, although banks with a high percentage of

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[46] R. Alton Gilbert, "Deposit Relationships and Bank Portfolio Selection," (unpublished dissertation, Texas A & M University, May, 1971).

> business loans may have their output reduced, their costs will also be reduced, and thus their average costs, which is of prime concern, may as a result be unaffected.

Costs

The other major component of efficiency, which must be discussed, is operating cost. Except for those studies that used average productivity of labor as the efficiency measure, all studies used each bank's reported operating cost, with slight modification in some cases.

Definition of Costs

Theoretically, "cost" refers to the economic or opportunity cost of operating a firm during a time period at a given rate of output. Measurement of "cost" is often complicated by the presence of externalities that are hard to quantify and by a lack of correspondence between the account data recorded by firms and opportunity costs.[47] Fortunately, these problems are much less severe for commercial banks than for almost any other industry. There are relatively few, if any, externalities in the production of financial services: no factory emission pollutes the air or sewage the rivers. Also, the accounting data recorded by commercial banks reflect well the present value of resources given up by the firms as a result of the production of their services. Salaries and wages are the major type of expenditure in commercial banks. These are a valid measure

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[47] Benston, "Economies of Scale of Financial Institutions," p. 8.

of opportunity costs except when employees are hired in advance of expected output, paid bonuses in a current period for work performed in a previous period or not fired until after the rate of output has declined. There is little unionization in banks, and one would not expect to find monopsony pricing of labor since most bank workers are very unskilled and mobile between a variety of unskilled jobs, and banks usually are located where other businesses exist giving employees alternative job opportunities. Supplies are another major item of expense. The amounts recorded in the accounting records are good estimates of opportunity costs since unexpended inventories are very small. Also, most supplies are bought from national companies making their prices identical throughout the country. Depreciation and occupancy expenses can present a problem. Depreciation rarely is a good measure of the decline in present value from using or holding assets. Other occupancy expenses, as recorded, may differ over firms because some rent their quarters, some own them, and of these, some rent out a portion of their owned buildings. Fortunately, these expenses are relatively small for financial institutions, generally about 10 per cent or less, whereas for other industries they are of a much greater proportion.[48]

Another problem for cost studies is the association of cost with output. Essentially the problem is that of allocating cost among time periods. The time period problem arises when output is produced in one period and the costs of its production are recorded in another.

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[48] Benston, "Economies of Scale of Financial Institutions," p. 9.

Obviously, the shorter the time period, the greater the problem is likely to be. Therefore, most cost studies have used annual, cross-section data, a procedure that reduces time period allocation problems and provides a sufficient number of observations for a meaningful statistical analysis. This study follows suit and uses annual data.

Although measuring a bank's operating cost is relatively straightforward, there are a few particular problems which should be mentioned.[49] One problem, pointed out by Benston, is that most studies exclude from consideration the opportunity cost of different reserve requirements imposed on city, country, and nonmember banks.[50] To remove this possible bias, this study only deals with Federal Reserve member banks, and a dummy variable is used to account for the differences between city and country banks in the multiple regression analyses in Chapter VI.

The custom, previously mentioned, of banks being able to choose whether to pay for services from other banks with compensating balances or with direct fees creates another problem.[51] For example, assume that two banks (A, B) each have deposits of $\underline{\$100}$ and operating cost outside of computer fees of $50. Bank A pays its computer services by paying other banks an annual fee (X), and, as a result, can use all its deposits to produce output which is therefore equal to $100 (or

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[49]No attempt will be made to mention all the possible biases, just those that seem important and failed to get much attention in other studies.

[50]Benston, "Economies of Scale of Financial Institutions," p. 10.

[51]Another similar problem, but more difficult conceptually, is that some banks hold cash balances as insurance to lower the probability of paying high rates for funds from the Fed funds market or borrowings from the Fed.

100 in units). In contrast, Bank B pays for its computer services by leaving an average balance (Y) in another bank, and, as a result, cannot use (Y) amount of its deposits for output production. How does this influence the banks average costs?

	Bank A	Bank B
$\frac{\text{Cost}}{\text{Output}}$	$\frac{50 + X}{100}$	$\frac{50}{100-Y}$

There is no reason to expect the banks are not operated with equal efficiency, therefore the ideal would be if both banks showed the same average cost. However, this would be so only if $Y = \frac{100X}{X + 50}$ and it is unlikely that this is the case. In this paper no adjustment is made for this possible distortion, because the data item which includes compensating balances, "cash due from," also includes vault cash, reserves, correspondent balances, and bank float.

A difficult problem in all cost studies results from differences in factor wages rates in different geographic parts of the country. In past cross-sectional studies, of all types of industries, the practice has been to adjust costs for these wage rate differences. This is made clear by Johnston:

> The desired range of output observations in the long-run analysis can probably only be obtained from 'cross-section' data for a reasonably large number of firms at some given period of time. This automatically rules out the possibility of temporal variations in factor prices distorting the cost-output relation, but it does admit the possibility of effects from

> spatial variation in factor prices. If these are systematically connected with size of firm, then they may or may not require correction. If, for example, the price of a certain raw material is low in a given area because the presence of a very large firm in that area is primarily responsible for large-scale production of the raw material at low unit cost, then a case could be made for leaving that price effect uncorrected as a case could be made for leaving that price effect uncorrected as being a consequence of scale. In general, however, such clear-cut cases will be so rare that it is probably best to correct for spatial price variations if they are judged important relative to other factors and if data exist for such corrections.[52]

However, this type of adjustment is only valid if the factor inputs are complementary to all others, and factor substitution does not occur. Rather than determining or making assumptions about the elasticity of substitution between different bank inputs, operating cost will remain unadjusted in the construction of the efficiency index. To account for the influence variations in factor prices might have on efficiency, cross-sectional indexes of labor wages and interest on deposits are developed and used as independent variables

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[52] J. Johnston, Statistical Cost Analysis (New York: McGraw-Hill, 1960), pp. 29-30.

in the regression analysis of Chapter VI. Another reason for choosing this method to account for differences in factor prices rather than simply adjusting cost is so that the estimates of the long-run average cost curve will be more comparable to those made in other studies in which adjustments also were not made.

Measurement of Costs

A bank's cost is calculated by taking its total operating expenses, and subtracting from them all service charges on deposits.

CHAPTER IV

DEFINITION AND MEASUREMENT OF CURRENT AND POTENTIAL COMPETITION

This chapter continues the task of the preceding one. It defines and develops procedures for measuring the concepts of current and potential competition which were used in the hypotheses formulated in Chapter II.

Current Competition

Definition of Current Competition

Competition is a behavioral concept relating to how firms adjust to and interact with one another in the process of doing business. Competition so defined is conceptually distinct from market structure or economic performance. However, these three concepts are linked in important ways, although this linkage is not always a precise one. If there is only a single firm in an industry, for example, and entry is closed, one would expect behavior to be noncompetitive, and performance to be unsatisfactory from the standpoint of the public interest. The opposite would be true if there were several thousand firms and free entry in an industry.[1] Most real world markets, including banking markets, fall between these extremes; and the interrelationships between structure, behavior, and performance are not likely to be as

[1] Jack M. Guttentag and Edward S. Herman, "Banking Structure and Performance," New York University Institute of Finance _Bulletin_, Nos. 41-43 (February, 1967), p. 18.

dependable in this world of nonextremes. It is not obvious that competition would be more intense and performance better in a city with 15 unit banks than in a city with five branch banks with 30 offices. Therefore, since competition is the causal link in one of the hypotheses being tested in this paper two assumptions concerning it are made. First, the degree of competition in a bank's market can be related by a monotonic function to a bank's market structure. Second, an increase in competition will lead to a more allocationally efficient market; that is, banks' prices will be lower and output greater, the greater the competition in a market.[2]

These two assumptions have been widely accepted in economic studies. Bain actually set forth these assumptions as hypotheses in his basic industrial organization text, and provided evidence to support them.[3]

> 1. In atomistic industries, each seller is so small that he will take the selling price for his output as given as beyond his control . . . Industry output will be extended and price reduced to the point when the marginal cost of supplying added output is just equal to the price at which output sells.
>
> 2. In Monopoly, the single seller has complete control of the market price at which he sells . . . Output will be smaller and selling price higher.
>
> 3. Oligopolies in some sense lie between atomistic competition and monopoly. Correspondingly, the market performance expected in oligopolies may

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[2] This assumption is very important for interpreting the results of this study. For if increased competition does not lead to lower prices of bank services, then there is little reason for a bank's efficiency level to change as competition changes as described in Williamson's model in the first chapter of this study.

[3] Joe Bain, Industrial Organization (New York, John Wiley and Sons, 1968), p. 466.

> range from that attributed to a single firm's monopoly to that attributed to atomistic competition, lying at either extreme or somewhere in between.[4]

Bain also recognized that only the extremely rare case, if any, fits perfectly into either the atomistic or monopoly framework, and formulated hypotheses concerning the relation between market structure and performance in terms of the "degree of oligopoly":

> Given the fact that oligopolies of sellers is something that varies by degrees, theoretical logic suggests two things. First, other things being equal, oligopolistic interdependence becomes stronger as seller concentration becomes higher, or weaker as seller concentration is less. Second, therefore, the higher the degree of seller concentration within oligopoly, the greater is the probability of the adoption of joint monopoly price and output policies by rival sellers. Conversely, the lower degree of seller concentration in oligopoly, the greater is the probability of some active rivalry among sellers and of departures from joint monopoly policies in the direction of competitive (atomistic) price and output determination.[5]

The appropriateness of these assumptions for the banking industry is confirmed by a long tradition in economic literature which describe banking behavior just as Bain described the behavior of an oligopoly above. In Chandler's 1938 article on banking competition, he described how collusive behavior permeates all phases of bank operations:

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[4]Bain, pp. 28-29.

[5]Bain, p. 117.

> They usually limit the free services that members (of a clearing house) may perform for their customers, prescribe the type and maximum amounts of stationery to be furnished to customers free of charge, and set the price to be charged on other supplies. They usually lay down at least general rules governing the types and amounts of advertising to be done, and they sometimes go as far to provide that all advertising, with stated exceptions, must be approved by clearing-house officials. Moreover, uniform charges for trust services are quite common.[6]

He also explained how banks set interest rates on bank loans, and that banks "cooperate to prevent customers from 'playing off' one local bank against another in order to secure a reduction from a customary rate . . . The aim is to force each customer to confine his patronage to one bank."[7]

Sixteen years later, Alhadeff presented the same picture of banking.

> It is well known that the clearing-house is often one of the most effective means by which bankers can join in agreements on a local or regional basis . . . A code of ethics has been evolved with regard to securing new business. Bankers seem agreed that, in soliciting new business, there should be 'nothing in the spirit of the bank's approach that can be interpreted as a bid for any considerable portion of another bank's business.[8]

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[6]Lester Chandler, "Monopolistic Elements in Banking," Journal of Political Economy, ILVI (February, 1938), p. 16.

[7]Chandler, p. 14.

[8]David A. Alhadeff, Monopoly and Competition in Banking (Berkeley, University of California Press, 1954), pp. 25-26.

After explaining why the rates on large loans are uniform at a prime rate, he then discussed the uniformity of rates between banks in the same market on the same type of debt.

> Small loan prices are not only rigid, they are also highly uniform for comparable categories of small-loan credit. As stated above, this uniformity results from tacit collusion induced by an oligopolistic rationale, which recognizes the mutual dependence of the rivals and instinctively eschews rate competition.[9]

There is also evidence to support the second assumption, that "increased competition" leads to allocational efficiency in the banking industry.

> Market concentration, especially, was found to be significantly associated with the pricing, output, and profits of banks; high concentration being associated with high loan rates . . . Contrary to the belief of many observers, therefore, structural changes in a banking market have an important impact on bank performance.[10]

Although the results of Edward's study are still being debated, Guttentag and Herman in their survey of bank performance literature found most current evidence supports Edward's results.[11]

Two characteristics of the banking industry make construction of a meaningful measure of competition based on market structure difficult.

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[9]Alhadeff, p. 122.

[10]Franklin R. Edwards, "The Banking Competition Controversy," The National Banking Review, III, (September, 1965), p. 25.

[11]Guttentag and Herman, p. 87.

First, a bank's market area is difficult to define. That is, what geographic area delineates that area in which a bank is cognizant of and responsive to changes in policy and actions of other sellers of the same products as itself. Sound, and a problem very similar to that of defining bank output, what it is that a "bank does" is difficult to define. That is, what aspect of a bank is representative of that bank's size.

Bank Competition in Other Studies

Reviewing the literature, which has dealt with these problems, may shed some light on the best way to measure competition in this paper. The literature, which is substantial in volume, can be broken into three categories: commentaries on legal decisions regarding bank anti-trust cases; empirical studies which try to define bank markets rigorously; and empirical studies which use measures of bank competition to explain bank performance.

Commentaries on legal interpretations: On June 17, 1963, the Supreme Court enjoined the proposed merger of the Philadelphia National Bank and Girard Trust Company Exchange Bank, the second and third largest commercial banks in Philadelphia, ruling that the merger would be in violation of Section 7 of the Clayton Act. The Philadelphia case raised a number of issues, two of which are of interest in this paper, and caused a rather lengthy debate between those economists who supported the court's approach, and those who did not. Since the arguments are, to a large extent, redundant, rather than presenting the whole debate, only a summary of what the court decided on both issues and one criticism and one defense of each decision are presented.

The Supreme Court, in this Philadelphia case had no trouble determining the relevant line of commerce (or what it is that banks do).

> We have no difficulty in determining the "line of commerce" (relevant product or services market) . . . in which to appraise the probably competitive effects of appellees' proposed merger. We argue with the District Court that the cluster of products (various kinds of credit) and services (such as checking accounts and trust administration) denoted by the term "commercial banking," . . . composes a distinct line of commerce.[12]

Deane Carson and Paul Horvitz were critical of this decision on the grounds that each bank service represents a unique product with unique competitors.

> It is quite clear that commercial banks do deal in a wide range of services and products, and also face a substantial amount of competition from non-bank financial institutions. Commercial banks are not products, . . . nor are "total loans." It is a more reasonable approach to the competitive problem to examine each of the relevant product lines . . . taking account of competition from non-bank institutions, and taking account of the substitutability among financial services.[13]

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[12] Deane Carson and Paul M. Horvitz, "Concentration Ratios and Competition" in Studies in Banking Competition and the Banking Structure (Washington, D. C., Comptroller of the Currency, 1966), p. 22.

[13] Carson and Horvitz, p. 23.

In defense of the Court's decision, Edward Herman did not question the theoretic logic of Carson and Horvitz's argument, but just its relevance to banking. He did not feel many non-banking products are reasonable substitutes for bank products. He concluded:

> It is reasonable to regard commercial banking as sufficiently distinctive both in range of services rendered and in services uniquely offered to constitute a line of commerce, or a meaningful "industry." This follows mainly from their unique position in providing checking account facilities to the public and their special importance in making short-term credit available to business, particularly small and medium-size business. There are other services rendered by commercial banks in which their special position might justify ignoring outside competitors (e.g., the provision of personal trust services), but these two seem clearly in the category. And they are sufficiently important to justify looking at commercial banking as a distinct industry, although overlapping with other industries in many of its activities.[14]

The Court also had "no difficulty in determining the . . . section of the country (relevant geographical market) in which to appraise the probable competitive effects" of the merger. The Court stated that convenience of location is important in banking:

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[14]Edward S. Herman, "The Philadelphia Bank Merger Decision and Its Critics" in Studies in Banking Competition and the Banking Structure (Washington, D. C., Comptroller of the Currency, 1966), p. 48.

> Individuals and corporations typically confer the bulk of their patronage on banks in their local communities; they find it impractical to conduct their banking business at a distance . . . The factor of inconvenience localizes banking competition as effectively as high transportation costs in other industries.[15]

The Court then concluded that because of the convenience factor, "the four-county area in which appelees' offices are located would seem to be the relevant geographical area."[16]

Consistent with their previous criticism, Carson and Horvitz commented on this market delineation:

> It follows . . . that a single geographical area cannot be chosen as the relevant market area in which to measure competition. The relevant market area differs for each banking product or service.[17]

Emanuel Celler, of the House of Representatives, took the opposite viewpoint and supported the Court's decision:

> For the bank as a whole . . . this is a relevant geographical area since an appreciable amount of its business comes from such area and this is all the more so if there are other banks in that area offering similar services. If the bank failed to recognize such an area as having economic significance,

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[15] Carson and Horvitz, p. 24.

[16] Carson and Horvitz, p. 24.

[17] Carson and Horvitz, p. 24.

> it would more than likely
> commit economic suicide.[18]

This debate could be best characterized as a disagreement on what emphasis to give theory and pragmatism when trying to answer an immediate problem. Carson and Horvitz emphasized economic theory. Whereas the Court and those supporting the Court's decision, although not disagreeing with Carson and Horvitz's interpretation of economic theory, felt that a compromise with economic theory was necessary to solve the problem before them.

Empirical analysis of market delineation: Two types of empirical economic analyses have been used to delineate bank markets. One type of analysis involved surveying bank's customers to determine from where they come. The second type looked at the dispersion of loan rates and terms in certain geographical areas based on the assumption that within an "economic market" rates different banks charge or other loan characteristics will be relatively similar either as a result of competitive pressures or oligopolistic collusion.

An example of the first type of study was done by the St. Louis Federal Reserve Bank in 1966.[19] This study analyzed a sample of loans from St. Louis banks and found that one-fourth of the large firms (net worth $1 million or more), and 42 per cent of the small firms (net worth under $1 million) had as their principal bank the bank nearest

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[18] Emanuel Celler, "The Philadelphia National Bank Case: A Rejoiner" in Studies in Banking Competition and the Banking Structure. (Washington, D.C., Comptroller of the Currency, 1966), p. 34.

[19] Clifton B. Luttrell and William Pettigrew, "Banking Markets for Business Firms in the St. Louis Area," Review, Federal Reserve Bank of St. Louis, September 1966, pp. 9-12.

to their place of business. The average distance to their principal banks was 5.7 miles for the large firms, and 2.9 miles for the small firms.

A more recent study of the same type was done by the New York Federal Reserve Bank.[20] They sent questionnaires to households, business firms, and professionals to inquire into their banking habits. From the evidence supplied through these questionnaires, they concluded that a "banking" market area for measuring bank competition should, at minimum, include banking alternatives convenient both to work and to home of a significant proportion of households in the community under consideration.[21] They asserted that competitive pressures are not only passed directly from one bank to another, but also indirectly through correspondents and through intermediate banks.

> Consider two banks that are not direct competitors, that do not share common customers or a common service area. If each of them competes significantly with a third bank, any important competitive efforts by either one of the banks that are not direct competitors will, nevertheless, be transmitted to the other through the competitive reaction to the third bank. Such indirect competition is a feature of economically integrated metropolitan areas.[22]

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[20] Ralph H. Gelder and George Budgeika, "Banking Market Determination: The Case of Central Nassau County," Monthly Review, Federal Reserve Bank of New York, LII (November, 1970), pp. 258-266.

[21] Gelder and Budgeika, p. 265.

[22] Geller and Budgeika, p. 261.

There have been three major studies which tried to define bank markets by looking at interest and term variations. There were done by Edwards, Sweigher and McGee, and Horvitz.[23] Each of these studies show some rate dispersion within metropolitan areas, but these results are very limited because there is no discussion of how much rate dispersion is enough to imply that a given geographic area is not a "market." Furthermore, there is no attempt to explain interest rate variations by economic forces other than current competition. For example, one of these studies noting that interest rates differed on different sides of state lines which cut through city limits, concluded that state borders are an effective barrier to bank competition. However, this conclusion does not follow directly from the evidence. If, for example, the difference in state branching laws caused potential entry to be different in the two states, interest rates might very well be different in the two states, but the whole city might still be a market as far as current competition is concerned. Although interest rates differ in the two parts of the city, a bank in one state might still react to change in interest rates by banks in the other state, and thus be competitors.

Bank performance studies: Studies of bank price and output performance, unlike the two previous types of studies were interested in

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[23] Franklin R. Edwards, "Concentration in Banking and Its Effects on Business Loan Rates," The Review of Economics and Statistics, XLVI (August, 1964), p. 297; Irving Schweiger and John S. McGee, "Chicago Banking," The Journal of Business, XXXIV (July, 1961), pp. 203-366; Paul Horvitz, "Price Uniformity and Banking Markets," an unpublished paper, 1968.

the measurement of bank competition only as a means towards testing other hypotheses. Therefore, these studies spent little time discussing the theoretical issues involved in measuring competition, and, for the most part, were concerned with finding a systematic approach to measuring a bank's competition.

The first study of the relationship between a bank's competitive environment and its pricing policy, which employed extensive statistical controls designed to distinguish the effects of competition from other influences, was by Frank R. Edwards.[24] He specified a bank's market as the SMSA in which it was located, and used the per cent of deposit held by the three largest banks as a measure of competition. Realizing that his market definition was unreasonable in states permitting state-wide branching, he developed different measures for those cases.

> Since no measure of concentration is likely to be perfect, two measures are used, one which underestimates the "true" value and one which over-estimates it. The rationale behind this procedure is that if both values can be used alternately in a statistical analysis and both can be shown to be significant, then surely any value in between will also be significant.
>
> The first measure of concentration is a "State ratio." It is the percentage of total deposits in a state accounted for by the largest three banks in that state . . .

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

> The second measure of concentration used for branch areas, called a SMA ratio, is apt to overestimate the degree of market power. This measure expresses the percentage of total deposits in a particular metropolitan area accounted for by the largest three banks in that area, but the deposits of the largest bank are deflated by a factor derived from the ratio of total metropolitan deposits to total state deposits.[25]

Edwards, also tried using the population per bank and bank offices in a given market as proxies for competition. His rationale was that in areas where there is a large number of people per bank, bankers have more discretion in setting rates than if there were few borrowers. However, these measures gave very poor results predicting bank pricing behavior.

George Kaufman in another study of market competition's influence on interest rates used a similar procedure to that of Edwards. However, Kaufman defined a bank market as its county rather than metropolitan areas.[26] This difference was not significant, however, since Kaufman's sample of banks was in Iowa where there are few large metropolitan areas.

A study of the effect of market competition on mortgage interest rates was done by Richard Aspinwall.[27] In this study he defined a bank's

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[25] Edwards, "Concentration and Competition in Commercial Banking," p. 59.

[26] George Kaufman, "Bank Market Structure and Performance: The Evidence from Iowa," The Southern Economic Journal, XXXII (April, 1966), pp. 429-39.

[27] Richard Aspinwall, "Market Structure and Commercial Mortgage Interest Rates," Southern Economic Journal, XXXVI (April, 1970), pp. 376-384.

market as its SMSA and used an absolute concentration ratio as Edwards did. But as a measure of a "bank's business," he did not use its total deposits as the other two did, but used only its time deposits. He used this measure of bank's business because he was interested in only one service banks provide, mortgages, and the amount of savings deposits a bank has is a constraint on what proportion of its total assets it can put in mortgages. The measure of competition he used was the percentage of time deposits held by three largest financial institutions (including savings and loan institutions) in a given market.

Measurement of Current Competition

This paper's measurement of bank competition was based on the attainment of two desired properties. First, the approach must be pragmatic and systematic. Close to 900 banks are included in the sample of banks which is studied in this paper, and this large number makes independent analysis of each bank's market, as Horvitz suggested, virtually impossible. This becomes even more evident when one considers the fact that it takes a team of economists and examiners at the Federal Reserve at least twenty days to examine just one market in which a merger has been proposed. The second desired property of the measure used in this paper is that it, at least, not be inconsistent with the previous work done in this area.

Although most economists would agree that a relationship does exist between a bank's market structure and the degree of competition in that bank's market, there is little agreement of what dimension or dimensions of market structure determine the degree of competition. Both the number of competing institutions and the relative sizes of competing institutions in a market are examples of market structure dimensions which some economists have thought important. Since no theory currently exists to help economists make this decision, they have, for the most part, simply used unidimensional measure of competition. The measures most frequently used are concentration ratios either of the "absolute" or "relative" variety. Absolute concentration ratios measure the percentage of assets, output, value of shipments, or value added accounted for by a given number of leading firms. Relative concentration ratios measure the relative sizes of firms in an industry.[28]

Unidimensional measures of bank competition are also used in this paper. However, since theory cannot guide us into what dimension is likely to be most important, a variety of measures are developed and used.[29]

A bank's market is assumed to be its SMSA if it is in one, and its county, if not. This is consistent with both Edward's and Kaufman's approach, and also with the court's approach to defining bank markets. Also, recognizing as Edwards did, that this delineation may not be very meaningful in states where branching is allowed, (especially states

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[28]Relative concentration ratios have never been used in bank performance studies.

[29]Although this reasoning might also be applied to market delineation and to the measure used to represent bank size, unique definitions were picked in these cases.

permitting statewide branch banking), the market delineation is slightly revised in these cases to include in a bank's market any county or SMSA in which it also has a branch office. For example, if a bank had an office in every county of a state, then its' market would be the entire state. It is admitted that this procedure is somewhat arbitrary, and intuitively some type of weighting scheme for the counties or SMSA's of a bank's branch offices would be better. For example, one might weight a county in a market by what per cent of the total bank's deposits are held by that office. But, since this procedure or any other would also be somewhat arbitrary the simple method, explained above, is used.

This procedure for measuring a branch bank's market competition can be applied because the Federal Deposit Insurance Corporation's "Summary of Deposits," which breaks down banks by branch offices, was made available t this writer. It should also be pointed out that these data have another favorable attribute that was not available in most other studies which used measures of bank competition; all branch offices are included in a bank's market even if the bank's head office is not located there. For example, if Bank A, a unit bank, was the only bank in a particular county, but, there were two branch offices of other banks also there, most previous measures of bank competition would have shown one bank in the market and 100 per cent of the deposits held by one bank. Measures used in this paper, on the other hand, would show three competiting institutions in the market, and the deposits divided by the three.

In accord with the Courts' decision, a bank's business is viewed as a unique line of business and only other banks are considered as competitors. The measure of a bank's business in a given market is its holding of IPC (Individual, Partnership, and Corporation) deposits under $10,000 in amount. This measure is better than ones, which have been used in most other studies, such as total deposits or assets. Deposits of a greater size or political deposits generally come from organizations that are large enough to compete for funds in the national market,[30] and, therefore, should not influence measures of local market competition. If a bank in St. Louis had a large deposit from a customer in San Francisco, this deposit should not alter a measure of the competition in the St. Louis bank market. Using deposits of less than $10,000 was also made possible by the "Summary of Deposits" data.

The measures of competition and the symbols by which they will be referred to hereafter follow:

1. The percent of IPC Deposits held by the largest bank (PC1B), the largest three banks (PC3B), and the largest five banks (PC5B) were developed as absolute measures of bank competition.
2. The Herfindahl Index (Herf) was constructed as a relative measure of concentration. It is computed by summing the squared per cent of deposits which each bank or bank office in a market holds of total deposits in that market. This

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[30] It is recognized that to a certain extent, banks do compete for customers against banks all over the country, but analysis of the deposits and loans of these banks still show the preponderance of business being local.

measure is based on the hypothesis that competition in a market is not determined by just a few large institutions, but also by the number and size of smaller institutions. It has been suggested that changes in the disparity of firm sizes can have significant repercussions on competition in a market even though the effects on the leading firms or top assets are minimal.[31]

3. In an effort to combine the two dimensions measured by the absolute and relative concentration ratios, a modified version of a measure suggested by Janos Horvath was constructed.[32] This measure which is called the "comprehensive concentration index" (CCIX) takes the absolute percentage of deposits held by the largest institution in a market and adds to it the squared percentages of deposits of the other banks or offices in the market (or the Herfindahl Index of the remaining banks).

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[31]Eugene Singer, Anti-Trust Economics: Selected Legal Cases and Economic Models (Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1968), p. 136.

[32]Janos Horvath, "Suggestion for a Comprehensive Measure of Concentration," Southern Economic Journal, XXXVI (April, 1970), pp. 446-52.

4. The population per independent bank (IPOP) and banking office (PPB) in a market were also constructed as measures of competition.[33]

Each of these measures is suppose to be inversely related to bank competition. That is, as the value of each measure increases, bank competition is expected to decrease. However, since each measure is negatively related to competition they should be positively correlated with each other, and furthermore, since they all are meant to measure the same thing they should also be highly correlated. Table V presents the correlation coefficient between each of the measures. The two measures which do not fit the a priori hypothesis are IPOP and PPB, which are low and negatively correlated with the other five measures. However, since there is no economic theory to rule out these measures, they cannot be ruled out for future use. They might still turn out to be the most meaningful for explaining a bank's operating efficiency, while the other five measures may do very poor jobs.

Potential Competition

Definition of Potential Competition

In his basic industrial organization text Bain defines the condition of entry (or the degree of potential competition) as the

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[33] Independent in terms of this measure and the others means the banks or bank offices are institutions with independent bank charters. In banking there are many group or chain banks, interlocking directorships, and even holding company connections that are not taken into account in these measures.

TABLE V

CORRELATION COEFFICIENTS BETWEEN MEASURES OF
CURRENT COMPETITION AND MEASURES OF POTENTIAL COMPETITION

	PC1B	PC3B	PC5B	HERF	CCIX	IPOP	PPB	LUBS	LLBS	LSB
PC1B	1.00000									
PC3B	0.87171	1.00000								
PC5B	0.74752	0.91163	1.00000							
HERF	0.95423	0.85394	0.72415	1.00000						
CCIX	0.96351	0.94713	0.83384	0.96299	1.00000					
IPOP	-0.12741	-0.15940	-0.16073	-0.16572	-0.15868	1.00000				
PPB	-0.28076	-0.33621	-0.36127	-0.26023	-0.31223	0.64066	1.00000			
LUBS	-0.17564	-0.19210	-0.25331	-0.10537	-0.17019	-0.32126	0.14355	1.00000		
LLBS	0.11926	0.13011	0.18200	0.07792	0.11959	0.21599	-0.10946	-0.81615	1.00000	
LSB	0.09320	0.10248	0.11793	0.04540	0.08369	0.17400	-0.05641	-0.30453	-0.30182	1.00000

extent to which established firms can elevate their selling price above the minimal average costs of production and distribution (those costs associated with operation and optimal scale) without inducing potential entrants to enter the industry.[34] Due to the fact that this paper deals with firms in a regulated industry, the definition of the condition of entry is slightly different. Rather than concentrating on prices, the definition is phrased in terms of profits reported. The condition of entry in this study is the size of profits which a bank can report without encouraging bank regulators to allow a new bank or new bank facility to enter that market.[35]

In order to test the hypothesis that potential competition influences a bank's level of operating efficiency, the degree of potential competition must be different in different markets, and the differences must be measurable. Fortunately, this may be possible in banking due to the complex framework of state entry laws for banking.

Current law provides for 53 government agencies being involved in some way in bank entry decisions. The Comptroller of the Currency exercises sole chartering authority for national banks. Each of the 50 states exercises chartering authority for state banks and their branches operating within its borders. The Federal Deposit Insurance Corporation must approve a bank for it to receive insurance, which is a legal condition

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[34] Bain, p. 252.

[35] In recent recommendations of bank merger and holding company cases, the term potential competition has been used in a slightly different fashion. It has been used to refer to the possibility that bank entrepreneurs might want to enter a market. In contrast, our use of the term implies that if a bank regulator would permit a bank to enter a market, some entrepreneur would be willing to do so.

for entry in some states and in others, a practical necessity. Finally, both the FDIC and the Federal Reserve System have a hand in approving banks' proposed mergers. As far as national agencies go, it is reasonable to assume that each agency makes regulatory decisions with the same criteria for every market area. That is, it is likely that the Comptroller of the Currency considers the same criteria when reviewing a bank's application for a charter in Maine as in California. However, it would not be very reasonable to make the same assumptions about state bank regulators as a group. Each state's agency is made up of a group of men whose philosophies toward banking and bank entry undoubtedly differ from state to state. For example, one state's regulators might weight competition more highly and safety from failure as less important goals of bank structure than another state's bank regulators.

Potential Competition in Other Studies

Now, if it can be assumed that banks regulators' philosophy on potential entry differs from state to state, the important question becomes: can these differences be identified and measured? Two approaches have been used to answer this question in the bank structure literature. One approach is simply a discussion of the varying problems bank regulators in different states face and the implications that follow deductively for the degree of potential competition. The second approach is an empirical one. Implications about the degree of potential entry in a state are made by the actual entry experience in that state. It is interesting and significant that each of these approaches lead to the same general conclusion: potential competition is greatest in states which permit branching and it is lowest in unit banking states.

Shull and Horvitz provide a very good example of the first approach.

> Not only are the economic barriers to entry lower under branch banking, but, of even more importance, there are considerations which tend to make the regulatory barriers lower. We have noted that in banking the regulatory barriers are more important than the economic barriers. By law as well as by tradition, the bank chartering authorities must consider the effects of new entry on bank safety. If a proposed bank is seeking a charter to compete against an existing unit bank in a given community, there is, of course, some risk one bank or the other will be unable to operate profitably. Since the regulatory authorities want to avoid bank failures, in close cases the decision may be to stay on the safe side by refusing to charter the new bank.
>
> If, on the other hand, the existing banking offices are branches, and the application is for a new branch, the regulatory authorities can safely take a more liberal and experimental attitude. A branch which turns out to be unprofitable can be closed with no loss to depositors. We may have communities with two or more branches which could safely support only one unit bank. Even if a new unit bank is proposed to compete with an existing branch, the regulatory authorities can evaluate the charter application with

> less concern for the effect of the new bank on the profitability or safety of existing banking offices. It is unlikely that a sizeable branch bank could fail because of loses incurred by any one of its branches.[36]

Guttentag and Herman commented similarly:

> In the interests of safety, regulatory authorities are likely to be more cautious in granting new bank charters than in giving branch permits to well-established institutions. They are also likely to be under less pressure to restrict entry under branch banking, since the branch banks wish to preserve their own freedom to open new offices.[37]

R. Rodney Pakonen's work is an example of the second type, he approached the question empirically.[38] He treated entry as a part of the more general phenomenon of capital investment. Desired banking capital in a state was assumed to be a function of the existing bank capital in the state, expected bank profits, and the level of income.

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[36]Bernard Shull and Paul Horvitz, "Branch Banking and the Structure of Competition," National Banking Review, II (March, 1964), p. 145.

[37]Guttentag and Herman, p. 18.

[38]R. Rodney Pakonen, "The Differential Effect of Branch Law Regulation on Commercial Bank Entry," (unpublished dissertation, Washington State University, 1969). It should be pointed out that Pakonen's analysis followed very closely that of Sam Peltzman's in his article "Entry in Commercial Banking" in the National Banking Review. Pakonen's two major contributions to the model were including bank office formation as a form of investment, and testing the model not only over time to evaluate the effect of the Banking Act of 1935, but he also measured the impact on entry of different branch restrictions.

Then to explain investment he incorporated a simple stock adjustment mechanism which assumed that each period investment in banking will be equal to some part of the difference between desired and current bank capital. Finally, in order to determine how much bank investment will be in existing facilities and how much will be in new facilities he assumed "that the average size of banking office is smaller in states where population is more dispersed."[39] His theoretical discussion may be summarized as follows:

$$e_t = f(c, \pi, Y) - S(L_t) + f_t$$

where:

e_t = new office formations

f = a function explaining desired banking capital

c = capital invested in commercial banking

π = expected profits in commercial banking

Y = level of income

L_t = population density

f_t = office closures

To empirically test the model he assumed a linear relationship between (e_t), new office formation, and the other independent variables, and used linear regression analysis to estimate the influence of each independent variable. Annual data for the years 1921-1965 were used.

He first tested the hypothesis that the Banking Act of 1935, which he assumed initiated the onset of effective entry regulation in the United States, would significantly lower the rate of bank capital

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[39]Pakonen, p. 20.

formation from what it would have been without such regulation. He did so by adding a dummy variable to the regression equation which had a value of zero before 1935 and a value of 1 thereafter. His results were significant and supported the hypothesis.

Second, and what is of primary interest in this paper, he tried to measure the relative severity of entry regulation in states with different branching restrictions. To do so he disaggregated the data by state branch laws and estimated the time series regression for each of the three groups. His results showed that regulation effectively restricted entry by 40 per cent in statewide branching states, 50 per cent in limited branch banking states, and 70 per cent in unit banking states.[40]

Pakonen suggested two explanations of his results. One was very similar to that of Shull and Horvitz's:

> When given the choice regulators prefer to issue charters for new branches. This infers that entry restrictions will be less if regulators can issue charters for both new branches and new banks. This phenomenon could be the partial result of regulators having to consider certain banking factors when issuing new charters, and it could be the partial result of regulator's aversion to the possibility of bank failures. When issuing a new charter the banking authorities must consider the financial history and condition of the bank, the character of the bank's management, and the adequacy of the capital structure of the bank. For all practical purposes there is no history to consider for a new unit bank, and the determination of management character and capital adequacy can only be estimated. In the case of a new branch the first two factors are easily determined. There is also a built-in safeguard if the regulators misjudge the market demand: a branch has retained earnings from previous years with which to carry the short-term losses incurred by a newly opened branch.[41]

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[40]Pakonen, p. 31

[41]Pakonen, p. 122

The second explanation Pakonen offered was that regulators might be willing to take greater risks with their policy toward bank entry in rapidly growing areas, because rapid growth could offset or cushion many of their mistakes.

> With a more favorable economic climate the optimism of potential entrants is not as crucial, for a new office, even though it may prove not to be as profitable as expected, can still be operated profitably. Regulators, feeling that the potential entrants are over-optimistic, might more closely approach the free market rate.[42]

He then pointed out that the most rapidly growing area of the country in recent years is also the area in which state-wide branching is most prevalent, and the area, which has grown least, happens to be where unit banking is dominant.

> To the extent that the reasoning of the previous paragraph is true, regional differences in the economic environment can explain some of branch law regulation on the rate of entry. Branching states are concentrated in the West; limited branching states are primarily found in the East; and unit banking states are most prevalent in the Midwest.
>
> Since in the past forty years the West has exhibited the greatest rates of economic and population growth, the demand for banking services has been the greatest in this area. The lowest rates of economic growth have occurred in the Midwest. The expectation that the greatest rate of entry should occur in the West is borne out by the data: the predicted rate of entry in the absence of entry regulation is highest in state-wide branching states, and unit banking states exhibit the lowest predicted rate of entry. If regulators are sensitive to pressures, it is expected that the actual rate of entry in states which are experiencing rapid economic growth will be more than proportionately greater than in states which are experiencing less rapid growth. A comparison of the differences in predicted entry with the differences in actual rate of entry in states with different branch laws shows that this prediction is also supported by the data.[43]

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[42] Pakonen, pp. 125-126.

[43] Pakonen, p. 123.

Measurement of Potential Competition

Pakonen's results demonstrate that bank regulators in unit banking states were most restrictive in their attitude toward bank entry from 1935 to 1965, and regulators in state-wide branching states were the least restrictive. If it is assumed that bankers sense their state's regulators' philosophies towards bank entry, then Pakonen's finding can be interpreted as demonstrating that differing degrees of potential competition exist in states with different branch laws. This assumption is accepted in this paper. It is assumed that the threat of potential competition is greatest in state-wide branching states (LSB), second in limited branching states (LLBS), and slightest in unit banking states (LUBS).[44] Dummy variables are used in the regression analysis to represent these branching restrictions. Table VI lists states by their branching law in 1968.

It should be emphasized, however, that state branching laws are far from the theoretically best measures of the degree of potential competition in a bank's market. As pointed out earlier, each state has its own bank regulators with their individual philosophies toward bank entry; therefore, any aggregation of these philosophies must result in some loss of precision. However, there were two reasons why dummy variables for each state could not be used in this study as measures of potential competition. First, computer constraints limited the number of independent variables that could be used in the regression analysis, and a state-by-state breakdown would have exceeded this limit. Second,

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[44] It should be pointed out that the limited branching classification incorporates many different types of laws. For example, included in this category would be both states that allow banks to branch just in contiguous counties, and also states that allow banks to branch as long as they do not place a branch in a town which already has the home office of another bank.

TABLE VI

CLASSIFICATION OF STATES ACCORDING TO TYPES OF BRANCHES PREVALENT*

Statewide Branch Banking Prevalent	Limited Branch Banking Prevalent	Unit Banking Prevalent
Arizona	Alabama	Arkansas
California	Georgia	Colorado
Connecticut	Indiana	Florida
Delaware	Kentucky	Illinois
District of Columbia	Louisiana	Iowa
Hawaii	Massachusetts	Kansas
Idaho	Michigan	Minnesota
Maine	Mississippi	Missouri
Maryland	New Hampshire	Montana
Nevada	New Jersey	Nebraska
North Carolina	New Mexico	North Dakota
Oregon	New York	Oklahoma
Rhode Island	Ohio	Texas
South Carolina	Pennsylvania	West Virginia
South Dakota	Tennessee	Wyoming
Utah	Wisconsin	
Vermont		
Virginia		
Washington		

* This classification was taken from the Federal Reserve Bulletin, March, 1970.

since there was no _a priori_ way to judge which state's regulators have harsh attitudes toward bank entry and which do not, it was impossible to set forth specific hypotheses concerning which state's banks are most likely to operate with the greatest efficiency, and so on. Another deficiency in using state branching laws as proxies for potential competition is that their acceptance in this role was based somewhat on the evidence provided by Pakonen's study on how regulators have restricted entry in different states up to 1965. Therefore, application of Pakonen's results to a study which used 1968 data is based strictly on the assumption that state bank regulators or the philosophies of state bank regulators did not change much between 1965 and 1968.

One other aspect of the proposed measures of potential competition must be examined. Since it is the purpose of this study to differentiate the influences which current and potential competition have on a bank's operating efficiency, it is desireable that the measures of current and potential competition be statistically unrelated. Fortunately, this relationship between a state's branch laws and the degree of competition in that state's banks' market has been the subject of other research studies, and examination of these other studies may be helpful for evaluating this paper's proposed measures of potential competition.

One such study was done by Donald Jacobs.[45] His approach was to estimate the following cross section regressions: (1) the number

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[45] Donald Jacobs, "The Interaction Effects of Restrictions on Branching and Other Bank Regulations," _Journal of Finance: Papers and Proceedings of the Twenty-third Annual Meeting of the American Finance Association_, XX (May, 1965), 332-348.

of banks or banking offices in each state during 1963 was related to the mean total assets per bank, total population, total personal income, per capita income, and a dummy variable denoting branching regulation; (2) the change in the number of banks or banking offices was explained by the change in total bank assets, change in population, change in income, and a dummy variable for branching regulations; and (3) the average size of bank was related to income and population variables in addition to the branch banking dummy variable. He ran the regressions with two sets of data. One included 48 states, and the other included just those states which prohibited branching or allowed state-wide branching.

His results showed that: (1) in 1963 the number of banks in branch banking states was significantly less than in unit banking states; (2) between 1946 and 1963 fewer new banks were established in state-wide branching states; and (3) the absolute change in the number of banking offices was significantly larger in branch banking states during the period 1946 to 1963.[46]

Jacobs felt that these results suggest two different conclusions. First, branching restrictions do not affect the number of banking offices. Instead, population and income variables tend to be more important. Second these results could imply that in 1946 branch banking states were underbanked because of strong barriers to entry during the Great Depression and during World War II.

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[46] Jacobs, p. 346.

In another study, Paul Horvitz and Bernard Shull, using the March, 1961 issue of Polk's Bank Directory and the 1960 census, compared the number of commercial banking offices with the number of people in different non-metropolitan areas.[47] In the smaller non-metropolitan areas (under 5,000 population) there were more banking offices per community in unit banking states. In all communities of more than 5,000 people there were more banking offices in state-wide branching states. Using a regression, they found that population was a significant determinent of the number of banking offices, but that branch law was only of borderline significance. Because they felt that this result could be due to regional differences, they then separated the United States into seven geographic areas and compared non-metropolitan communities in unit and branch banking states. They concluded:

> The finding that the apparent advantage in number of offices of small unit banking communities disappears when regional comparisons are made, while the advantage of large branch banking communities is maintained, exactly parallels our finding reported previously with respect to numbers of competing banks.
> We would conclude that branch banking is likely to result in somewhat greater convenience of banking facilities in moderate and large-sized non-metropolitan areas. The number of additional facilities on average is small in all but the largest communities. The difference in the very small communities is negligible.[48]

It is evident from these studies that there is no clear-cut relationship between a state's branching laws and the competition in the bank markets in that state. The question must be answered empirically for each particular case or group of bank markets.

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[47] Paul M. Horvitz and Bernard Shull, "The Impact of Branch Banking on Bank Performance," National Banking Review (December, 1964), reprinted in Studies in Banking Competition and the Banking Structure (Washington, D.C., Comptroller of the Currency, 1966).

[48] Horvitz and Shull, p. 146.

However, before turning to the empirical evidence it should be recognized that there are two aspects of this particular study which are likely to diminish the possibility of a strong relationship between the current competition variables and the states grouped by branching laws. First, current competition is defined with respect to local banking markets, many of which in this study are small communities and thus are not likely to show the strong relationship found by Shull and Horvitz in large metropolitan areas. Second, since any county or SMSA in which a branch bank has a branch office is included in that bank's market area, branch bank's measure of current competition will be lower than they would have been if a branch bank's market was considered as only the county or SMSA of its head office, as in most other studies.

Table V presents the correlation coefficients between the seven measures of current competition and the three measures of potential competition. Since the highest correlation between a current competition measure and a potential competition measure is only .32 (IPOP and LUBS), and most are less than .20, it is the opinion of this author that it will be possible to differentiate the influence of the current competition a bank faces (as measured by the seven variables formulated earlier in this chapter) and the potential competition in a bank's market (as measured by the bank's state's branching laws) on that bank's degree of operating efficiency.

CHAPTER V

ENVIRONMENTAL AND OTHER CONSTRAINTS ON A BANK'S OPERATING EFFICIENCY

Multiple regression analysis is used in this paper to test the hypotheses that current and potential competition influence a bank's operating efficiency. The dependent variable in these regressions is the managerial index of efficiency constructed by the frontier technique. The major independent variables are those proxies for current and potential competition described in the preceding chapter. Although the "frontier technique" results in a managerial efficiency index insensitive to economies of scale or organizational form, there are still other production constraints on managerial efficiency which must be accounted for in the regression equation if it is desired that the estimated coefficients of current and potential competition be unbiased. This chapter defines these other constraints, and outlines procedures for measuring them for use as independent variables in the regression equation.

City Classified Banks (ICB)[1]

Federal Reserve member banks, which all banks in our sample are, are classified either as "city" or "country" banks for purposes of determining their reserve requirements. City banks are required to hold a

[1]Throughout this chapter the variable names used hereafter are given in parenthesis if not given elsewhere.

greater percentage of their deposits in reserve than a country bank, and as a result city banks may be less efficient than unit banks. On the other hand, the fact that many banks desire to be classified as city banks suggest there are aspects of the classification which might make a bank more profitable and correspondingly more efficient.[2] Two possible reasons why city bank status might make a bank more efficient are: 1.) it gives banks prestige and brings in additional business relatively cheaply; and 2.) the fact that certain state laws give city bank's preference on placement of state's deposits. To account for either direction of influence a dummy variable will be used which takes on a value of 1 for city banks and 0 for county banks.

Bank's Growth (PCDE)

A bank's growth may influence its level of operating efficiency in any given year. For example, a bank whose deposits are growing or decreasing rapidly may have higher current costs because of its temporary inability to adjust fully to a given level of output.[3] This implies that the bank is not on the long-run average cost curve, and if it is cost minimizing, it is on a short-run cost curve. Each bank's percentage growth (or shrinkage) of its total deposits from 1965 to 1968 will be used as a proxy for that bank's growth, and entered as an independent variable in the multiple regression equation to explain efficiency.

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[2] If economies of scale exist, this is not necessarily true in terms of our efficiency index. A bank might become more profitable by growing larger but not more efficient.

[3] George Benston, "Economies of Scale and Marginal Costs in Bank Operations," Studies in Banking Competition and the Banking Structure (Washington, D. C., Comptroller of the Currency, 1966), p. 358.

Geographic Differences in Factor Payments

Bank production utilizes four major inputs: labor, demand deposits, time deposits, and capital services. It is generally accepted that the machinery and materials that banks use, which make up the major portion of its capital expenses, are produced by companies, which sell nation wide, and as a result prices are similar for banks throughout the country. Bell and Murphy remarked, "capital costs or rentals on equipment are, however, uniform across regions since suppliers are few and quote national prices."[4] Unfortunately, this is not a reasonable assumption for the labor or deposit inputs, and as was pointed out in Chapter III these differences can bias the efficiency measure.

One way which has been suggested to account for varying factor prices is to adjust costs so that every firm's inputs are priced similarly. A general procedure for this is to find the average factor price across the sample, multiply it by each firm's uses of that factor, and sum the factor payments to form an adjusted cost. However, this adjustment is only correct if the factor input being considered is complementary to all other factor inputs, because if factor substitution does occur, differences in factor payments not only reflect geographic differences but also factor productivity.[5] This study does not use

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[4]Frederick W. Bell and Neil B. Murphy, Costs in Commercial Banking: A Quantitative Analysis of Bank Behavior and Its Relation to Bank Regulation. Research Report No. 41 to the Federal Reserve Bank of Boston, April, 1968 (Boston: Federal Reserve Bank of Boston, 1968), p. 13.

[5]Apriori knowledge of the banking production function would allow the correct adjustment to be made, but it was one of the advantages of "frontier" method not to have to assume any special type of production function or in this case the cost function.

this approach of adjusting cost for differences in factor payments for two reasons. First, labor inputs are certainly not completely complementary with capital inputs, and although all deposits (demand plus savings) might be considered as complementary inputs with other inputs, they are not necessarily complementary with each other. Second, costs are not adjusted in this study so the long-run average cost curve estimated by the "frontier" method would be comparable to the cost curves estimated by regression analysis in prior studies in which cost data also were not adjusted.

In this paper geographic differences in factor wages are accounted for by developing factor wage indexes, and using them as independent variables in the regression analysis. Each input index is developed independently.

Savings Deposits

The saving deposit index was constructed as:

$$AI_i = 1 - \left[\frac{SR_i - AR}{AR}\right]$$

where:

SR_i = the effective rate bank (i) paid on saving deposits. It was found by dividing interest paid on saving deposits by average monthly amount of saving deposits at each bank. Certificates of deposit (CD's) were not included in saving deposits because it was felt that they are a type of deposit that is bought on the national market and its price for the same maturity would be similar across the sample.

AR = national interest rate on savings deposits, or the average of all bank's SR_i's.

The index is constructed so that the higher the interest a bank paid the lower is the index. The index value for a bank that just pays the average rate is 1.

Demand Deposits

The preferred measure of the payment for demand deposits would be:

$$W_D = \frac{C_P - SC}{DD}$$[6]

where:

C_P = the costs of operation by the check and deposit processing facility at the bank.

SC = service charges paid for demand deposit services.

DD = volume of demand deposits.

However, since no data exists on C_P an alternative measure was tried.

$$WID_i = 1 - \left[\frac{\left(\frac{SCi}{DD_i}\right) - \left(\frac{SC}{DD}\right)}{\frac{SC}{DD}}\right]$$

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[6]Stuart A. Schweitzer, "Costs and Production in Banking: The Case of the Ninth Federal Reserve District," (unpublished dissertation, University of Minnesota, Minneapolis, August, 1970), p. 67.

where:

(i) refers to an individual bank, and the subscripted terms are averages across the sample of banks.

A danger with this measure is that differences in service charges may reflect differences in deposit quality. That is, inactive deposit accounts are considered high quality deposits by a bank because they require very little processing costs, and conversely for an active account. If service charge reflects this difference in quality then they should not be averaged. However, the one bit of evidence available on this suggests banks do not set service charges to account for these quality differences. Bell and Murphy tried to determine what factors influence banks' service charges on demand deposits and concluded banks do not attempt to recover full costs of processing via service charges.[7]

Labor

The index of labor wages was constructed as:

$$\text{WAGIX} = 1 - \left[\frac{\text{WAGES}_i - \text{AVERAGE WAGES}}{\text{AVERAGE WAGES}}\right]$$

where:

WAGES_i = the average wages paid to workers in financial institutions (insurance, savings and loan associations, savings banks, commercial banks, and credit unions) in a given market.[8] A bank's market is

[7]Bell and Murphy, p. 194.

[8]The source of data for this index was the U.S. Department of Commerce's County Business Patterns, 1968.

defined exactly as it was for construction of its competition measures. AVERAGE WAGES = the average of $WAGES_i$ across all banks.

This index is based on the assumption that most bank workers are not highly specialized in their skills, and that their skills could be used equally in many businesses, especially other types of financial institutions. The major problem with this index is it averages out differences in skill and pay between jobs within banks.

Quality of Deposit Inputs

If deposit quality does differ from bank to bank, and the difference is not the result of management error[9] then it is important that we account for this influence on a bank's operating efficiency. The measures of deposit quality can be divided into two groups. The measures in the first group account for the activity per account in a bank that is not due to a regular seasonal pattern. The measures used are:

1. $\dfrac{\text{Home Debits}^{10}}{\text{Average Number of Accounts}}$ DQ

2. $\dfrac{\text{Deposits}^{11}}{\text{Average Number of Accounts}}$ DQ(1)

3. $\dfrac{\text{Transit Checks}^{12}}{\text{Average Number of Accounts}}$ DQ(2)

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[9] To a certain extent management can control the type of deposit they received by advertising, fee structure, and personal procurement.

[10] Home Debits are composed of all "on us" checks plus all charges against checking accounts.

[11] Deposits are composed of all credits to checking accounts.

[12] Transit Checks are composed of all outgoing clearing items, including local clearings and checks drawn on out of town banks.

The measures in the second groups account for the seasonal variability of a bank's deposit structure. A bank which experiences highly variable deposits might keep a higher proportion in excess funds, not producing output. Similarly a bank experiencing relatively variable deposits might utilize less specialized machinery and more temporary labor than a bank with more stable deposits. Fortunately, the Functional Cost Program makes available a measure of the variability of a bank's deposits. One part of the program is a questionnaire which asks the banker to rate his own bank's deposits fluctuations as "low," moderate, or high. Each banker's appraisal of his own bank's deposit variability is accepted, and dummy variables are used to characterize the variables.

Seasonal Fluctuation	Variable Name	Dummy Variable Value
Low	ISFL	1 if low and 0 if not
Medium	IMFL	1 if medium and 0 is not
High	IHFL	1 if high and 0 if not

Number of Branch Offices or Subsidiaries in a Holding Company

Past studies of bank costs hypothesized that the number of branch offices a bank had or the number of co-subsidiaries a holding company member bank had would influence the costs of that branch bank or that holding company subsidiary. Therefore, measures are constructed to account for this possible influence. The actual number of branch offices (IQ) a branch bank has, and the number of subsidiaries in a holding company (NHC) are used. Also, since there is no a priori reason to assume linearity in this measure, a set of dummy variables is also used.

Number of Branches	Name of Variable	Dummy Variable Value	Number of Subsidiaries	Name of Variable	Dummy Variable Value
If 1	IBR1	1 if not 0	If less than 5	IHC1	1 if not 0
2-4	IBR2	1 if not 0	5-15	IHC2	1 if not 0
5-8	IBR3	1 if not 0	Above 15	IHC3	1 if not 0
9-15	IBR4	1 if not 0			
Above 15	IBR5	1 if not 0			

Product Mix

Product mix variables were used in most studies of bank costs that used balance sheet items as output proxies to account for different costs involved in producing different types of output. That is, it was accepted that a bank with 75 per cent business loans and 25 per cent installments should not be compared to a bank with the opposite proportions in its portfolio, because one loan might be more costly to produce than another.

In contrast, product mix variables were not used in studies that used adjusted revenue measures of output in the belief that these measures already accounted for different output mixes and the resulting different costs of production. However, even if all services are priced at marginal cost, there is a certain condition under which product mix variables are also important for explaining efficiency when output is defined as revenue. This condition is that the cost curves for individual services be non-linear. Since the evidence from Bell and Murphy and Benston's studies suggest this is the case, product mix variables are also used in the regression analysis when the dependent variable is based on (RA).

The product mix variables used are:

1. $\frac{\text{loans}}{\text{loans and investments}}$ (PMLO)

2. $\frac{\text{installment loans}}{\text{total loans}}$ (PMIL)

3. $\frac{\text{commercial loans}}{\text{total loans}}$ (PMCL)

4. $\frac{\text{mortgage loans}}{\text{total loans}}$ (PMML)

5. $\frac{\text{charge plan loans}}{\text{total loans}}$ (PMAC)

6. $\frac{\text{revenue not from loan or investment}}{\text{total revenue}}$ (PMNB)

CHAPTER VI

BANK SAMPLE AND RESULTS OF EMPIRICAL TESTS

Characterization of the Bank Sample

The sample of banks with which the hypotheses developed in the preceding chapters is tested was taken from those banks that participated in the Federal Reserve's Functional Cost Analysis program in 1968. This program was administered by all Federal Reserve Banks with the exception of the Federal Reserve Bank of Kansas City (Tenth Federal Reserve District), and was available to all member banks in each respective district on a volunteer basis. The definitions of terms and accounting conventions were drawn up in cooperation with participating banks, and workshops were held to insure uniformity. Moreover, upon submission of completed forms, the Federal Reserve edited the raw data for "reasonableness," and likely errors were checked with the participating bank and errors corrected. Motivation for participation was created by providing each participating bank with reports which allowed them to make a comparative analysis of their operation by product line with similar sized banks or trace their own performance over time.

From the 977 banks that participated in this program in 1968, 898 were used in the sample. The 79 banks were deleted from the sample for one of three reasons:

1. Banks were deleted which had not been

in existence long enough to have deposits in 1965.

2. Banks were dropped which were both branch banks and were a holding company subsidiary.

3. All banks in Massachusetts and some in Connecticut were dropped because the borders of SMSA's in these states were not consistent with county lines, and made the task of attaining meaningful market data burdensome.

Tables VII and VIII (on the following pages) characterize the sample of 898 banks. This bank sample has two extremely desirable characteristics. First, banks of all three organizational forms are in each of the state groupings and, second, the size range of banks of each organizational form are widely dispersed. Perhaps, the weakest part of the sample is the relative lack of holding company bank subsidiaries. But this is probably unavoidable, given the fact there were relatively few holding companies in existence in 1968.

Frontier Estimates of the Long Run Average Cost Curve and Measurement of the Managerial Inefficiency Index

Frontier long run average cost curves can be estimated in a number of ways. Therefore, in order to put the estimating procedure, which is used in this paper, in clearer perspective two other procedures are described with their relative advantages and disadvantages.

One approach is the frontier could be estimated by finding the function that minimizes the sum of the squared residuals, but requires all the residuals be greater than zero.

TABLE VII

A CHARACTERIZATION OF THE BANK SAMPLE BY LOCATION AND ORGANIZATIONAL FORM

	State Law		
	Unit Banking	Limited Branching	State-Wide Branching
Unit Bank	314	126	20
Holding Co. Subsidiary Bank	75	9	2
Branch Bank[a]	17[b]	266	69

[a]Teller windows are not considered branches of a bank.

[b]The branch banks in the unit banking states are the result of Grandfather clause provisions in unit banking state laws.

That is, most states allowed banks to keep branches already in existence when laws prohibiting branches were passed. Neither these specific banks nor all the banks in the state where their oddity exist have to be removed from my sample since the state laws are used as proxies for potential competition, and the structure of existing competition does not necessarily influence this.

TABLE VIII

BANK SAMPLE BY

ASSET SIZE

Assets in Thousands of Dollars	Unit Banks	Branch Banks	Holding Company Banks	Total
Less than $5,000	17	1	4	22
$5,000 to $10,000	82	15	6	103
$10,000 to $20,000	126	49	21	196
$20,000 to $50,000	132	120	35	287
$50,000 to $100,000	59	58	10	127
$100,000 to $200,000	26	38	6	70
Greater than $200,000	18	71	4	93
Total	460	86	352	898

An advantage of this approach is that the estimated curve is presented in a form similar to the form of a curve estimated by the more familiar tool of ordinary least squares. A disadvantage is that it requires the functional form of the curve be specified before estimation. Also, this procedure necessitates the use of quadratic programming which uses much more computer time than the procedure which is used in this paper.

Another approach to the estimation of a frontier cost curve grew out of the fear of errors in measurement biasing the estimated curve. The suggested procedure is essentially to discard a certain prespecified percentage of the most efficient firms. Thus 5 per cent of the extreme observations might be discarded with 95 per cent of the observations determining the frontier.

Although it has been stated that this type of procedure refutes the objections to estimating the frontier curve due to data problems,[1] this result does not seem perfectly clear. Unless one knows something definite about the distribution of measurement errors and also the relationship between this distribution of measurement errors and the distribution of firms above the long run average cost curve, then it seems to this writer that the "percentage" chosen for discarding observations is completely arbitrary and what one gets is another type of average cost function, which has already been shown to be inconsistent with economic theory.

The procedure used in this paper estimates the frontier long run average cost curve by an algorithm which is described in Appendix II.

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[1]C. P. Timmer, "On Measuring Technical Efficiency," (unpublished doctoral dissertation, Harvard University, 1969).

The only constraint on the estimated curve is that it be convex. This assumption is a common one in economic theory and was thus adopted, but it was by no means necessary. An algorith for estimating the frontier long run average cost curve not requiring convexity is also given in Appendix II.

The estimates of frontier long run average cost curves are presented in Tables IX thru XIV.[2] The first three tables apply when a bank's output is (L+I) and the last three apply when it is measured as (RA). The first column of each table refers to the bank's relative size within its own organizational group. That is, on Table IX the second bank which falls on the estimated function is larger in terms of its output than 21 other unit banks. The second column is that bank's output, and the third its average cost. The fourth column gives the estimated slope of the function between the two banks. Given these estimated functions each bank's index of managerial efficiency is calculated by:

$$IMI_i = AC_i - [AC_i^o + D^o X_i]$$

where:

IMI = the i^{th} bank's index of managerial efficiency

AC_i = the i^{th} bank's average cost

AC_i^o = the average cost of the smallest bank (bank o) that falls on the same line segment portion of the estimated function as the i^{th} bank falls on or above.

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[2]Graphical plots of the observations used to estimate these functions appear in Appendix II.

Table IX

Frontier Long Run Average Cost Curve

(Loans Plus Investments)

UNIT BANKS

Banks Relative Position	Output	Average Cost	Slope
1	$ 1,409,060	$.04221	
			$-3.5027X10^{-9}$
22	4,399,500	.03174	
			$-4.6684X10^{-10}$
54	6,470,753	.03077	
			$-8.8561X10^{-11}$
134	10,675,222	.03040	
			$1.3445X10^{-11}$
428	110,036,062	.03173	
			$1.5729X10^{-11}$
460	1,284,230,000	.05020	

Table X

Frontier Long Run Average Cost Curve

(Loans Plus Investments)

BRANCH BANKS

Banks Relative Position	Output	Average Cost	Slope
1	$ 3,477,609	$.04595	
			$-4.1845X10^{-9}$
5	5,360,507	.03807	
			$-1.0279X10^{-9}$
8	6,090,812	.03732	
			$-5.8657X10^{-10}$
67	17,640,650	.03054	
			$4.293X10^{-12}$
353	4,854,586,000	.05131	

Table XI

Frontier Long Run Average Cost Curve

(Loans Plus Investments)

HOLDING COMPANY SUBSIDIARIES

Banks Relative Position	Output	Average Cost	Slope
1	$ 1,462,108	$.05556	
			$-8.5883X10^{-9}$
3	3,928,579	.03437	
			$-1.2166X10^{-10}$
22	14,776,520	.03309	
			$3.8507X10^{-11}$
86	471,513,000	.05069	

Table XII

Frontier Long Run Average Cost Curve

(Adjusted Revenue)

UNIT BANKS

Banks Relative Position	Output	Average Cost	Slope
1	$ 82,434	$.721	
			$-1.0089X10^{-6}$
21	255,106	.547	
			$-3.28X10^{-7}$
59	397,792	.501	
			$-2.061X10^{-9}$
430	7,176,716	.486	
			$3.186X10^{-9}$
460	87,014,000	.741	

Table XIII

Frontier Long Run Average Cost Curve

(Adjusted Revenue)

BRANCH BANKS

Banks Relative Position	Output	Average Cost	Slope
1	$ 213,845	$.742	
			-8.5788×10^{-7}
9	371,335	.612	
			-1.2770×10^{-7}
64	1,017,361	.529	
			8.54×10^{-8}
353	312,934,437	.796	

Table XIV

Frontier Long Run Average Cost Curve

(Adjusted Revenue)

HOLDING COMPANY SUBSIDIARIES

Banks Relative Position	Output	Average Cost	Slope
1	$ 103,682	$.783	
			$-1.6268X10^{-6}$
3	241,392	.559	
			$-5.1451X10^{-8}$
22	912,722	.524	
			$7.180X10^{-9}$
86	31,960,371	.747	

DX_i^o = the difference in output between the i^{th} bank and bank o.

For example, the IMI of a unit bank with an (L+I) output of \$20,000,000 and an average cost of .06 is:

$$IMI = .06 - [.03040 + 1.3445X10^{-11}(20,000,000 - 10,675,222)]$$

or:

$$IMI = .02948$$

Some nonrigorous support is given both the frontier estimates and the measures of output utilized by the consistency of the estimated functions for (L+I) and (RA). For all three types of bank organizational forms, the same banks (or within three or four banks to either side) define the long run average cost curve for both (L+I) and (RA). The one exception to this is the unit banks estimated long run average cost curve for (L+I) is partially determined by the 134th bank while no banks in this range determine it for the (RA) case.

Although nonparametric tests are not completely appropriate for testing the estimated long run average cost curves, examples of their use are given in Appendix I. However, if one were willing to accept the test as providing some evidence of the reliability of the estimated curves then the results of these tests were that three out of the four tests that were made do not reject these estimates of the long run average cost curves as being the true ones.

Implications for Efficiency of Size and Organizational Form

The estimation of how efficiency is related to size and organizational form was not one of the primary purpose of this paper.

However, since the frontier procedure used here provides a measure of these relationships it is worth mentioning the results in passing.

Efficiency of Size

The estimated cost curve for each output measure and for each organizational form was of the same general shape. Relatively large economies of scale exist in the range of small banks; becoming milder as banks become larger, with minimum cost achieved at a fairly low output level. For all six estimated curves the largest of the minimum cost banks was about 1/12 the size of the largest bank in that sample. As the size of banks increases above the minimum cost point, the estimated curves all rise at a very slow rate. However, the amounts being dealt with are sizable enough so that the savings which could be achieved by dividing large banks or combining small banks into optimum size banks would be quite significant. For example, holding everything else constant if the largest unit bank (as measured by (L+I)) was divided into optimum size banks the savings in terms of resources utilized would be about $25,000,000.

It is also interesting to compare the frontier estimated long run average cost curve with long run average cost curves estimated in past studies by averaging techniques, and also with the long run average cost curve estimated by least squares on this paper's sample of banks. Table XV makes this comparison for unit banks with balance sheet measures of output.[3] It gives the average costs associated with

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[3]Comparisons were not made for (RA) outputs because no good comparison could be made. For example, Greenbaum's estimate of the long run average cost curve of unit banks included banks up to only $10,000,000 in size which is not really enough to compare in a table. However, this

distinct output sizes by different estimates of the long run average cost curve. Below each average cost is the per cent which that average cost was of the smallest bank on that curve. This lower figure is the best for comparison since the actual average costs might vary from curve to curve depending on what balance sheet item was used as an output measure or for what year the particular curve was estimated. The most similar of the estimated curves are those of Alhadeff and Gramley's studies; they both demonstrate economies of scale throughout.[4] The frontier estimated long run average cost curve shows the general shape as Alhadeff's and Gramley's throughout most of the comparable curve, but in the range of output near the top of these past studies the frontier curve turns up. However, it should be recognized that the output range in this area is very broad, and the upward slope of the estimated curve is very slight. The curve estimated by least squares on this paper's sample of banks gave results completely inconsistent with past estimates and with the frontier. It rises throughout the relevant range of banks. Although these results seem somewhat surprising, a look at the data in Appendix III makes the least squares estimate look reasonable. Appendix IV gives least square estimates of the long run average cost curves for each output classification and organizational breakdown. The curves estimated by least squares explain relatively little of the variance of the banks' average costs when compared to the estimated curves in

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[3](Continued) estimate of the curve declined throughout as does this paper's frontier estimate in this range, but the frontier turns up for greater outputs.

[4]David A. Alhadeff, Monopoly and Competition in Banking (Berkeley: University of California Press, 1954); Lyle E. Gramley, A Study of Scale Economies in Commercial Banking (Kansas City, Mo.: Federal Reserve Bank of Kansas City, 1962).

TABLE XV

COMPARISON OF ESTIMATED LONG RUN AVERAGE COST CURVES WITH BALANCE SHEET ITEMS AS OUTPUT PROXIES*

(Unit Banks)

Bank Size ($000)	Alhadeff[A]	Gramley[B]	LS[C]	Frontier
Under $2,000	4.38 100.00	2.78[a] 100.00	4.68 100.00	4.01 100.00
$2,000 to $5,000	2.89 65.98		4.68 100.06	3.49 86.92
$5,000 to $15,000	2.56 58.45	2.39[b] 86.00	4.69 100.27	3.04 75.88
$15,000 to $50,000	2.82 64.38		4.73 101.13	3.07 76.46
$50,000 to $150,000	2.55 58.22	2.00[c] 71.94	4.84 103.44	3.18 79.45
Above $150,000	1.99 45.43	1.96[d] 70.50	4.93 105.34	3.23 80.62
1,000,000[D]			5.23 111.90	4.57 113.90

* All figures are in percentage terms.

[A]Data from California banks were used in this study. This particular estimate is for 1950. The output measure was loans plus investments, but the size groupings were in terms of deposits.

[B]Banks from the Tenth Federal Reserve District made up the sample used in this study. Assets were the output measure.

a at $1,000,000 of assets
b at $10,000,000 of assets
c at $100,000,000 of assets
d at $200,000,000 of assets

[C]The curve estimated by least squares in our study for unit banks was $ac = .04677 + .00176X - .0012\ X^2$. Average costs were estimated at $2,000,000 and at the mean of the other categories for this curve and that generated by the frontier method.

[D]Estimates for $1,000,000,000 were only for the curves estimated in our bank sample since the other sample did not include banks of that size.

other studies. For example, the R^2's of Stuart Greenbaum's estimated cost curves ranged upwards from about .50, whereas, the highest R^2 in this study was only .26.[5] Also, although the coefficients of the estimated curves varied with the bank organizational breakdown, (actually taking on the shape of the frontier estimates in regression runs 5b, 6b, and 8b) the estimated curves can perhaps be best described as straight lines through the relevant range of data due to the very low value of the coefficients.

Efficiencies Due to Organizational Form

Statements about the relative efficiencies of organizational form are made by comparing the relative position of frontier estimated long run average cost curves at each output size. The lowest curve at a given output size is the organizational form which is most efficient at that size.

Charts 4 and 5 illustrate the relative positions of the frontier estimated long run average cost curve for each output measure and for each organizational form. Since the relative positions of the curves are the same for each output type, their implications for economies of organizational form will be discussed simultaneously.

Unit banks appear to be the most efficient organizational form along almost the whole range of unit banks in the sample. The one exception to this is the largest of the 460 unit banks is less efficient than the branch bank of the same size. This finding that unit banks are more efficient than branch banks is consistent with the findings in all past studies.[6]

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[5] Stuart I. Greenbaum, "A Study of Bank Costs," The National B Banking Review, (June, 1966).

[6] Jack M. Guttentag and Edward S. Herman, "Banking Structure and Performance," New York University Institute of Finance Bulletin, Nos. 41-43 (February, 1967), p. 28.

Holding company subsidiary banks seem to be more efficient than branch banks up to banks of about $1,000,000 in (RA) and $10,000,000 in (L+I) output, and less efficient at higher levels of output. These results cannot be compared to findings in other studies since this is the first study to compare the operating efficiency of branch banks and holding company subsidiary banks.

Holding company subsidiary banks are less efficient than unit banks at every output size. These results are somewhat surprising since they are inconsistent with what Schweitzer found in his study, which was the only other one to deal with the subject. He found that holding company subsidiary banks were more efficient than unit banks.

> It was also shown that holding company affiliation could result in cost reductions, particularly for banks in the approximate assets range of about $3.5 million to $25.0 billion.[7]

However, there is one reason why these results may be quite reasonable. Banks become holding company subsidiaries among other reasons, because one group of management (the buyers) think they can run the bank more profitably than another group of management (the owners). Therefore, it is not unreasonable to suppose these holding company subsidiary banks were inefficiently run unit banks that were bought for this very reason. Furthermore, since it takes time to improve operational efficiency, it is possible that this measured relative inefficiency is the result of these circumstances. Unfortunately, data could not be obtained on how long these particular banks were holding company subsidiaries.

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[7] Stuart A. Schweitzer, "Costs and Production in Banking: The Case of the Ninth Federal Reserve District," (unpublished dissertation, University of Minnesota, Minneapolis, August, 1970), p. 98.

Chart 4

Frontier Long-Run Average Cost Curve

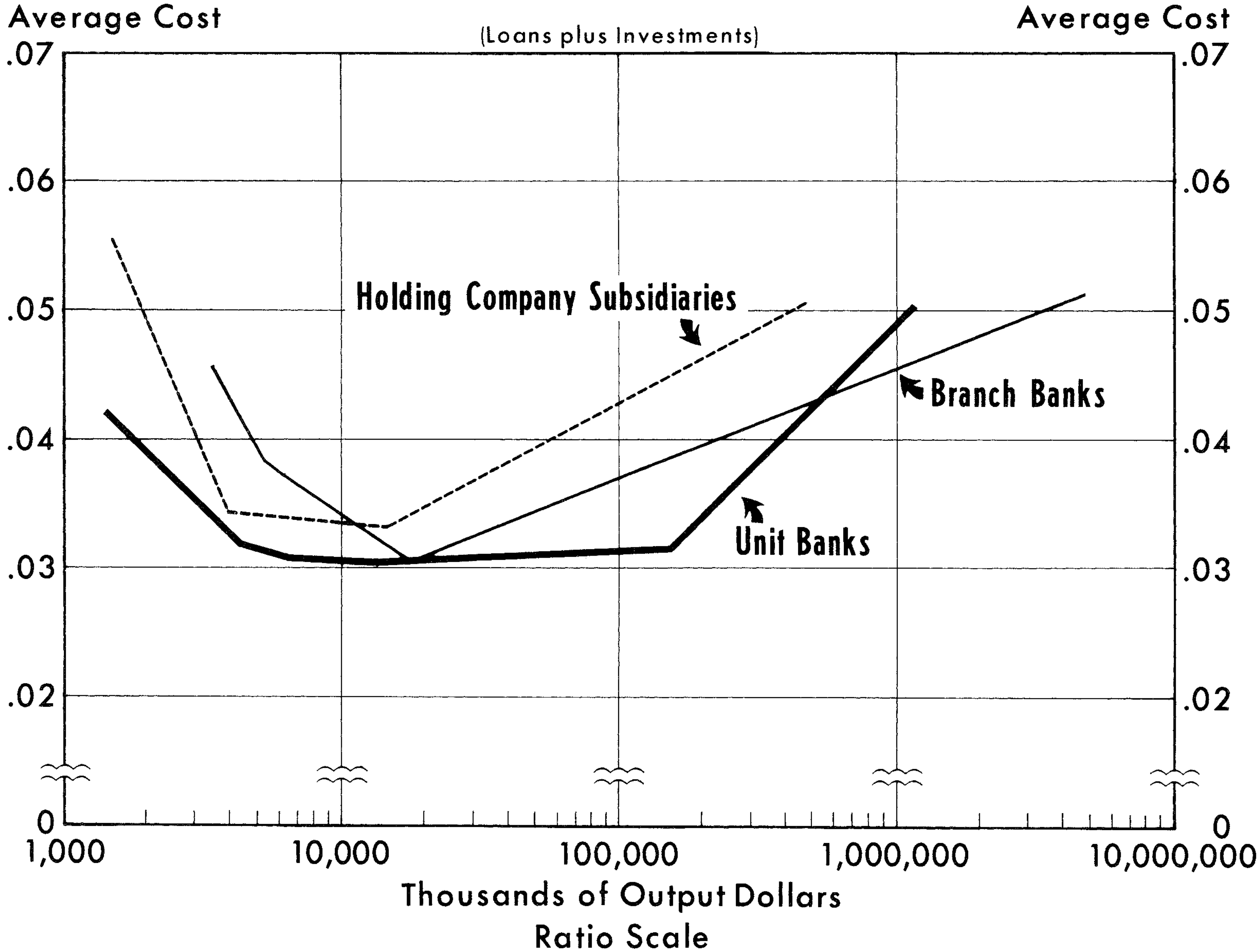
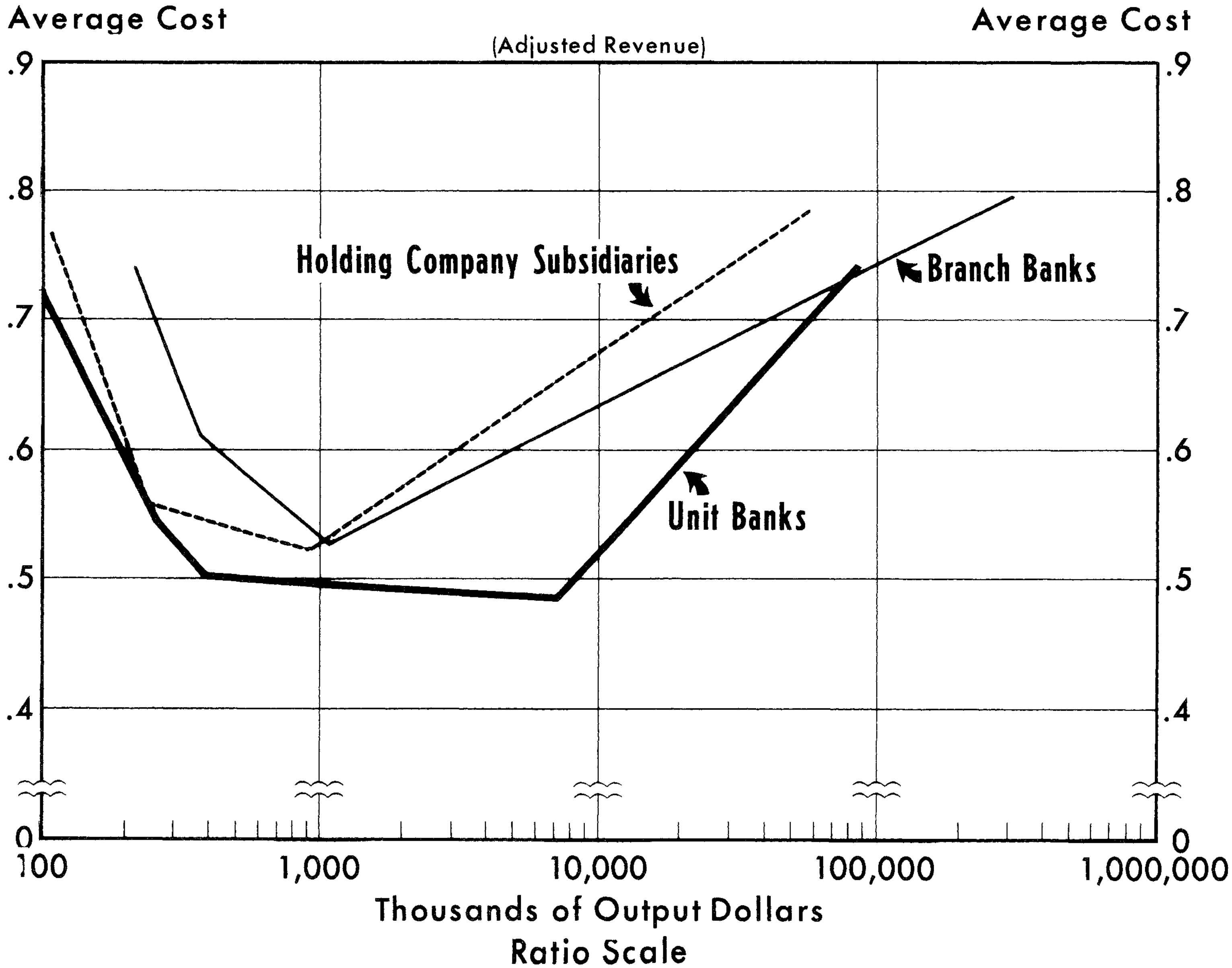


Chart 5

Frontier Long-Run Average Cost Curve



Empirically Testing the Relationship Between the Current and Potential Competition a Bank Faces and its Level of Operating Efficiency

It is assumed that the relationship between a bank's managerial efficiency measure (IMI) and its market structure and its environmental variables is linear. The coefficients are then estimated by applying multiple regression analysis to the equation:

$$IMI = B_o + \sum_{i=1}^{i=k} B_i X_i$$

where:

the X_i's are a subset of the following independent variables (Table XVI defines these variables).

Variable Name	Hypothesized Relationship
The first x_i's are measures of current competition.	
PC1B	$b_{PC1B} > 0$
PC3B	$b_{PC3B} > 0$
PC5B	$b_{PC5B} > 0$
Herf	$b_{Herf} > 0$
CCIX	$b_{CCIX} > 0$
IPOP	$b_{IPOP} > 0$
PPB	$b_{PPB} > 0$

The next two variables are proxies for potential competition, the intercept (B_o) acts as the third proxy.

LUBS	$b_{LUBS} < 0$, $b_{LLBS} < 0$
	and
LLBS	$b_{LUBS} < b_{LLBS}$

The next group of variables are environmental variables.

ICB	$b_{ICB} > 0$
PCDE	$b_{PCDE} > 0$

Deposit Quality

IMFL	$b_{IHFL} > 0$, $b_{IMFL} > 0$
	and
IHFL	$b_{IHFL} > b_{IMFL}$
DQ	$b_{DQ} > 0$
DQ(1)	$b_{DQ(1)} > 0$
DQ(2)	$b_{DQ(2)} > 0$

Factor Payment Variables

AI	$b_{AI} < 0$
WID	$b_{WID} < 0$
WAGIX	$b_{WAGIX} < 0$

Bank Organization Variables

IQ	
NHC	
IBR2	
IBR3	No Specific Hypotheses
IBR4	for These Variables
IBR5	
IHC2	
IHC3	

Product Mix Variables

PMLO	
PMIL	
PMCL	No Specific Hypotheses
PMML	for These Variables
PMAC	
PMNB	

TABLE XVI

DEFINITION OF VARIABLES

Efficiency Indexes

$IMI_{(L+I)}$	Efficiency index based on a bank's output when measured as the total dollar volume of loans and investments.
$IMI_{(RA)}$	Efficiency index based on a bank's output when measured as revenue adjusted for monopoly pricing.

Current Competition Variables

PC1B	The per cent of deposits which the largest bank in a market holds of all deposits in that market.
PC3B	The per cent of deposits which the largest three banks in a market hold of all deposits in that market.
PC5B	The per cent of deposits which the largest five banks in a market hold of all deposits in that market.
Herf	The summation of the squared per cent which each bank deposits in a market are of the total deposits in that market.
CCIX	The per cent of deposits which the largest bank in a market holds of all deposits in that market plus the Herfindahl index (Herf) of the remaining banks.
IPOP	The population per bank.
PPB	The population per banking office.

Potential Competition

LUBS	A dummy variable equal to 1 when a bank is in a unit banking state.
LLBS	A dummy variable equal to 1 when a bank is in a limited branching state.

Deposit Quality

IMFL	A dummy variable equal to 1 when a bank has a moderate seasonal fluctuation in deposits.
IHFL	A dummy variable equal to 1 when a bank has a large seasonal fluctuation of deposits.
DQ	A bank's "home debits" per account.
DQ1	A bank's "deposits" per account.
DQ2	A bank's "transit checks" per account.

Factor Price Indexes

AI	A savings deposit price index.
WID	A demand deposit price index.
WAGIX	A labor price index.

Bank Organization

IQ	The number of branch offices operated by a branch bank.
NHC	The number of subsidiaries in a multi-bank holding company.
IBR's	Dummy variables used to capture specific number of branch offices operated by a branch bank.
IHC's	Dummy variables used to capture specific numbers of holding company subsidiaries in a holding company.

Product Mix

PMLO	The per cent which loans is of total loans and investments.
PMIL	The per cent which installment loans is of total loans.
PMCL	The per cent which commercial loans is of total loans.
PMML	The per cent which mortgage loans is of total loans.
PMAC	The per cent which charge plan loans is of total loans.
PMNB	The per cent which non loan or investment revenue is to total bank revenue.

Other Constraint

ICB	A dummy variable equal to 1 when the bank is a "city" bank.
PCDE	A bank's percentage growth in deposits from 1965 to 1968.

Estimating Procedure

The procedure used in this paper to analyze the influence of current and potential competition on a bank's operating efficiency could be called "experimentation."[8] The procedure was to run regressions with different combinations of the other constraint variables along with the current and potential competition variables with the goal of achieving significant competition variables and significant and correctly ordered potential competition variables. If addition or exclusion of a variable altered the significance of the major variables or the ordering of their coefficients then further combinations were tried.

Empirical Results

Tables XVII and XVIII gives the results of the regression equations when the efficiency index are based on $IMI_{(L+I)}$ and $IMI_{(RA)}$, respectively. Equations on Tables XVII are labelled "a", and those on Table XVIII are labelled "b". The coefficients are the upper numbers in each equation, and the lower numbers (in parenthesis) are t-values for independent variables and F-statistics for sets of dummy variables.[9] The t-values and F-values significant at the 5 per cent level are given asterisks.

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[8] N.R. Draper, and H. Smith, Applied Regression Analysis (New York: John Wiley and Sons, March 1968), point out there is no unique statistical procedure for selecting the "best" regression equation. The procedure chosen must be on personal judgment.

[9] Sets of dummy variables are bracketed, and their F-statistics are centered under the group.

Discussion of the regression findings proceeds as follows. First, the implications of the estimated regression equations for the hypothesized relationship between the current competition in a bank's market and that bank's operating efficiency are presented. Second, the implications of the regression analysis for the hypothesized relationship between the potential competition in a bank's market and that bank's operating efficiency are given. Finally, the influence of each of the environmental variables on banks' operating efficiencies are noted.

Current Competition:[10] The estimated regression equations did not support the hypothesized relationship between a bank's operating efficiency and the degree of competition faced by the bank. That is, the regressions did not demonstrate that banks in highly competitive markets (as measured by any of the five concentration ratios or either of the measures of population per bank) operate any more efficiently than banks in less competitive markets.

In only one equation 3a was the coefficient of a current competition variable significant at the 5 per cent level, and in one equation, 3b, it bordered on this level of significance. In equation 3a the estimated coefficient of Herf was -.003 with a t-value of -2.25, and in equation 3b the estimated coefficient of Herf was -.04 with a t-value of -1.93. However, these two equations contained only these market concentration variables and the state branching proxies. When other environmental variables were included, these particular competition variables also became insignificant. For example, the

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[10] In order to save time and space, the results of the measures of PC5B and PBB are not presented, because their coefficients and t-values were almost exactly the same as PC3B and IPOP, respectively.

highest t-value achieved by any competition variable in equations 6a thru 17a was -1.43 and in equations 6b thru 17b the highest was -1.65. These results suggest that in that equation in which the current competition variable was significant and in that equation, which it bordered on significance, that the current competition variable was acting as a proxy for one of the environmental variables, and thus these equations do not offer evidence of a significant relationship between competition and efficiency.

In an effort to find a significant relationship between current competition and operating efficiency, the regressions were also run with just the unit banks as observations. This was done based on the assumption that the unit bank data are the cleanest. That is, they are not subject to as many possible biases as the branch and holding company bank data. For example, the Functional Cost data do not register the size of offices which branch banks have nor do they contain the expenses which a holding company subsidiary bank might be hiding in its parent company's expenses, or conversely the expenses a holding company might be imposing on a subsidiary bank. Table XIX gives the results of these regressions runs. These equations are labelled "c" for the runs based on $IMI_{(L+I)}$, and "d" for those based on $IMI_{(RA)}$. These regressions also did not support the hypotheses that a bank's operating efficiency and the current competition it faces are positively related. These regressions not only did not product significant coefficients on the competition variables, but did not even produce a t-value as high as .5.

A possible explanation for this insignificant finding is that bank behavior may be related to competition in ways other than Williamson's model implies, and these influences are offsetting the relationship stated in the hypothesis. Two such possible relationships are that between competition and advertising and that between competition and technological implementation. Either of these could have offset the negative relationship between competition and efficiency. However, it should be pointed out that most of these other hypotheses do not imply a straightforward relationship, nor has empirical work reveled any clear cut relationship.

Lester Telser makes both these points very clear in his article on the relationship between competition and advertising.

> Thus there are some kinds of advertising that are compatible with, and indeed essential to competition-information on seller identity and reliability, price and terms of sale, and instructions on the use of the product. There are other kinds that only pay if the selling firm has some monopoly power, for example, if it is large relative to total supply so that it benefits from increases in total demand. Apriori reasoning cannot reveal to what extent advertising is associated with reduced competition. Therefore, it is necessary to turn to empirical evidence on the compatibility of advertising and competition.[11]

Moreover, his conclusions after empirical analysis were "there is little empirical support for an inverse association between advertising and competition."[12]

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[11] Lester G. Telser, "Advertising and Competition," Journal of Political Economy, LXXI (December 1964), p. 541.

[12] Telser, p. 558.

Bain makes a similar statement about the relationship between market structure and firm's adoption of new technology.

> The situation is similar when we turn to the putative relationship of market structure to technological progress. Theoretical indications on the issue are extremely inconclusive and ambivelent. Empirical exploration . . . has produced findings that are not very meaningful.[13]

Potential Competition

The estimated regression equations also did not support the hypothesis that the degree of potential competition in a bank market is inversely related to the operating efficiency of banks in that market. The evidence did not show that banks in states where potential competition was assumed greatest (statewide branching states) tend to operate more efficiently than banks in states with a lower degree of potential competition (limited branch banking states); nor did it show that banks in a limited branching state tend to operate more efficiently than banks in states where the threat of potential competition was assumed to be the least (unit banking states).

Although the potential competition dummy variables were significant at the 5 per cent level of significance in all equations in Table XVII and Table XVIII, the hypothesized ordering of coefficients by size was never achieved. In those regressions based on $IMI_{(L+I)}$ the coefficient of statewide branching was, as hypothesized, the largest of the three potential competition variable coefficients, but the coefficient of unit banking states was larger than the estimated coefficient of limited branching state variable, which was inconsistent with the

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13/ Joe Bain, Industrial Organization (New York: John Wiley and Sons, 1968), p. 461.

hypothesis. Equation 7a is typical of the ordering of the potential competition coefficients in all the "a" equations. In this equation the coefficient of the limited branch banking state dummy variable was -.0025, and the coefficient of the unit banking state dummy variable was -.0009.

The relative sizes of the coefficients of the potential competition variables in the first five equations based on $IMI_{(RA)}$, 1b to 5b, were exactly the same as all the equations on Table XVII. These five equations contained only a current competition measure and the state branching proxies as independent variables. However, when environmental variables were included in the equations (as in equations 6b thru 17b) the estimated coefficients took on a different size ordering. In these equations the estimated coefficient of the unit banking states had the largest value and the estimated coefficient of the limited branching states variable had the lowest value. For example, in equation 17b the coefficient of limited branching variable was -.02 and that of unit banking states, 06.

Further evidence concerning the relationship between a bank's level of operating efficiency and its state branching laws was provided by the regressions run with just unit bank data. Not in one of these equations did the potential competition variables become significant at the 5 per cent level. The F-statistic for the set of potential competition variables in all ten equations was .50.

These regressions did not support the hypothesis that a bank's operating efficiency is related inversely to the potential competition in its market (as measured by state branching laws). That is, the results do not demonstrate that banks tend to operate most efficiently in unit banking states and least efficiently in statewide branching states. However, before completely discarding the hypothesis one slight revision is made which might give more positive results. Rather than defining three degrees of potential competition, only two are delineated: branch banking states and unit banking states. This revision is quite reasonable when one recalls that the original distinction between statewide branching states and limited branching was somewhat arbitrary in the first place.

This change is made easily in the regression equation by simply leaving the dummy variable for limited branch banking states out of the equation. The results which would support the revised hypothesis are:

$$b_{LUBS} < 0$$

The results for these runs are given in Table XX. The regressions based on $IMI_{(L+I)}$ are labelled "e" and those based on $IMI_{(RA)}$ are labelled "f". Unfortunately, these regressions also do not support the hypothesis. The coefficient of the unit banking dummy is always greater than zero, and the t-values are all highly significant. In the "e" equations the estimated coefficient of the unit banking states was .001 and the t-values ranged from a low of 2.36 to a high of 2.48. In the "f" equations the estimated coefficient of the unit banking was .021 and the t-values ranged from 2.65 to 2.84.

These results imply that banks tend to operate more efficiently in branch banking states than in unit banking states. Exactly the opposite of what was hypothesized in Chapter II. One possible explanation of this result was suggested in the work of Rodney Pakonen. He pointed out that new office formation occurs differently in branching and unit states. In branching states, a bank that wants to open a new office will tend to use retained earnings to obtain the necessary capital, whereas in unit banking states the capital needed for a new facility must come from outside sources. Therefore, if banks in branching states are holding profits so they can open offices rather than spending the profits on items that would show as expenses, then banks in branching states would appear more efficient.

Bank Organization Variables: For both branch banks and holding company subsidiaries two types of variables were used to account for the number of branches and other banks in the holding company, respectively. One was a cardinal variable that was simply equal to the number of branch offices (IQ) or banks in that organization (NHC), and the other was a set of dummy variables that aggregated the branches (IBR's) or banks (IHC's) into discrete groups.

In the case of branch banks, both the cardinal variable and the set of dummy variables were significant. In equations 11a through 17a on Table XVII coefficients of the IQ's ranged from -.00004 to -.00003 with t-values all below -3.00. Equations 10b through 17b all showed the same value for IQ coefficients of -.0007, and also had highly significant t-values. The negative coefficient on the cardinal variable suggest that as a branch bank increases its number of branch offices, its operations become relatively more efficient. It is interesting that this result is consistent with Stuart Greenbaum's findings. "The firm elasticities are negative, indicating that average costs fall as firm size increases and [individual] plant size is unchanged."[14/]

[14/] Stuart I. Greenbaum, "A Study of Bank Costs," National Banking Review, IV (June 1967), p. 433.

The dummy variable breakdown provides additional information. The estimated coefficients of the branch dummy variables for the $IMI_{(L+I)}$ and $IMI_{(RA)}$ regressions are respectively:

	(L+I)	(RA)
IBR2 (2 to 4 offices)	.0001	-.008
IBR3 (5 to 8 offices)	.0007	-.025
IBR4 (9 to 15 offices)	-.0004	-.04
IBR5 (Above 15 offices)	.0001	-.036

The regressions based on $IMI_{(L+I)}$ shows that increasing branches from 1 up to around 5 to 8 seems to lead to an increase in average cost. The optimum number of branches (that number that results in the lowest average cost of operation) appears to be from 9 to 15, and increasing branches to numbers greater than 15 seems to lead to increased average cost again. The regressions based on $IMI_{(RA)}$ reveal a more straightforward relationship between efficiency and number of branches. The ordering of the coefficients suggest branch banks become more efficient up to about fifteen branches, and then as more branches are added their efficiency declines.

Neither of the holding company measures achieved significance. This was somewhat surprising, since Schweitzer found in his dissertation that membership in a large holding company led to greater efficiency in its member banks relative to unit banks or member banks of holding companies with few subsidiaries. He made the following comment on the cost savings resulting from holding company membership. "These savings were achieved mostly by affiliates of the two large holding company groups."[15/] The cardinal variable did, however, have

[15/] Schweitzer, p. 98.

the sign consistent with Schweitzer's findings (negative). The estimated coefficient of NHC in the $IMI_{(L+I)}$ equations ranged from -.00001 to -.00002, and the estimated coefficients of NHC in the $IMI_{(RA)}$ equations were all -.0001. Also the dummy coefficients had hypothesized size ordering. That is, the coefficient for the dummy representing the greatest number of member banks had the lowest negative value.

Factor Price Variables: The factor payment indexes for both demand and saving deposits had coefficients of the hypothesized sign (negative), and were both highly significant. This is the result that would be expected for an input that is complementary with other inputs. The value of the estimated coefficient of the saving deposits index (AI) ranged from -.004 to -.005 in the $IMI_{L+I)}$ equations and the t-values ranged from -3.58 to -4.55. In all the $IMI_{(RA)}$ equations estimated coefficient of AI was -.06 and the t-values ranged from -3.40 to -3.91. The value of the estimated coefficient of the demand deposit index (WID) ranged from -.001 to -.002 and also very highly significant with t-values all lower than -4.20. Similarly the coefficient of WID in the $IMI_{(RA)}$ equations ranged from -.01 to -.04 and had t-values from -2.89 to -3.64.

The interpretation of the estimated coefficients of the labor wage index is not as simple. Although in most equations its coefficient was not significant, which suggests that capital and labor are readily substituted for each other in the banking industry, they were significant in equations 11a-14a. In these four equations the estimated coefficients of WAGIX all were -.004 with t-values less than -2.13. No reason is apparent to this writer why WAGIX should be significant in these equations and not the other equations.

<u>City Bank Status</u>: The regression equations suggest that banks with "city" bank status tend to operate inefficiently. The city bank dummy variable (ICB) was significant in equations 15a - 17a and 1d - 5d. In equations 15a to 17a the estimated coefficient of ICB was .003 or .002, and in equations 1d thru 5d the estimated coefficients were all .006.

<u>Bank Growth (PCDE)</u>: In most equations a bank's deposit growth over the last three years was not significant at the 5 per cent level. The only equations in which growth was significant were those using just unit bank data. In these equations, 1c thru 5c and 1d thru 5d, the coefficients were all positive, suggesting that rapidly growing unit banks are less efficient then stable ones. The estimated coefficients of PCDE in equations 1c thru 5c were about <u>.00001</u> and in equations 1d thru 5d were .0001.

<u>Deposit Quality</u>: An interesting result was that of the three variables used to capture deposit activity only one, DQ1 ever achieved significance. It was significant in equations 6b-9b and had an estimated coefficient of .0008. DQ1 was also found to be significant in all equations run on unit banks alone. In equations 1c thru 5c its coefficient was .00007 and equations 1d thru 5d it had an estimated coefficient of .0009. These positive coefficients imply, as was hypothesized, that as a bank "credits per account" tends to go up its average cost increases correspondingly. The fact that DQ and DQ2 were not significant may be because banks gear their service charges to these two activities, and as a result this influence was captured in WID.

In all equations, deposit fluctuation dummy variables had the proper size ordering, and, in most cases, were significant. Listed below are the estimated coefficients of the seasonal fluctuations variable of equation 14a and 10b.

	(L+I)	(RA)
IMFL (Moderate Deposit Fluctuation)	.0009	.008
IHFL (High Depsoit Fluctuation)	.002	.012

Since the coefficient of IHFL is always greater than IMFL these results support the hypothesis that banks with greater deposit fluctuations are less efficient than banks with a lower fluctuation.

Portfolio Mix Variables: The estimates of the coefficients of the portfolio mix variables were just about as they were expected to be. However, since the interpretation of these variables differs depending on whether the regressions were based on $IMI_{(L+I)}$ or $IMI_{(RA)}$ each is discussed independently. In the regressions based on $IMI_{(L+I)}$ the only portfolio variable that was not significant was the per cent which commercial loans were of total loans (PMCL). Equation 6a is typical of these "a" equations. The estimated coefficient of PMLO was .024 with a t-value of 10.1 which suggests that as a bank increases the loans in its portfolio its costs also go up. The per cent of installment loans to total loans (PMIL), mortgage loans to total loans (PMMC), and charge plan loans (PMAC) to total loans were also significant. The estimated coefficient of PMIL was .008, PMML was -.02, and PMAC was .15. The negative coefficient of PMML implies that a bank's costs decline as its proportion of mortgages increases. A possible cause of this is that banks buy a large number of their mortgages on the secondary market, and are thus no more costly a service to provide than an investment. The per cent which nonloan and investment revenue was of total revenue

(PMNB) was positive with a coefficient of .095. This result was expected with the efficiency index based on the (L+I) measure of output since the costs of these nonbanking services are accounted for in a bank's average costs, but there is no greater output associated with these services to offset the costs.

In the regressions based on $IMI_{(RA)}$ only PMLO and PMAC were clearly significant at the 5 per cent level. In equation 6b, for example the coefficient of PMLO was .14 with a t-value of 3.84 and the coefficient of PMAC was .16 with a t-value of 2.98. These results suggest that the independent cost curves for these particular services are non-linear.

Table XVII
Regression Results
(All Banks)
Efficiency Index based on Loans and Investments "Output": $IMI_{(L+I)}$

Environmental and Other Variables . . .

Regression Run Number	R^2	F Value	Intercept	IQ	WAGIX	AI	WID	ICB	IMFL	IHFL	PCDE	DQ	DQ1	DQ2
1a	.03	10.1*	.02											
2a	.03	10.1*	.02											
3a	.03	10.1*	.02											
4a	.03	10.2*	.02											
5a	.03	10.1*	.02											
6a	.29	16.4*	.01		-.002 (-1.39)	-.0039 (-3.59)*	-.0014 (-4.21)*				0.00 (1.88)	-0.00 (-.63)	.00003 (1.50)	-0.00 (-.99)
7a	.29	16.4*	.01		-.002 (-1.07)	-.0039 (-3.59)*	-.0014 (-4.24)*				0.00 (1.85)	-0.00 (-.63)	.00003 (1.50)	-0.00 (-1.03)
8a	.29	16.4*	.01		-.002 (-1.08)	-.0039 (-3.59)*	-.0014 (-4.26)*				0.00 (1.85)	-0.00 (-.61)	.00003 (1.42)	-0.00 (-1.05)
9a	.29	16.4*	.01		-.002 (-1.17)	-.0039 (-3.58)*	-.0014 (-4.23)*				0.00 (1.86)	-0.00 (-.61)	.00003 (1.40)	-0.00 (-1.05)
10a	.29	16.4*	.01		-.002 (-.99)	-.0039 (-3.37)*	-.0014 (-4.20)*				0.00 (1.84)	-0.00 (-.67)	.00003 (1.45)	-0.00 (-.98)
11a	.29	22.7*	.01	-.00004 (-4.20)*	-.004 (-2.58)*	-.004 (-3.92)*	-.002 (-4.93)*	.0007 (.90)	.0009 (4.33)*	.002	0.00 (1.79)		.00002 (1.06)	
12a	.29	22.7*	.01	-.00004 (-4.18)*	-.004 (-2.24)*	-.004 (-3.97)*	-.002 (-4.94)*	.0007 (.83)	.0009 (4.33)*	.002	0.00 (1.82)			
13a	.29	22.7*	.01	-.00004 (-4.15)*	-.004 (-2.13)*	-.004 (-3.92)*	-.002 (-4.97)*	.0007 (.85)	.0009 (4.33)*	.002	0.00 (1.77)			
14a	.22	22.7	.01	-.00004 (-4.14)*	-.003 (-2.10)*	-.004 (-3.92)*	-.002 (-4.98)*	.0007 (.84)	.0009 (4.33)*	.002	0.00 (1.76)			
15a	.22	19.2*	.01	-.00003 (-3.16)*		-.005 (-4.57)*	-.001 (-4.33)*	.003 (3.12)*			0.00 (1.65)			
16a	.22	19.2*	.01	-.00003 (-3.19)*		-.005 (-4.55)*	-.001 (-4.35)*	.002 (2.98)*			0.00 (1.59)			
17a	.22	19.2*	.01	-.00003 (-3.18)*		-.005 (-4.47)*	-.001 (-4.35)*	.002 (3.00)*			0.00 (1.60)			

Regression Run Number	IBR2	IBR3	IBR4	IBR5	IHC2	IHC3	PMLO	PMIL	PMCL	PMML	PMOB	PMAC
6a	.001	.0007 (4.00)*	-.0004	.0001	.002	-.001 (2.00)	.024 (10.1)*	.008 (4.34)*	.0004 (.34)	-.02 (-2.57)*	.095 (7.43)*	.15 (4.10)*
7a	.001	.0007 (4.00)*	-.0004	.0001	.002	-.003 (2.00)	.024 (10.1)*	.008 (4.36)*	.0004 (.36)	-.02 (-2.61)*	.096 (7.44)*	.15 (4.13)*
8a	.001	.0007 (4.00)*	-.0004	.0001	.002	-.001 (2.00)	.024 (10.1)*	.008 (4.36)*	.0004 (.35)	-.020 (-2.61)*	.096 (7.45)*	.15 (4.15)*
9a	.001	.0007 (4.00)*	-.0004	.0001	.002	-.001 (2.00)	.024 (10.1)*	.008 (4.35)*	.0004 (.35)	-.020 (-2.63)*	.095 (7.44)	.15 (4.13)*
10a	.001	.0007 (4.00)*	-.0004	.0001	.002	-.001 (2.00)	.024 (10.1)*	.008 (4.34)*	.0004 (.34)	-.020 (-2.59)*	.096 (7.44)*	.15 (4.14)*
11a							.024 (10.1)*	.008 (4.61)*			.09 (7.25)*	.17 (4.84)*
12a							.024 (10.1)*	.008 (4.76)*			.09 (7.38)*	.17 (4.98)*
13a							.024 (10.1)*	.008 (4.77)*			.09 (7.38)*	.17 (5.01)*
14a							.024 (10.1)*	.008 (4.79)*			.09 (7.38)*	.17 (5.03)*
15a							.025 (10.1)*	.008 (4.55)*				
16a							.025 (10.1)*	.008 (4.60)*				
17a							.025 (10.1)*	.008 (4.58)*				

Regression Run Number	Current Competition: PC1B	PC3B	HERF	CCIX	LPOP	Potential Competition: [illegible]	[illegible]	MHC*
1a	-.002 (-1.08)					-.0039 (5.00)*	-.0037	
2a		-.001 (-1.15)				-.0039 (5.00)*	-.0037	
3a			-.003 (-2.25)*			-.0039 (5.00)*	-.0037	
4a				-.00002 (-1.54)		-.0039 (5.00)*	-.0037	
5a					-.00001 (.65)	-.004 (5.50)*	-.003	
6a	.0006 (-.45)					-.0025 (11.2)*	-.0008	
7a		-.0002 (-.18)				-.0026 (11.2)*	-.0009	
8a			-.007 (-.45)			-.0026 (11.2)*	-.0009	
9a				-0.00 (-.003)		-.0026 (11.2)*	-.0008	
10a					-.00001 (-.17)	-.0025 (11.2)*	-.0007	
11a	.0011 (.62)					-.003 (9.40)*	-.0014	-.00002 (-1.33)
12a		.0009 (.68)				-.003 (9.40)*	-.0015	-.00002 (-1.55)
13a			-.0005 (-.059)			-.003 (9.40)*	-.0016	-.00002 (-1.34)
14a			-.0005 (-.315)			-.003 (9.40)*	-.002	-.00002 (-1.26)
15a						-.003 (10.0)*	-.002	-.00001 (-1.28)
16a		-.001 (-1.29)				-.003 (10.0)*	-.001	-.00001 (-1.21)
17a			-.0019 (-1.43)			-.003 (10.0)*	-.001	-.00001 (-1.25)

T - Values are under each regression coefficient, and in the case of sets of dummy variables F - values are presented. Variables significant at the 5 per cent level of significance are given asterisks.

*MHC belongs in the other variable classification.

Table XVIII
Regression Results
(All Banks)
Efficiency Index based on Revenue Adjusted "Output": $IMI_{(RA)}$

Regression Run Number	R^2	F Value	Intercept	Environmental and Other Variables . . . IQ	WAGIX	AI	WID	ICB	IMFL	IHFL	PCDE	DQ	DQ1	DQ2	IBR2	IBR3	IBR4	IBR5	IHC2	IHC3	PMLO	PMIL	PMCL	PMML	PMNB	PMAC	Current Competition PC1B	PC3B	HERF	CCIX	IPOP	Potential Competition LLBS	LUBS	MHC*
1b	.02	7.56	.27																								-.02 (-1.20)					-.02	-.00009 (9.80)*	
2b	.03	8.03	.28																									-.02 (-1.67)				-.02	-.0009 (9.70)*	
3b	.03	8.34	.27																										-.04 (-1.93)			-.02	.0002 (9.80)*	
4b	.03	7.97	.27																											-.03 (-1.61)		-.02	-.0005 (9.80)*	
5b	.03	7.91	.26																												-.0002 (-1.57)	-.02	-.003 (8.50)*	
6b	.11	4.70	.29		-.02 (-.62)	-.06 (-3.86)*	-.01 (-2.89)*				.00003 (1.19)	-.00006 (-1.32)	.0008 (2.53)*	-.00001 (-.73)	-.008	-.025 (5.50)*	-.04	-.036	-.008	-.02 (1.84)	.14 (3.84)*	-.05 (-1.92)	-.03 (-1.52)	-.17 (-1.48)	.23 (1.18)	.16 (2.98)*	-.01 (-.417)					-.02	.006 (5.90)*	
7b	.11	4.76	.29		.005 (-.18)	-.06 (-3.91)*	-.02 (-2.95)*				.00003 (1.14)	-.00006 (-1.31)	.0008 (2.42)*	-.00001 (-.81)	-.008	-.025 (7.31)*	-.04	-.036	-.008	-.02 (1.83)	.14 (3.88)*	-.05 (-1.87)	-.03 (-1.48)	-.18 (-1.57)	.24 (1.21)	.16 (3.01)*		-.02 (-1.19)				-.02	.005 (5.80)*	
8b	.11	4.75	.29		-.008 (-.31)	-.06 (-3.85)*	-.04 (-2.93)*				.00003 (1.17)	-.00006 (-1.31)	.0008 (2.45)*	-.00001 (-.77)	-.008	-.026 (6.50)*	-.04	-.036	-.007	-.02 (1.85)	.14 (3.80)*	-.05 (-1.91)	-.03 (-1.52)	-.18 (-1.53)	.23 (1.19)	.16 (3.03)*			.03 (-1.12)			-.02	.005 (5.80)*	
9b	.11	4.73	.29		-.009 (-.34)	-.06 (-3.87)*	-.02 (-2.93)*				.00003 (1.17)	-.00006 (-1.31)	.0008 (2.47)*	-.00001 (-.77)	-.008	-.026 (6.40)*	-.04	-.036	-.007	-.02 (1.85)	.14 (3.84)*	-.05 (-1.90)	-.03 (-1.51)	-.18 (-1.53)	.23 (1.19)	.16 (3.00)*					-.02 (-.90)	-.02	.005 (5.90)*	
10b	.10	6.18	.29	-.007 (-4.56)*	-.019 (-.77)	-.06 (-3.40)*	-.02 (-3.81)*	.004 (.33)	.008 (1.95)	.012	.00003 (1.34)										.12 (3.45)*	-.04 (-1.34)			.05 (.22)	.16 (3.11)*	-.01 (-.48)					-.02	.006 (9.71)*	-.0001 (-.79)
11b	.10	5.89	.27	-.007 (-4.54)*	-.012 (-.48)	-.06 (-3.45)*	-.02 (-3.82)*	.003 (.27)	.008 (1.97)	.012	.00003 (1.36)		.0003 (1.09)								.13 (3.40)*	-.04 (-1.45)			.03 (.16)	.16 (2.99)*		-.007 (-.32)				-.02	.007 (9.81)*	-.0001 (-.85)
12b	.10	6.31	.29	-.007 (-4.54)*	-.004 (-.17)	-.06 (-3.48)*	-.02 (-3.88)*	.003 (.25)	.008 (1.96)	.012	.00003 (1.28)										.13 (3.50)*	-.03 (-1.29)			.05 (.28)	.17 (3.17)*			.02 (-1.48)			-.02	.004 (9.83)*	-.0001 (-.72)
13b	.10	6.27	.29	-.0007 (-4.55)*	-.01 (.40)	-.05 (-3.40)*	-.02 (-3.61)*	.004 (.26)	.008 (2.00)	.013	.00003 (1.31)										.12 (3.40)*	-.04 (-1.33)			.05 (.27)	.16 (3.15)			.03 (-1.24)			-.02	.005 (9.83)*	-.0001 (-.80)
14b	.10	7.49	.25	-.0007 (-4.50)*		-.06 (-3.62)*	-.02 (-3.68)*		.008 (1.75)	.013	.00003 (1.24)		.0003 (1.19)								.12 (3.46)					.15 (2.98)*	-.01 (-.70)					-.02	.008 (11.2)*	-.0001 (-.78)
15b	.10	7.68	.27	-.0007 (-4.59)*		-.06 (-3.59)*	-.02 (-3.68)*		.008 (1.76)	.013	.00003 (1.18)		.0002 (.86)								.12 (3.51)*					.15 (3.01)*		-.02 (-1.65)				-.02	.005 (12.1)*	-.0001 (-.69)
16b	.10	7.62	.26	-.0007 (-4.60)*		-.06 (-3.54)*	-.02 (-3.64)*		.008 (1.75)	.013	.00003 (1.21)		.0003 (.99)								.12 (3.41)*					.15 (2.99)*			-.03 (-1.40)			-.02	.007 (11.2)*	-.00001 (-.76)
17b	.10	7.59	.26	-.0007 (-4.54)*		-.06 (-3.58)*	-.02 (-3.60)*		.008 (1.73)	.013	.00003 (1.21)		.0003 (1.00)								.12 (3.45)*					.15 (2.99)*						-.02	.006 (11.2)*	-.0001 (-.73)

T - Values are under each regression coefficient, and in the case of sets of dummy variables F - values are presented. Variables significant at the 5 per cent level of significance are given asterisks.

*MHC belongs in the other variable classification.

Table XIX

REGRESSION RESULTS
(Unit Banks)

Environmental and Other Variables . . .

Regression Run Number	R^2	F Value	Intercept	IQ	WAGIX	AI	WID	ICB	IMFL	IHFL	PCDE	DQ	DQ1	DQ2
1c	.34	11.8*	.003		-.002	-.003	-.001	.001	.001	.003	0.0	-0.0	.00007	-0.0
					(-.7[illegible])	(-2.47)*	(-2.55)*	(.97)		(3.66)*	(4.21)*	(-1.27)	(2.01)*	(-.41)
2c	.34	11.8*	.003		-.001	-.003	-.001	.001	.001	.003	.00001	-0.0	.00007	-0.0
					(-.54)	(-2.46)*	(-2.54)*	(.92)		(3.61)*	(4.23)*	(-1.47)	(2.03)*	(-.41)
3c	.34	11.8*	.003		-.001	-.003	-.001	.001	.001	.003	.00001	-.00001	.00007	-0.0
					(-.54)	(-2.45)*	(-2.54)*	(.93)		(3.62)*	(4.24)*	(-1.46)	(2.04)*	(-.41)
4c	.34	11.[illegible]*	.003		-.001	-.003	-.001	.001	.001	.003	.00001	-.00001	.00007	-0.0
					(-.58)	(-2.45)*	(-2.53)*	(.93)		(3.66)*	(4.23)*	(-1.43)	(2.04)*	(-.41)
5c	.34	11.8*	.003		-.001	-.003	-.001	.001	.001	.003	.00001	-.00001	.00007	-0.0
					(.-60)	(-2.45)*	(-2.54)*	(.94)		(3.66)*	(4.23)*	(-1.47)	(2.03)*	(-.41)
1d	.14	4.39*	.21		.001	-.06	-.01	.06	.02	.03	.0001		.0009	
					(.03)	(-3.11)*	(-1.95)*	(3.19)*		(6.32)*	(2.65)*		(2.25)*	
2d	.14	4.39*	.21		.003	-.06	-.01	.06	.02	.03	.0001		.0009	
					(.22)	(-3.11)*	(-1.96)*	(3.13)*		(6.33)*	(2.65)*		(2.18)*	
3d	.14	4.39*	.21		.004	-.06	-.01	.06	.02	.03	.0001		.0009	
					(.11)	(-3.10)*	(-1.94)*	(3.18)*		(6.32)*	(2.66)*		(2.23)*	
4d	.14	4.39*	.22		.006	-.06	-.01	.06	.02	.03	.0001		.0009	
					(.15)	(-3.10)*	(-1.96)*	(3.16)*		(6.33)*	(2.66)*		(2.21)*	
5d	.14	4.39*	.21		.006	-.06	-.01	.06	.02	.03	.0001		.0009	
					(.14)	(-3.11)*	(-1.96)*	(3.15)*		(6.32)*	(2.65)*		(2.20)*	

Regression Run Number	IBR2	IBR3	IBR4	IBR5	IHC2	IHC3	PMLO	PMIL	PMCL	PMML	PMNB	PMAC	Current Competition: PC1B	PC3B	HERF	CCIX	IPOP	Potential Competition: LLBS	LUBS	NRC*
Inefficiency Index Based on (L+I)																				
1c							.02	.007	-.0004	-.03	.12	.15	.0008					-.0002	.0006	
							(8.54)*	(3.08)*	(-.29)	(-2.59)*	(6.19)*	(2.02)*	(.48)					(.50)		
2c							.02	.007	-.0005	-.03	.12	.15		.00002				-.0002	.0006	
							(8.49)*	(3.07)*	(-.29)	(-2.63)*	(6.19)*	(2.03)*		(.008)				(.50)		
3c							.02	.007	-.0005	-.03	.12	.15			.00002			-.0002	.0006	
							(8.49)*	(3.10)*	(-.29)	(-2.63)*	(6.19)*	(2.03)*			(.008)			(.50)		
4c							.02	.007	-.0004	-.03	.12	.15				.0002		-.0002	.0006	
							(8.53)*	(3.10)*	(-.29)	(-2.63)*	(6.19)*	(2.02)*				(.11)		(.50)		
5c							.02	.007	-.0004	-.03	.12	.16					.00001	-.0002	.0006	
							(8.50)*	(3.10)*	(-.29)	(-2.62)*	(6.19)*	(2.03)*					(.005)	(.50)		
Inefficiency Index Based on (RA)																				
1d							.14	-.05	-.02	-.44	.57	1.15	.004					.003	.005	
							(3.37)*	(-1.53)	(-1.02)	(-2.26)*	(2.11)*	(1.04)	(.15)					(.50)		
2d							.14	-.05	-.02	-.45	.57	1.16		-.004				.003	.004	
							(3.37)*	(-1.51)	(-1.02)	(-2.30)*	(2.10)*	(1.04)		(-.21)				(.50)		
3d							.14	-.05	-.02	-.45	.57	1.16			-.003			.003	.005	
							(3.35)*	(-1.52)	(-1.02)	(-2.29)*	(2.11)*	(1.04)			(-.01)			(.50)		
4d							.14	-.05	-.02	-.44	.57	1.16				-.002		.003	.005	
							(3.36)*	(-1.52)	(-1.02)	(-2.24)*	(2.11)*	(1.04)				(-.09)		(.50)		
5d							.14	-.05	-.02	-.44	.56	1.16					-.001	.003	.004	
							(3.36)*	(-1.51)	(-1.03)	(-2.25)*	(2.10)*	(1.04)					(-.08)	(.50)		

T - Values are under each regression coefficient, and in the case of sets of dummy variables F - values are presented. Variables significant at the 5 per cent level of significance are given asterisks.

*NRC belongs in the other variable classification.

Table XX

RESULTS OF REGRESSION RUNS
(All Banks)
(Branch States Combined)

Environmental and Other Variables . . . | Current Competition | Potential Competition

Regression Run Number	R^2	F Value	Intercept	IQ	WAGIX	AI	WID	ICB	IMPL	IHFL	PCDE	DQ	DQ1	DQ2	IBR2	IBR3	IBR4	IBR5	IHC2	IHC3	PMLO	PMIL	PMCL	PMML	PMNB	PMAC	PC1B	PC3B	HERF	CCIX	IPOP	LLBS	LUBS	MHC*
															Inefficiency Index Based on (L+I)																			
1e	.28	14.7*	.006		-.002	-.004	-.002	.0002	.0010	.002	0.0	-0.0	.00004	-0.0	.001	.0004	-.0002	.0006	.002	-.002	.024	.008	.0005	-.02	.10	.14	.0005						.001	
					(-1.15)	(-3.96)*	(-4.82)*	(.26)	(4.31)*		(1.75)	(-.58)	(1.77)	(-1.04)		(3.31)*			(2.05)		(10.2)*	(4.20)*	(.39)	(-2.68)*	(7.51)*	(3.99)*	(.36)						(2.48)*	
2e	.28	14.7	.006		-.001	-.004	-.002	.0002	.0010	.002	0.0	-0.0	.00004	-0.0	.001	.0005	-.0002	.0007	.002	-.002	.025	.008	.0005	-.02	.10	.14		-.0003					.001	
					(-.82)	(-3.97)*	(-4.85)*	(.24)	(4.30)*		(1.72)	(-.57)	(1.69)	(-1.08)		(3.32)*			(2.04)		(10.2)*	(4.23)*	(.41)	(-2.73)*	(7.53)*	(4.03)*		(-.39)					(2.34)*	
3e	.28	14.7*	.006		-.001	-.004	-.002	.0002	.0010	.002	0.0	-0.0	.00004	-0.0	.001	.0004	-.0002	.0007	.002	-.002	.024	.008	.0005	-.02	.10	.14			-.0009				.001	
					(-.75)	(-3.96)*	(-4.88)*	(.23)	(4.31)*		(1.72)	(-.56)	(1.66)	(-1.10)		(3.31)*			(2.04)		(10.2)*	(4.23)*	(.41)	(-2.75)*	(7.54)*	(4.04)*			(-.61)				(2.35)*	
4e	.28	14.7*	.006		-.002	-.004	-.002	.0002	.001	.002	0.0	-0.0	.00004	-0.0	.001	.0004	-.0002	.0007	.0007	-.002	.025	.008	.0005	-.02	.10	.14				-.007			.001	
					(-.99)	(-3.96)*	(-4.88)*	(.25)	(4.32)*		(1.73)	(-.56)	(1.70)	(-1.09)		(3.33)*			(2.06)		(10.2)*	(4.21)*	(.41)	(-2.70)*	(7.51)*	(4.03)*				(-.51)			(2.34)*	
5e	.28	14.7*	.006		-.001	-.004	-.002	.0002	.001	.002	0.0	-0.0	.00004	-0.0	.001	.0004	-.0002	.0007	.0007	-.002	.024	.008	.0005	-.02	.10	.14					-.0006		.001	
					(-1.10)	(-3.96)*	(-4.88)*	(.23)	(4.32)*		(1.72)	(-.57)	(1.71)	(-1.10)		(3.35)*			(2.05)		(10.2)*	(4.22)*	(.41)	(-2.71)*	(7.51)*	(4.03)*					(-.41)		(2.36)*	
															Inefficiency Index Based on (RA)																			
1f	.10	4.31*	.26		-.013	-.067	-.016	.009	.010	.020	.00003	-.00006	.0009	-.00001	-.007	-.028	-.041	-.034	-.009	-.019	.14	-.053	-.031	-.176	.240	.15	-.009						.021	
					(-.50)	(-4.08)*	(-3.21)*	(.63)	(2.00)		(1.15)	(-1.31)	(2.73)*	(-.92)		(4.53)*			(.50)		(3.93)*	(-1.95)*	(-1.59)	(-1.53)	(1.23)	(2.90)*	(-.45)						(2.84)*	
2f	.10	4.37*	.26		-.001	-.067	-.016	.008	.010	.020	.00002	-.00006	.0009	-.00001	-.007	-.027	-.040	-.033	-.009	-.019	.14	-.052	-.030	-.187	.246	.15		-.016					.020	
					(-.05)	(-4.33)*	(-3.27)*	(.58)	(2.00)		(1.10)	(-1.30)	(2.60)*	(-.98)		(4.50)*			(.49)		(3.97)*	(-1.94)*	(-1.54)	(-1.62)	(1.26)	(2.94)*		(-1.25)					(2.65)*	
3f	.10	4.36*	.26		-.005	-.066	-.016	.008	.010	.020	.00003	-.00006	.0009	-.00001	-.007	-.027	-.041	-.034	-.009	-.019	.14	-.052	-.030	-.182	.243	.15			-.026				.021	
					(-.18)	(-4.07)*	(-3.24)*	(.61)	(2.01)		(1.12)	(-1.30)	(2.64)*	(-.96)		(4.50)*			(.48)		(3.88)*	(-1.94)*	(-1.58)	(-1.58)	(1.24)	(2.93)*			(-1.20)				(2.78)*	
4f	.10	4.34*	.26		-.005	-.067	-.015	.008	.010	.020	.00003	-.00006	.0009	-.00001	-.007	-.027	-.041	-.034	-.009	-.019	.14	-.052	-.030	-.182	.242	.15				-.018			.021	
					(-.20)	(-4.09)*	(-3.25)*	(.61)	(2.00)		(1.12)	(-1.30)	(2.65)*	(-.95)		(4.51)*			(.50)		(3.92)*	(-1.94)*	(-1.57)	(-1.58)	(1.24)	(2.92)*				(-.98)			(2.72)*	
5f	.10	4.35*	.26		-.006	-.066	-.016	.008	.01	.02	.00003	-.00006	.0009	-.00001	-.007	-.027	-.041	-.034	-.009	-.019	.14	-.053	-.030	-.182	.242	.15					-.018		.021	
					(-.21)	(-4.08)*	(-3.24)*	(.62)	(2.00)		(1.11)	(-1.30)	(2.65)*	(-.95)		(4.50)*			(.50)		(3.88)*	(-1.94)*	(-1.58)	(-1.60)	(1.24)	(2.92)*					(-.97)		(2.75)*	

T - Values are under each regression coefficient, and in the case of sets of dummy variables F - values are presented. Variables significant at the 5 per cent level of significance are given asterisks.

*MHC belongs in the other variable classification.

CHAPTER VII

SUMMARY AND CONCLUSIONS

The relationship between a bank's operating efficiency and the current and potential competition in that bank's market has been the topic of this paper. A behavioral model of the firm was used to develop hypotheses which suggested that a bank becomes more efficient as the competition it faces becomes more intense, and that a bank becomes more efficient the less extreme is the threat of entry of potential competitors into its market. The methodology employed to test these two hypotheses had two parts. First, an index of managerial efficiency was constructed. Second, this index was regressed against proxies for current and potential competition.

A major portion of this paper involved defining and developing procedures for measuring the economic concepts mentioned in the hypotheses. "Operational efficiency" was the first concept discussed. An operationally efficient bank was defined as one operating at the lowest possible cost, given the bank's size and organization form; and the managerial efficiency index was defined as the difference between a bank's average cost and the average cost of the most efficient bank of the same size and organizational form.

Two efficiency indexes were developed in response to two different ways of measuring a "bank's output". One output measure was the dollar volume of loans and investments held by a bank. The other measure was a bank's operating revenue adjusted to remove the influence of monopoly pricing from the income received from its production of loan services.

A bank's reported operating expenses minus the revenue received as service charges on deposit, was accepted as a bank's "operating costs". Revenues received as service charges on deposits were subtracted from costs because they were viewed strictly as a reduction in a bank's payment for its deposit inputs.

Seven measures of the "current competition" in a bank's market were developed. A bank's IPC (Individual, Partnership, and Corporation) deposits of less than $10,000 were used as a proxy for a bank's size in those measures that needed a size variable. A bank's market was defined as the SMSA in which it was located, and if it was not in one, its county; and if a bank had branch offices, any county or SMSA in which it had an office was considered part of the bank's market. Three of the measures of competition were absolute concentration ratios: the percentage of deposits held by largest, the three largest, and five largest banks in a given market. Two measures were relative concentration ratios. One was the Herfindahl index, and the other was the per cent of deposits held by the largest bank added to the Herfindahl Index of the remaining banks in a market. The two remaining measures of competition, which were developed, were the population per bank and the population per banking office.

The last concept examined was potential competition. The degree of potential competition in a bank's market was measured by the type of branching law in the state in which the bank was located. Potential entry was assumed to be greatest in states permitting statewide branching; next greatest in states permitting limited branch banking; and least in states permitting only unit banking.

Multiple regression analysis was used to test the influence of the current and potential competition variables on the efficiency indexes. In order to remove specification bias from the estimated coefficients of these variables, other variables which might influence a bank's operating efficiency were included as independent variables in the regression equations. These variables included factor payment indexes, measures of the quality of banks' deposits, and measures of banks' product mix.

The estimates of the regression equation resulted in two major findings. First, the estimated regressions did not support the hypothesis that the current competition a bank faces influences its level of operating efficiency. However, it is recommended that further research be done in this area with a more detailed breakdown of possible relationships. For example, it would be helpful and interesting to know how competition is related to the amount of advertising a bank does, and how rapidly a bank implements technological change, as well as knowing if it is related to management slack or to overall average costs. The second major finding was that the hypothesis that the greater the degree of potential competition in a bank's market (as measured by the bank's state's branching laws), the less efficiently banks in that market will operate could not be supported. In fact, the regression results suggested that banks in states where potential entry is greatest (branch banking states) tend to operate more efficiently than those in states where potential entry is of a lesser degree (unit banking states).

This study also produced evidence on other aspects of bank structure that are important to bank regulators. Estimates of banking's long-run average cost curve demonstrated rather substantial economies of scale in the range of very small banks with constant to slightly-increasing cost characterizing the curve thereafter. A comparison of the cost curves fitted to banks of different organizational forms revealed that unit banks were the most efficient form of bank throughout almost the whole range of banking. In addition, it was found that while holding company banks were more efficient than branch banks in the range of small banks, they were less efficient in the larger range of banks.

The findings of this study have some direct implications for what bank market structure is most conducive to efficient bank production. But, it must be emphasized, that since efficient production is only one goal of bank regulation, the results of this study should not be taken to have any direct implications for the "optimal bank structure."

An important controversy in bank regulation has centered around the incompatibility between the bank structure needed to obtain technically efficient production (production at the lowest point on the long-run average cost curve), and that needed to obtain competitive price and output performance. Jacobs described this dilemma clearly:

> If there are substantial economies of scale in banking, a competitive structure would not be viable, or it would be inefficient. Either a race for optimal size would result in some number of survivors less than that necessary to maintain competition, or the firm would engage in some sort of collusion out of fear of 'cut throat' competition.[1/]

The findings of this study suggest this controversy is still a meaningful one from the efficiency side of the debate. The evidence

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[1/] D.P. Jacobs, "The Framework of Commercial Bank Regulation," The National Banking Review, I (March, 1964), p. 344.

shows that substantial savings could be obtained by eliminating banks operating at a very low output. Furthermore, the evidence suggests that less extreme limits should be the setting for the debate than has been implied in recent discussions. Since few past estimates of the long-run average cost curves revealed any range in which banking experiences increasing costs, the controversy has often been referred to in the extreme -- contrasting the benefits society could gain from the existence of one huge bank, which could take full advantage of economies of scale, and the dangers to society inherent in the monopoly power which that one large bank would possess. The estimated cost curve in this study, however, does show a range of increasing cost. In fact, the minimum average cost of operation is achieved at a relatively small size. If this finding is accepted, the number of banks has only to be reduced enough to allow very small banks to grow to optimum size. Moreover, since the estimate of the long-run average cost curve shows rising costs after a certain point, the controversy might even be reversed in certain markets where large banks exist. In these markets it may be desirable to allow new banks to enter the market, increasing the competition and thus decreasing the size of large banks to a more technically efficient size.

The relationship found between a bank's operating efficiency and its organizational form also has implications for bank regulations. The fact that there was a distinct ordering of efficiency in terms of bank organization form for each size category suggests this aspect of bank structure should be taken into account by bank regulators. Unless there is some offsetting reason, an inefficient bank organizational form should not be approved, because it has been demonstrated that this is a less efficient organization form. Of course, as was pointed out in the paper, there are many limitations to this finding, and future research in this area would be useful.

The results of this paper have one other implication for this controversy. The findings suggest that regulators need not concern themselves with the degree of competition or the threat of potential competition in a market when making decisions about efficient production. If regulators can decide on the optimum bank size and attain a bank structure consistent with that size bank, they can assume that bank management will not choose to operate less efficiently due to the competition currently in the market or the degree of the threat of potential competition in that market.

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APPENDICES

APPENDIX I

A TEST OF FRONTIER ESTIMATES

The Kruskal-Wallis One Way Analysis of Variance By Rank was not applied to the frontier estimates in the main body of this paper because the necessary assumption did not seem reasonable given the data. The assumption requires that firms (banks) stochastically fall on or above the long-run average cost curve. However, in this paper the actual hypothesis being tested is that banks lie above the cost curves for systematic reasons like the degree of competition in its market. Moreover, some of these systematic reasons may be related to size.

Therefore, the test will be applied to the estimates of the long-run average cost curve as an example of the test's application. The Kruskal-Wallis One Way Analysis of Variance By Rank was chosen as the nonparametric test because it is the most efficient of the nonparametric tests for K independent samples. It has a power-efficiency of $3/\pi = 95.5$ per cent, when compared with the F test, the most powerful parametric test.[1]

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[1]Sidney Siegel, Nonparametric Tests for the Behavioral Sciences (New York: McGraw-Hill, 1956).

Explanation of the Kruskal-Wallis One Way Analysis of Variance By Rank

Function

The Kruskal-Wallis One Way Analysis of Variance By Rank is an extremely useful test for deciding whether K independent samples are from different populations. Sample values almost invariably differ somewhat, and the question is whether the differences among the samples signify genuine population differences or whether they represent merely chance variations such as are to be expected among several random samples from the same population. The Kruskal-Wallis technique tests the null hypothesis that the K samples come from the same population or from identical populations with respect to averages. The test assumes that the variable under study has an underlying continuous distribution. It requires at least ordinal measurement of that variable.

Rationale and Method

In the computation of the Kruskal-Wallis test, each of the N observations are replaced by ranks. That is, all of the scores from all of the K samples combined are ranked in a single series. The smallest score is replaced by rank 1, the next to smallest by rank 2, and the largest by rank N. N = the total number of independent observations in the K samples.

When this has been done, the sum of the ranks in each sample (column) is found. The Kruskal-Wallis test determines whether these sums of ranks are so disparate that they are not likely to have come from samples which were all drawn from the same population.

It can be shown that if the K samples actually are from the same population or from identical populations, that is, if H_o is true, then H (the statistic used in the Kruskal-Wallis test and defined by formula (a) below) is distributed as chi squares with df = K-1, provided that the sizes of the various K samples are not too small. That is,

$$\text{(a)} \quad H = \frac{12}{N(N+1)} \sum_{j=1}^{K} \frac{R_j^2}{n_j} - 3(N+1)$$ [2]

where:

K = number of samples

n_j = number of cases in j^{th} samples

N = Σn_j, number of cases in all samples combined

---

[2] Tied Observations - When ties occur between two or more scores, each score is given the mean of the ranks for which it is tied. Since the value of H is somewhat influenced by ties, one may wish to correct for ties in computing H. To correct for the effect of ties, H is computed by formula (a) and then divided by:

$$1 - \frac{\Sigma T}{N^3 - N}$$

where $T = t^3 - 1$ (when t is the number of tied observations in a tied group of scores)

N = number of observations in all K samples together

that is, $N = \Sigma n_j$

ΣT directs one to sum over all groups of ties. Thus, a general expression for H corrected for ties is:

$$\text{(b)} \quad H = \frac{\dfrac{12}{N(N+1)} \sum_{j=1}^{K} \dfrac{R_j^2}{n_j} - 3(N+1)}{1 - \Sigma T \;/\; (N^3 - n)}$$

The effect of correcting for ties is to increase the value of H and thus to make the result more significant than it would have been if uncorrected. Therefore, if one is able to reject H_o without making the correction (i.e., by using formula (a) for computing H), one will be able to reject H_o at an even more stringent level of significance if the correction is made.

R_j = sum of ranks in j^{th} sample (column)

$\sum_{j=1}^{K}$ = directs one to sum over the K samples (columns)

is distributed approximately as chi square with df = K-1, for sample sizes (n_j's) sufficiently large. Then, if the observed value of H is equal to or larger than the value of chi square given in Table XX for the previously set level of significance and for the observed value of df = K, then H_o may be rejected at that level of significance.

Application in This Paper

1. For both output measures the inefficiency index for each bank (which is its vertical distance above the fitted long-run average cost curve) was divided into two groups of subsamples.

   a. They were divided by their organizational form (unit, branch, and holding company).

   b. They were divided by their output size. The banks were ordered by output size, and grouped into eight subsamples of 100 banks and one of 98.

2. The null hypothesis for the tests were:
   H_o: There is no difference in the average inefficiency indices of banks of different organizational form or size groups.

3. The significance level was assumed to be .01 (α = .01), and, therefore, the rejection region

consists of all values of H which are so large that the probability associated with their occurrence under H_o for df = K-1 is equal to or less than $\alpha = .01$.

4. Results

TABLE XXI

H-VALUES [a]

Subsample Type

Output Measure	Organizational Form	Size
Loans Plus Investments	3.6 (9.2)	15.9 (20.9)
Revenue Adjusted for Monopoly Prices	45.3* (9.2)	19.2 (20.9)

* This is the only H which is large enough so that the null hypothesis rejected.

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[a]The top value in each category was the calculated H. The figure in parenthesis is the critical value for this particular test. If the top value is larger than the bottom, then H_o is rejected.

APPENDIX II

BABB'S ALGORITHM FOR ESTIMATING THE "FRONTIER" [1] LONG-RUN AVERAGE COST CURVES REQUIRING CONVEXITY

1. Banks are put in ascending order by output size.
2. Banks' average cost are plotted on the Y axis and outputs are the X axis of a Cartesian plane.
3. The slopes of the line segments connecting the smallest bank observation with all other bank observations are calculated.
4. The line segment having the slope with the lowest value is chosen as the first segment of the estimated "frontier" long-run average cost curve.
5. The observation having the larger output of the two which formed the chosen line segment now becomes the base point, and the slopes of the line segments connecting this base observation with those observations of all larger banks are calculated.
6. The line segment with the lowest slope becomes the second segment of the estimated curve.
7. This procedure is followed until the largest bank observation falls on a chosen line segment.

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[1] The algorithm was named after Christopher T. Babb who first conceived it. Fortran programs to estimate these curves are available on request from the author.

Not Requiring Convexity

This procedure is a slight revision of Babb's algorithm in that it does not require the estimated frontier long-run average cost curve to be convex, but it does limit the curve to changing the sign of its slope only once.

1. Banks are ordered by output size.

2. Banks' average costs are plotted on the Y axis and outputs on the X axis of a Cartesian plane.

3. The slope of the line segments connecting the smallest bank observation a with other bank observations are calculated. They are calculated in ascending order starting with the second smallest, third, and so forth. When any line segment's slope is zero or less, the procedure is stopped, and this line segment is accepted as a segment of the estimated "frontier" curve. The second observation of the chosen line segment denote as b, and the procedure begins again with this point.

4. However, if the lowest slope found on any iteration is not zero or less, then a slightly different procedure is followed. If this occurs the procedure is:

   a. Starting with the largest observation b in the latest line segment that was accepted, the slope of the line segment to the next largest observation _c_ is calculated. Then, the slopes of the line segments connecting _c_ and all larger banks are calculated if any of these are less than zero line segment _bc_ is rejected as part of the frontier. If no slope is less than zero _bc_ is accepted, and the procedure continues with point _c_ as the base point.

b. If _bc_ is rejected then the slope of the line segment connecting _b_ and the bank _d_ just larger than _c_ is calculated, and as in step _a_ the slopes of all segments connecting _d_ with larges banks are calculated. If any of the slopes are less than zero line segment _bd_ is rejected and the search procedure continues, if none are less than zero _bd_ becomes part of the frontier, and _d_ becomes the base point.

APPENDIX III

SCATTER DIAGRAMS OF SAMPLE BANK OBSERVATIONS

The charts on the following pages plot the average cost and output observations of the sample banks. Charts based on output measured (L+I) as well as (RA) are presented. In order to plot output observations on one page, output was divided by a thousand and taken to the log 10, and plotted in this form. This is the same as subtracting 3 from the log to the base 10 of the original output. It is important to recognize that average cost scale varies from diagram to diagram.

Chart 6
Scatter Diagram of All Banks
(Loans Plus Investments)

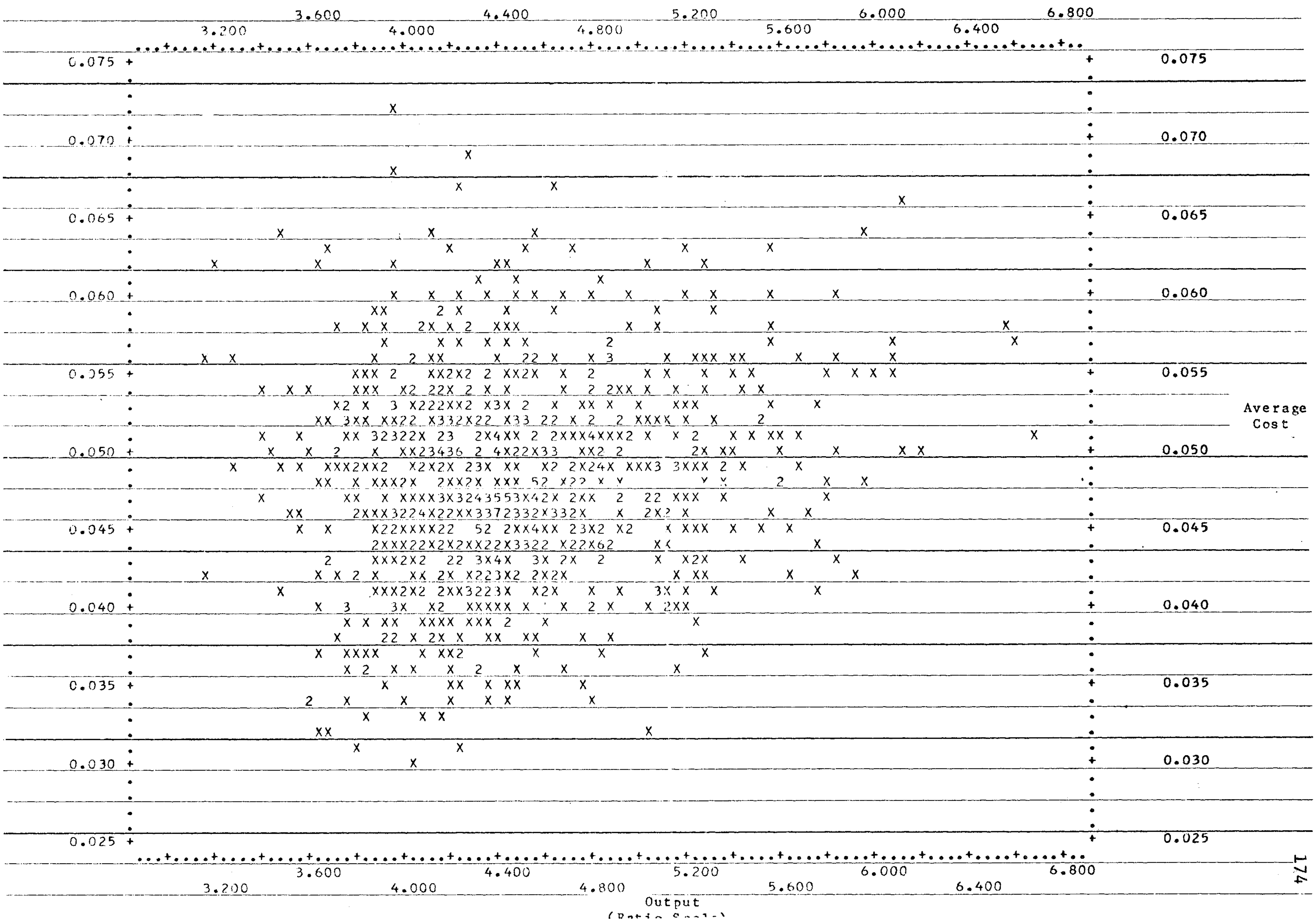


Chart 7
Scatter Diagram of Unit Banks
(Loans Plus Investments)

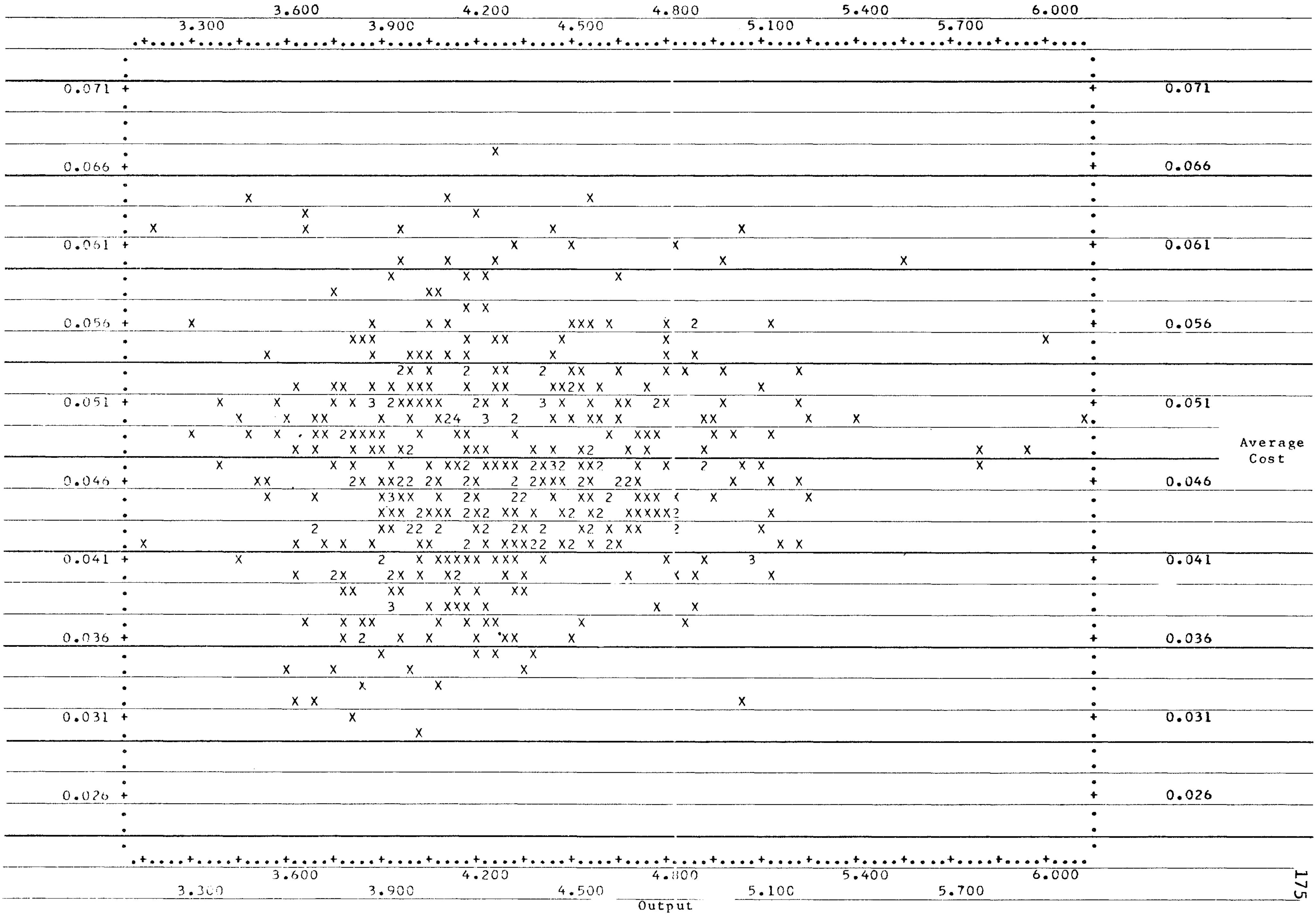


Chart 8
Scatter Diagram of Branch Banks
(Loans Plus Investments)

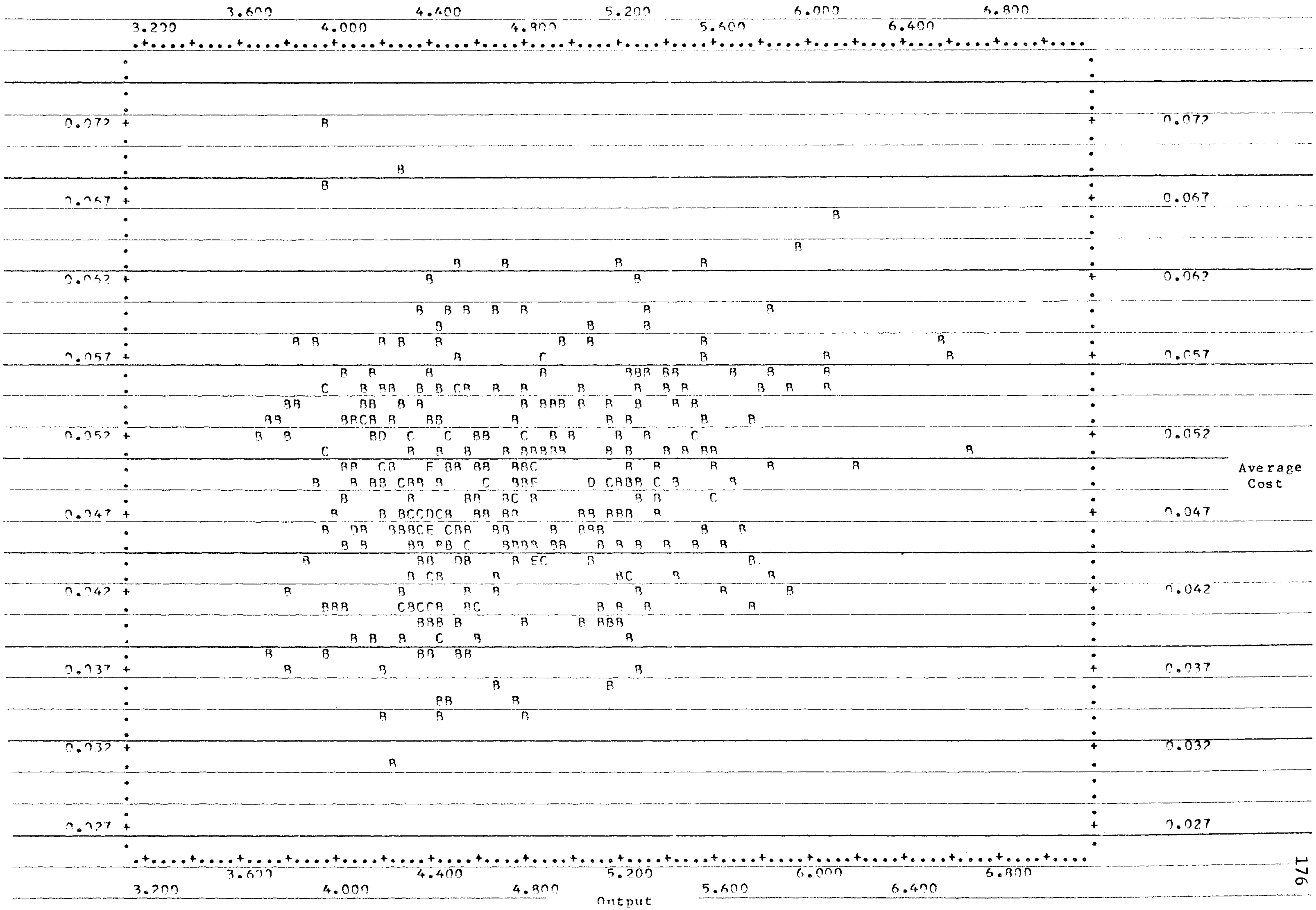


Chart 9
Scatter Diagram of Holding Company Subsidiary Banks
(Loans Plus Investments)

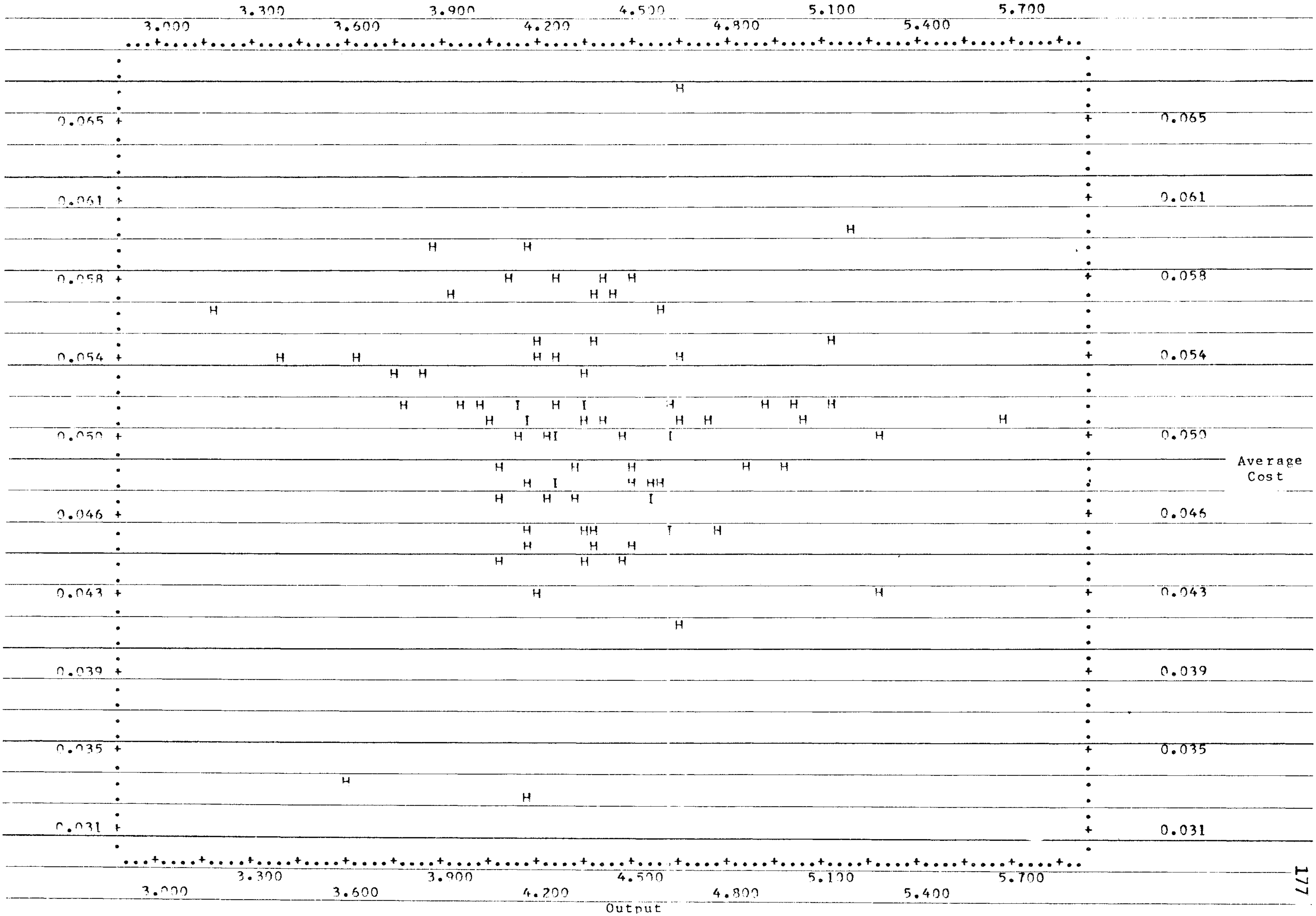


Chart 10
Scatter Diagram of All Banks
(Adjusted Revenue)

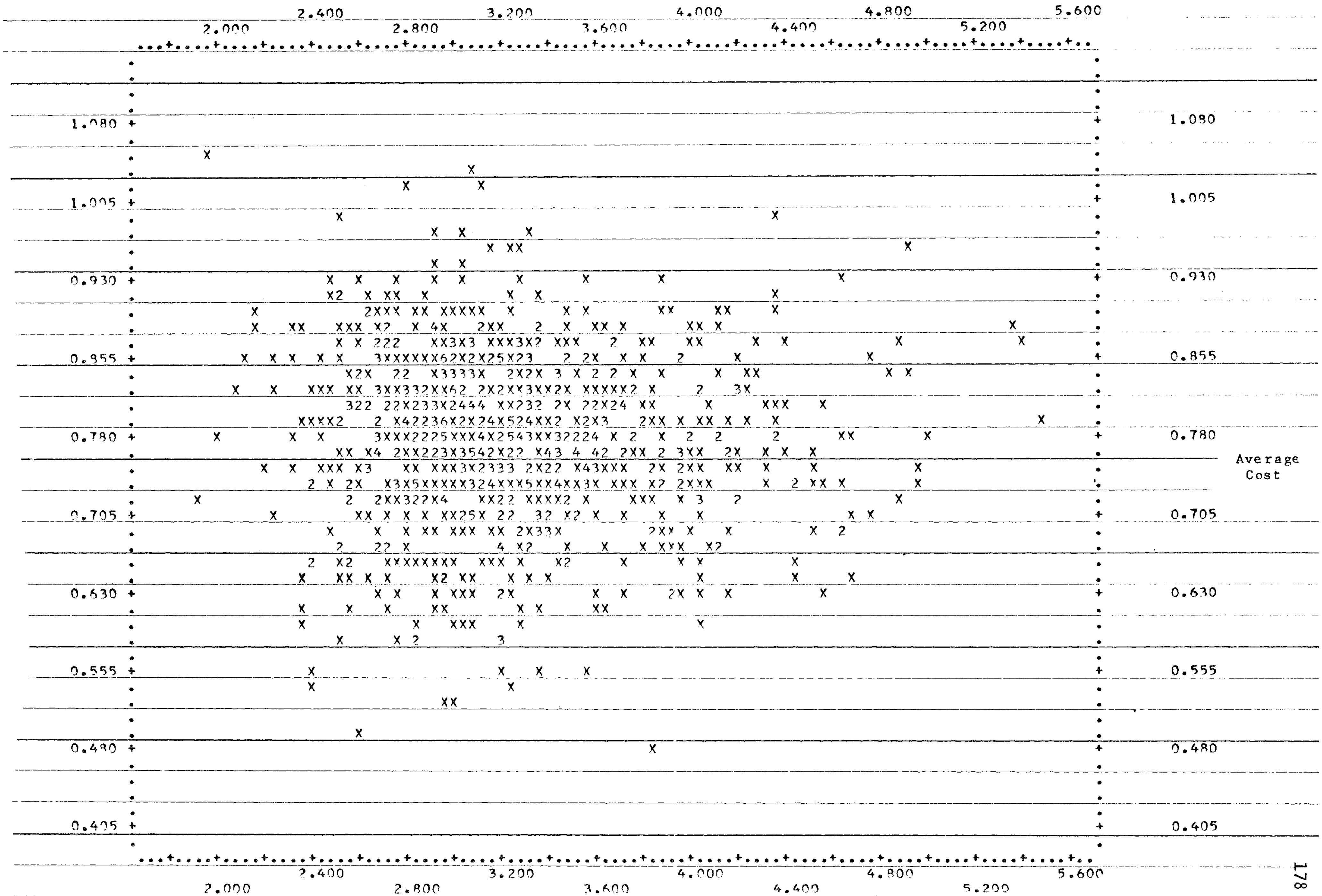


Chart 11
Scatter Diagram of Unit Banks
(Adjusted Revenue)

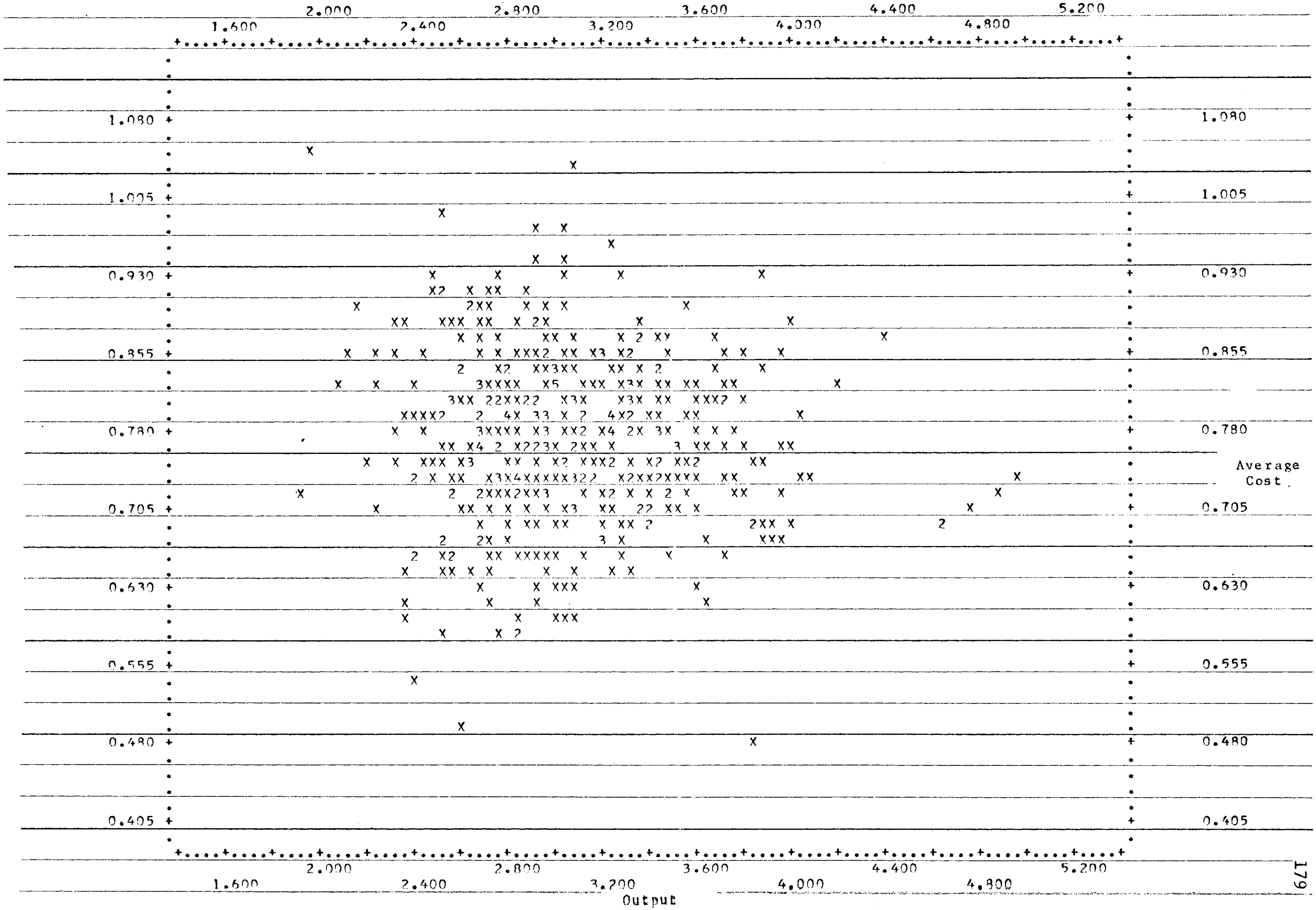


Chart 12
Scatter Diagram of Branch Bank
(Adjusted Revenue)

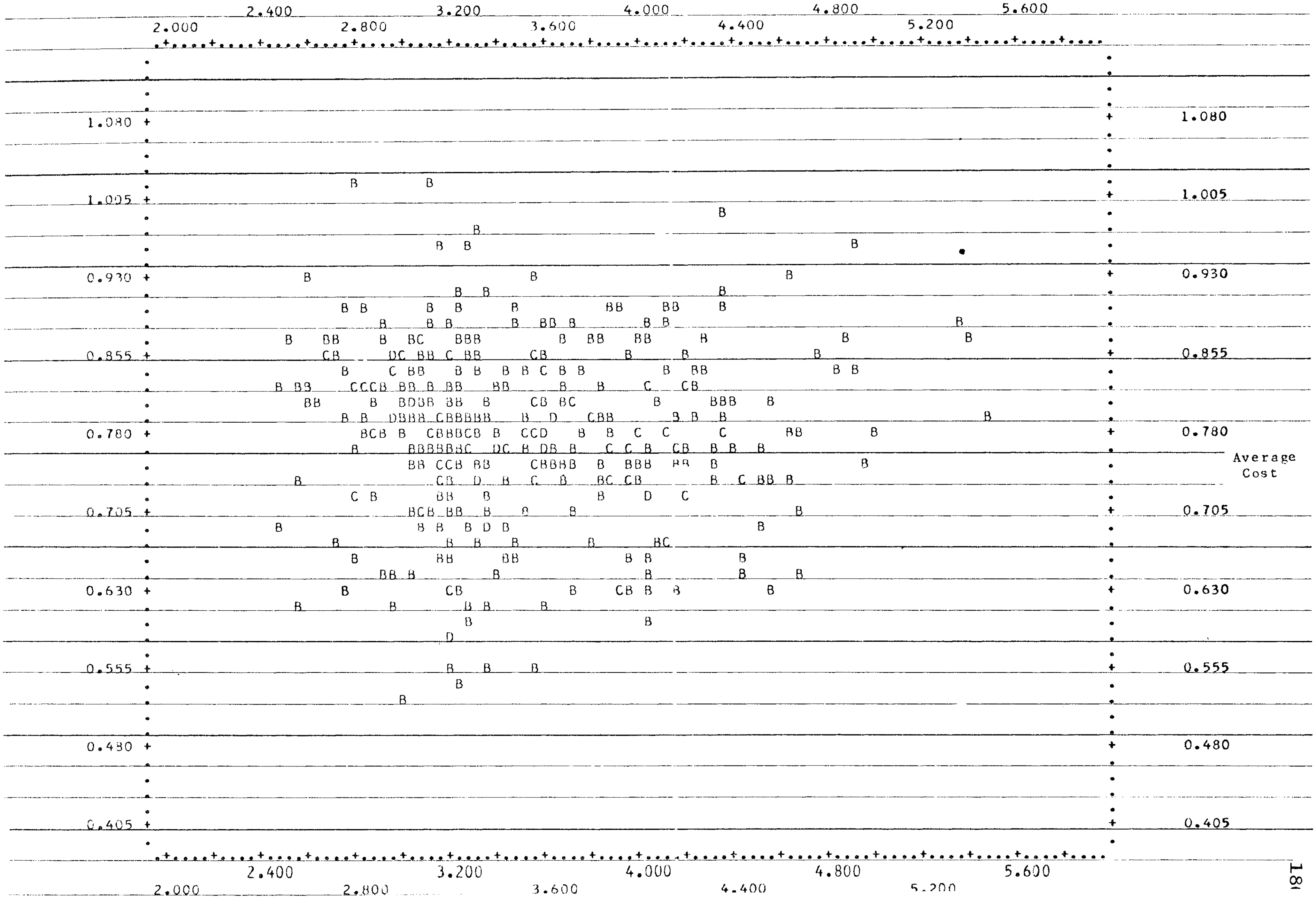
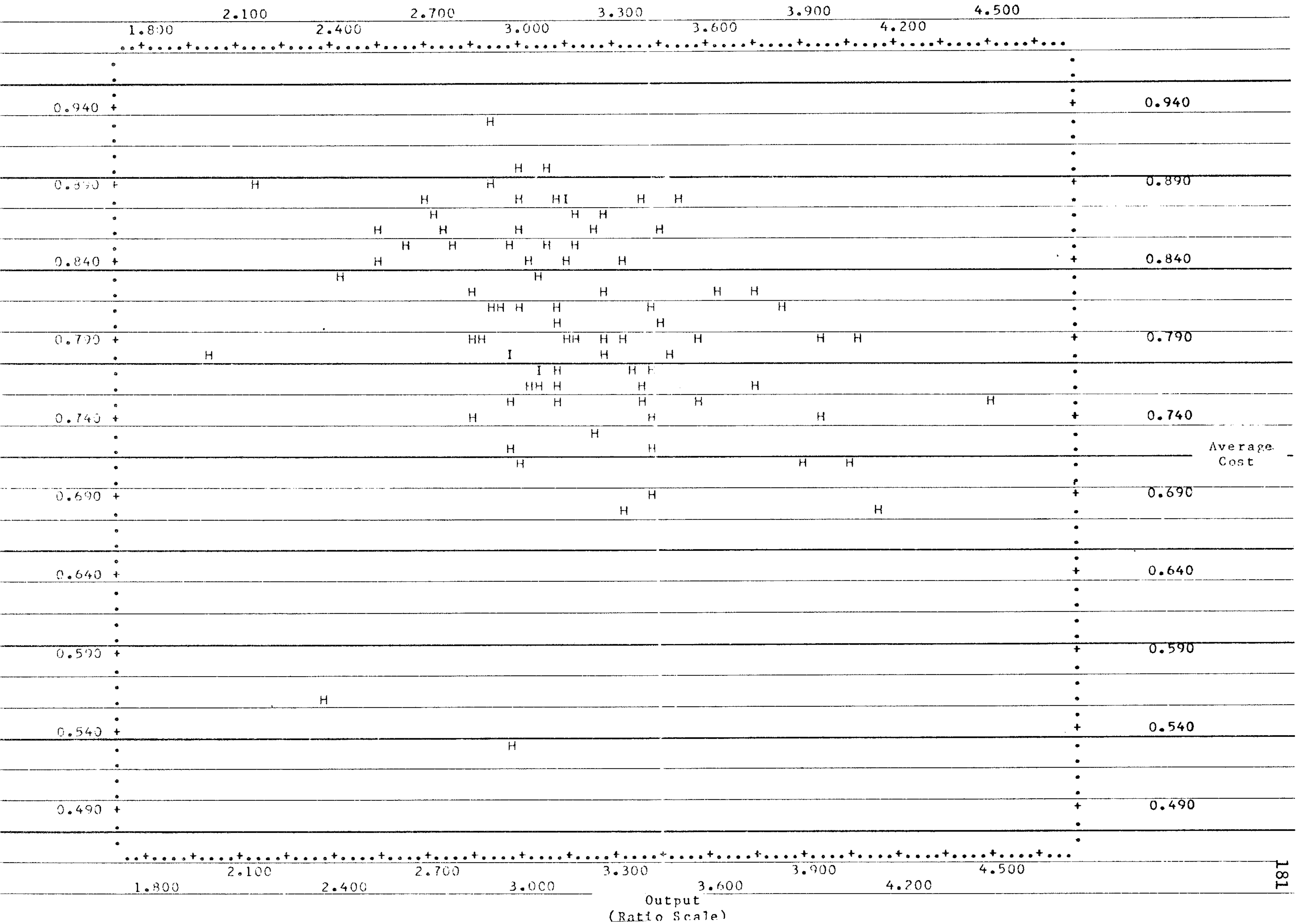


Chart 13
Scatter Diagram of Holding Company Subsidiary Banks
(Adjusted Revenue)



APPENDIX IV [1]

LEAST SQUARE ESTIMATES OF LONG RUN
AVERAGE COST CURVES

Loans Plus Investments

All Banks

1a $ac = .047 + \underset{(4.20)}{3.2 \times 10^{-12}} (L+I)$ $R^2 = .14$

1b $ac = .047 + \underset{(4.87)}{8.4 \times 10^{-12}} (L+I) - \underset{(-3.37)}{2.0 \times 10^{-13}} (L+I)$ $R^2 = .18$

Unit Banks

2a $ac = .047 + \underset{(2.12)}{6.3 \times 10^{-11}} (L+I)$ $R^2 = .099$

2b $ac = .047 + \underset{(2.34)}{1.76 \times 10^{-11}} (L+I) - \underset{(-1.63)}{1.2 \times 10^{-12}} (L+I)^2$ $R^2 = .12$

Branch Banks

3a $ac = .048 + \underset{(3.45)}{2.7 \times 10^{-12}} (L+I)$ $R^2 = .18$

3b $ac = .048 + \underset{(4.02)}{8.1 \times 10^{-12}} (L+I) - \underset{(-2.89)}{1.0 \times 10^{-13}} (L+I)$ $R^2 = .24$

Holding Company Banks

4a $ac = .05 + \underset{(.239)}{2.3 \times 10^{-12}} (L+I)$ $R^2 = .02$

4b $ac = .05 + \underset{(.32)}{7.5 \times 10^{-12}} (L+I) - \underset{(-.24)}{1.4 \times 10^{-12}} (L+I)$ $R^2 = .04$

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[1] Since a few banks are considerably larger than the other banks, the least square estimates were also made after these large banks had been dropped from the sample. This, however, did not alter the results at all, so only the estimates for the entire sample are given.

Revenue Adjusted for Monopoly Prices

All Banks

5a $ac = .78 + \underset{(1.24)}{1.8} \times 10^{-10}\ (RA)$ $\qquad R^2 = .04$

5b $ac = .78 - \underset{(-.15)}{5.0} \times 10^{-11} + \underset{(.78)}{1.0 \times 10^{-15}}\ (RA)^2$ $\qquad R^2 = .08$

Unit Banks

6a $ac = .77 - \underset{(-1.54)}{8.5} \times 10^{-10}\ (RA)$ $\qquad R^2 = .07$

6b $ac = .78 - \underset{(-1.17)}{1.84} \times 10^{-9}\ (RA) + \underset{(.68)}{1.0} \times 10^{-11}\ (RA)^2$ $\qquad R^2 = .08$

Branch Banks

7a $ac = .77 + \underset{(1.73)}{2.8} \times 10^{-10}\ (RA)$ $\qquad R^2 = .09$

7b $ac = .77 + \underset{(.89)}{3.7} \times 10\ (RA) - \underset{(-.24)}{1.0 \times 10^{-15}}\ (RA)$ $\qquad R^2 = .09$

Holding Company Banks

8a $ac = .81 - \underset{(-2.08)}{3.69} \times 10^{-9}\ (RA)$ $\qquad R^2 = .22$

8b $ac = .81 - 8.7 \times 10^{-9}\ (RA) + 2.0 \times 10^{-10}\ (RA)^2$ $\qquad R^2 = .26$