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Changes in the Structure of Urban Banking Markets in the West

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This paper begins with a discussion of the influence of the number of firms and the variance of market shares on the Herfindahl-Hirschman Index (HHI) measure of market concentration. The paper then reports the changes in the number of depository institutions (DIs) and in the HHI in the Twelfth District and its 65 individual urban banking markets between 1982 and 1992, attributing these changes to underlying causes. I find that, although an increase in concentration need not accompany a decrease in firms, more than two-thirds of the 53 markets with DI decreases showed concentration increases. This suggests that regulatory review of DI mergers has been and will continue to be important in assuring the competitiveness of banking markets.

Over the past decade, consolidation has led to many changes in the banking landscape. In the West, mergers such as those between Wells Fargo Bank and Crocker National Bank and between Bank of America and Security Pacific National Bank, as well as many less dramatic combinations, have eliminated banks from Alaska to Arizona. At the same time, numerous banks and even more thrifts have failed. Although brand new banks and thrifts continue to be formed, between 1982 and 1992, the Twelfth District saw the number of depository institution competitors decline by 15 percent, from 932 to 792.[1]

In this paper, I will discuss the changes wrought by a decade of bank and thrift mergers, failures, and entry on the structure of urban banking markets in the West.[2] Market structure is important because it is thought to influence competition, which, ultimately, can affect the welfare of the entire economy. The paper will focus on two aspects of market structure: the number of competitors and the concentration of market shares.

The paper will proceed as follows. In the first section, I briefly discuss the structure-conduct-performance paradigm of industrial organization theory. I also introduce the concept of market concentration and the statistic often used to measure it, the Herfindahl-Hirschman Index (HHI). The second section discusses how changes in the distribution of market shares and the number of depository institutions affect concentration. In the third section, I discuss the changes in concentration and in the number of depository institutions in the Twelfth District overall. In the fourth section, I report the changes in concentration and in the number of depository institutions in 65 local urban markets between 1982 and 1992 and attribute these changes to underlying causes. I also draw some general conclusions

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1. Here and throughout the paper, I refer to the states of Alaska, Arizona, California, Hawaii, Idaho, Nevada, Oregon, Utah, and Washington collectively as the Twelfth District. The Federal Reserve Bank of San Francisco, which serves the Twelfth Federal Reserve District, also serves American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands.

2. Relatively little research of this type has been conducted. However, David Holdsworth (1993) does provide some information on changes in the structure of banking markets in New York and New Jersey between 1980 and 1991.

regarding causes for changes in concentration and competitiveness in these markets. The fifth section concludes the paper.

I. THE STRUCTURE-CONDUCT-PERFORMANCE PARADIGM AND THE HHI

The structure-conduct-performance paradigm states that market structure influences firm conduct and, in turn, economic performance, and that the direction of such effects often is predictable. Elements of market structure include the number and size distribution of sellers and buyers, the degree of product differentiation, and the existence and extent of barriers to entry into the market. Characteristics of firm conduct include pricing behavior, advertising strategy, and technological innovation. Performance includes the efficiency of production and resource allocation.[3]

It is one of the most fundamental structure-conduct-performance theories of industrial organization that the smaller the number of firms dominating a market, the more likely those firms will be able to collude to maintain prices above the competitive level and thereby operate at an inefficient point on the production function. This link makes the study of market concentration valuable. Ideally, one would study market performance directly, because this is what we really care about, but this usually is infeasible. For example, determining the efficiency of production requires knowing the production technology, which often is very difficult, especially for multidimensional services such as banking. Alternatively, the structure-conduct-performance paradigm suggests that the conduct of firms is closely connected to performance. Here again, however, we often cannot directly observe firms' behavior. However, market concentration usually is fairly easy to measure. Determining changes in market concentration, then, can help to suggest the changes that may have taken place in competitiveness and productive efficiency.

However, the relationship between concentration and efficiency is not necessarily as unambiguous as just described. Many economists have pointed out that more concentrated markets may in fact be more efficient. This could be because efficient firms are more profitable, which causes them to grow and acquire market share. Therefore, efficient markets are ones in which there are a few large, profitable, and efficient firms, and inefficient markets are

ones in which no such efficient firms have emerged to take the lead in market share. In addition, economies of scale or scope in production may mean that being large *causes* a firm to be efficient. Again, this may mean that a market with a few large firms is more efficient than a market with many smaller firms.

Despite the validity of these arguments, numerous empirical studies support the view that, in many industries and under many circumstances, the greater the concentration of output in a small number of firms, the greater the likelihood of welfare losses due to weak competition and thereby low efficiency of production.

The Herfindahl-Hirschman Index

In fact, the link between concentration and the likelihood of welfare losses is sufficiently accepted that an assessment of the change in concentration is central to regulators' analyses of the effects of proposed mergers between firms in many industries, including banking. Banks and bank holding companies must apply to one or more of the federal banking agencies for approval of mergers and acquisitions. If regulators find that the proposed transaction would raise market concentration too much, the merger or acquisition application may be denied, or divestitures of branches or other assets to third parties may be required.

To measure concentration in banking markets, the federal bank regulatory agencies and the Department of Justice (DOJ) use a statistic called the Herfindahl-Hirschman Index (HHI). The HHI is computed as the sum of the squares of the percentage of deposits held by each of the competitors in a market. For example, if a market has only one firm, then the HHI is 100^2, or 10,000. If the market is evenly divided between two firms, the HHI is $50^2 + 50^2$, or 5,000.

The following example illustrates the use of the HHI for the evaluation of a hypothetical merger. Say that there are four banks in a market: A, B, C, and D. Say that, before the merger, A produces 35 percent of the output in the market, B 30 percent, C 20 percent, and D 15 percent. The premerger HHI, then, is $35^2 + 30^2 + 20^2 + 15^2$, or 2,750. Now, assume that banks B and D merge. The HHI after the merger would be $35^2 + (30 + 15)^2 + 20^2$, or 3,475. The merger increases the HHI by 725.

For evaluating individual mergers, the DOJ's bank merger policy indicates that a bank merger that increases the HHI in a local market by 200 points or more *and* results in an HHI of at least 1,800 would raise competitive concerns. While the policy is not hard and fast, its use has led to the denial of merger applications and, more often, to the divestiture of banking offices to third parties to reduce the effects on market concentration. As a result, the policy has

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3. F.M. Scherer discusses the structure-conduct-performance paradigm and uses it as the organizing theme for his classic textbook of industrial organization theory, *Industrial Market Structure and Economic Performance* (1980).

helped contain the adverse effects of individual mergers on competition.

In addition to being used for individual merger analysis, the HHI can be used to track changes in concentration over a period of time. Changes in concentration may be due to mergers, acquisitions, failures, withdrawals from the market, or simple shifts in market shares due to the dynamics of competition among an established set of banks and thrifts. The purpose of this paper is to describe how concentration and competitiveness in urban banking markets in the West changed between 1982 and 1992 and to discuss underlying causes for these changes and implications for policy. Because of its use in the competitive analysis of bank mergers, the HHI is an intuitively appealing measure of concentration and will be used in this paper.[4]

II. DETERMINANTS AND DYNAMICS OF THE HHI

In this section, I will discuss the relationship between the HHI and its two underlying determinants: the number of firms in a market and the distribution of market shares among those firms. The key to this relationship is the recognition that the HHI can be decomposed into the sum of two terms, one that depends on the number of firms and one that depends on the variance of their market shares.[5]

The HHI is given by

$$(1) \qquad HHI = \sum_{i=1}^{N} x_i^2 ,$$

where x_i is the percentage market share held by firm i and N is the total number of firms in the market. The variance of market shares, V, is

$$(2) \qquad V = \frac{1}{N} \sum_{i=1}^{N} (x_i - \bar{x})^2 ,$$

where $\bar{x}$ is the mean market share. Noting that

$$(3) \qquad V = \frac{1}{N} \sum_{i=1}^{N} x_i^2 - \bar{x}^2 ,$$

and that

$$(4) \qquad \bar{x} = \frac{1}{N} \sum_{i=1}^{N} x_i = \frac{100}{N} ,$$

we have, from (1),

$$(5) \qquad HHI = NV + N\bar{x}^2 = NV + \frac{10,000}{N} .$$

Equation (5) states that the HHI is the sum of two terms, the first a function of the number of firms and the variance of market shares and the second a function only of the number of firms. Two conclusions emerge directly from equation (5). First, the HHI increases with the variance of market shares. Therefore, given the number of firms, if the variance is at its minimum, the HHI also must be at its minimum. The minimum value of the variance is zero, and this yields a minimum HHI of 10,000/N. Second, if the HHI exceeds 10,000/N, it must be because the variance is greater than zero. By definition, the variance of a group of numbers is zero if and only if all of the numbers are equal. Therefore, the first term on the right-hand side of equation (5) can be interpreted as the contribution to the HHI of the dispersion of market shares away from equality, the "inequality effect," while the second term is what the HHI would be were the market shares of all N firms equal, the "number of firms" effect.

Because the HHI depends on the variance of market shares, shifts in the distribution of market shares affect the HHI. The effect of a change in market shares, holding N constant, can most easily be seen for the case in which only two market shares change. Let the original HHI be given by (1). Then, let the new HHI be given by

$$(6) \qquad HHI' = y^2 + z^2 + \sum_{i=3}^{N} x_i^2 .$$

Here, in the new distribution of market shares, x_1 and x_2 have been replaced by y and z, but none of the other market shares have changed. Subtracting (1) from (6), one finds that the HHI rises if and only if

$$(7) \qquad y^2 + z^2 > x_1^2 + x_2^2 .$$

However, we know that the sum of market shares must always be 100, so we can use the requirement that $x_1 + x_2$ equal $y + z$, and therefore that their squares be equal, to simplify the above condition to

$$(8) \qquad x_1 x_2 > yz.$$

We now see that, if two of the market shares change, the new HHI will exceed the old HHI if and only if the product of the new shares is less than the product of the old shares. The product of two numbers, the sum of which is a constant, increases as the two numbers converge and decreases as they diverge. Therefore, the new HHI will exceed the old HHI if the two shares have diverged and will be less than the old HHI if the two shares have converged. This also is the condition under which the variance of market shares increases when two market shares change. This is expected: From (5), it is apparent that, if the number of firms is held constant, concentration increases if and only if the variance of market shares increases.

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4. For more on the HHI, see Rhoades (1993).

5. I thank Mark Levonian for pointing out this relationship.

The insight offered by equation (8) also provides a convenient way to prove that within-market mergers must increase concentration if none of the market shares of the uninvolved firms change. Let N be the number of firms in the market before the merger, and let the firms that will merge, firm 1 and firm 2, have market shares of x_1 and x_2. After the merger, one can still think of the market as having N firms. The new, merged firm, has market share $y = x_1 + x_2$, and it can be thought to have replaced, say, firm 1. Firm 2's new share, z, is now zero. As long as the market shares of all of the $N-2$ uninvolved firms have not shifted, concentration must have increased because the shares of the involved firms have diverged.[6] Likewise, the entry of a new firm into a market must decrease concentration as long as the market share of only one firm already in the market is affected.

The condition under which the HHI will increase when more than two market shares change is a simple generalization of the condition expressed in (8): In order for any number of changes in market shares to increase the HHI, the sum of all of the cross-products of the new market shares has to be less than the sum of all of the cross-products of the shares that they replaced. (This is exactly the condition under which the variance of market shares increases when market shares change.) For example, if, in two lists of equal numbers of market shares, three market shares differ across lists, the HHI for the new list will be greater than the HHI for the old list if and only if

$$(9) \qquad x_1x_2 + x_1x_3 + x_2x_3 > wy + wz + yz,$$

where w, y, and z are the new market shares, and x_1, x_2, and x_3 are the shares that they replaced.

A final point regarding the relationship between the HHI and the distribution of market shares is that, using (5),

$$(10) \qquad \frac{\partial HHI}{\partial V} = N.$$

Holding N constant, a given increase in the variance increases the HHI more, the greater the number of firms.

Regarding the relationship between the number of competitors and the HHI, equation (5) offers several insights. It says that the minimum HHI, obtained when the variance is zero and all market shares are equal, is lower with more firms in the market (higher N). In addition, equation (5) provides intuition for the meaning of the DOJ's definition

of a "highly concentrated" banking market.[7] Express any value of the HHI as 10,000 times the inverse of some number. Then, that number is the number of equal-sized firms that would give the same value of the HHI. The DOJ definition of a highly concentrated banking market as one with an HHI of at least 1,800 means that a market with six equal-sized banks is not too concentrated, but one with five equal-sized banks is. This is because

$$(11) \quad \frac{10,000}{6} = 1,666.67 < 1,800 < \frac{10,000}{5} = 2,000.$$

If market shares are not equal, the relationship between the number of firms and the HHI is somewhat more complicated. *If V is held constant,* we can determine the effect on the HHI of an increase in the number of firms by taking the partial derivative of the HHI with respect to N. From (5), we have

$$(12) \qquad \frac{\partial HHI}{\partial N} = V - \frac{10,000}{N^2}.$$

Holding V constant, an increase in N lowers the HHI if V is less than $10,000/N^2$ and raises the HHI if V is greater than $10,000/N^2$. Also, note that

$$(13) \qquad \frac{\partial^2 H}{\partial N^2} = \frac{2}{N^3} > 0,$$

so that, the larger is N, the less the decline in the HHI when firms are added. In addition, note that the first term on the right-hand side of (12), the partial derivative of the inequality effect with respect to N, is positive as long as V is positive. This means that, as long as V is positive, an increase (decrease) in the number of firms will increase (decrease) the *effect* of the inequality of shares on concentration, even if inequality as measured by the variance does not change.

However, it is likely that, in many situations, equations (12) and (13) do not apply. This is because, in practice, a change in the number of firms must change some market shares and therefore likely will change the variance of market shares. If the variance changes, the derivative of the HHI with respect to N is given by:

$$(14) \qquad \frac{dHHI}{dN} = V + N\frac{dV}{dN} - \frac{10,000}{N^2}.$$

Unfortunately, the variance of market shares can change any number of ways as the number of firms changes, so neither the sign nor the size of dV/dN is known.

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6. There is a tendency for some acquiring banks to lose some of the combined market share of the merged firms following an acquisition. Sometimes, competitors have been able to attract customers from merged institutions because they closed branches or otherwise changed bank practices. This type of effect helps to reduce the concentrating effects of within-market mergers.

7. The DOJ classifies markets with an HHI below 1,000 as "unconcentrated," those with an HHI between 1,000 and 1,800 as "moderately concentrated," and those with an HHI above 1,800 as "highly concentrated."

However, it is straightforward to derive an expression for the discrete change in the HHI in terms of given discrete changes in N and V. Using equation (5), the change in the HHI due to moving from initial levels N_0 and V_0 to levels N_1 and V_1 is:

$$(15) \quad \Delta HHI = HHI_1 - HHI_0$$

$$= N_1V_1 + \frac{10,000}{N_1} - N_0V_0 - \frac{10,000}{N_0}.$$

Subtracting and adding N_1V_0 and gathering terms, this yields:

$$(16) \quad \Delta HHI = N_1\Delta V + \left(V_0 - \frac{10,000}{N_0N_1}\right)\Delta N.$$

Here, one can see that, as long as the initial variance of market shares is greater than $10,000/N_0N_1$, an increase in the number of firms along with an increase in the variance of market shares guarantees that concentration will increase. On the other hand, if initial variance exceeds $10,000/N_0N_1$ and V decreases, an increase in the number of firms will not necessarily increase concentration. The condition that initial variance exceed $10,000/N_0N_1$ is the discrete analogue to the condition in equation (12) that initial variance exceed $10,000/N^2$ in order for an increase in N to increase concentration if the variance of market shares does not change. If initial variance is less than $10,000/N_0N_1$, then an increase in N along with a decrease in V definitely will lower concentration. However, if V increases under these circumstances, concentration may increase.

Equation (5) also yields an alternative decomposition of discrete changes in concentration. Simply,

$$(17) \quad \Delta HHI = (N_1V_1 - N_0V_0)$$

$$+ \left(\frac{10,000}{N_1} - \frac{10,000}{N_0}\right).$$

The first term in (17) is the change in the inequality effect, and the second term is the change in the numbers of firms effect, that is the change in concentration in going from N_0 equal-sized firms to N_1 equal-sized firms. Equivalently, it is the change in concentration in going from N_0 firms to N_1 firms, *while holding the inequality effect constant*. Clearly, the second term is positive if and only if N_1 is less than N_0.

Of course, the changes in the variance of market shares, the number of firms, and the inequality effect all interact with one another, and one can combine the two decompositions in (16) and (17). Table 1 shows what happens to concentration given various combinations of increases and decreases in the number of firms, the inequality effect, and the variance of market shares. Panel A gives the breakdown for the case in which the initial variance of

TABLE 1

EFFECTS ON HHI OF CHANGES IN INEQUALITY EFFECT, VARIANCE, AND NUMBER OF FIRMS

PANEL A: $V_0 > (10,000/N_0N_1)$

		N Increases	No Change in N	N Decreases
NV Increases	V Increases	+	+	+
	V Decreases	+ or −	n.a.	n.a.
NV Decreases	V Increases	n.a.	n.a.	+ or −
	V Decreases	−	−	−

PANEL B: $V_0 < (10,000/N_0N_1)$

		N Increases	No Change in N	N Decreases
NV Increases	V Increases	+ or −	+	+
	V Decreases	−	n.a.	n.a.
NV Decreases	V Increases	n.a.	n.a.	+
	V Decreases	−	−	+ or −

NOTE: NV = inequality effect
V = variance
N = number of firms

market shares is greater than $10,000/N_0N_1$ and Panel B gives the breakdown for the case in which it is less than $10,000/N_0N_1$. Some of the cases in the table have ambiguous implications for concentration. The decomposition given in this table will be used to show the underlying causes for increases and decreases in concentration in local banking markets in the Twelfth District.

To summarize the important conclusions of this section:

1. Concentration depends on a "number of firms effect" and an "inequality effect," so changes in concentration depend on changes in these factors

2. The inequality effect itself depends on the number of firms and the variance of market shares

3. When both the number of firms and the variance of market shares change, the change in concentration depends on changes in these factors and on the size of the initial variance of market shares relative to a function of the initial and terminal numbers of firms.

III. Changes in the Number of Depository Institutions and in the HHI in the Twelfth District

The number of bank and thrift competitors in the Twelfth District declined by approximately 15 percent between 1982 and 1992, as the number of bank competitors went from 631 to 612, and the number of thrift competitors went from 301 to 180.[8] Note that these are the numbers of separate bank and thrift *competitors,* not the numbers of banks and thrifts. Many banks and some thrifts are subsidiaries of holding companies, and some of these holding companies have more than one bank or thrift subsidiary. Because they have common corporate control, I do not count separate subsidiaries of the same holding company as separate competitors.[9] I will refer to bank and thrift competitors as depository institutions (DIs). The number of DIs is the sum of all bank and thrift holding companies plus the number of banks and thrifts that are not holding company subsidiaries.

The number of DIs in the District has been influenced by several forces. First, there have been mergers between DIs. A merger between an in-District DI (a DI with at least one branch in the District, but not necessarily headquartered in the District) and another in-District DI, or an acquisition of an in-District DI by an in-District DI, reduces the number of DIs in the District by one. When the assets and liabilities of one DI are split up and sold to multiple DIs, this also reduces the number of DIs by one. Some mergers or acquisitions may have involved an out-of-District DI merging with or acquiring an in-District DI. These would have only changed DIs' names and would not have affected the number of DIs in the District.

Second, some DIs have failed, and their assets and liabilities have been taken over by other DIs. In essence, these were acquisitions, although it is likely that many of them differed from ordinary acquisitions in that the buyer received government assistance for the purchase. However, some DIs failed and were completely liquidated, with insured depositors paid off by the bank or thrift deposit insurance fund. Each such failure reduced the number of DIs by one.

Finally, some new DIs came into being, and each occurrence raised the number of DIs by one. New DIs arise when an applicant receives a new bank or thrift charter. Note, however, that when a holding company already in the market establishes a new subsidiary bank or thrift in the market by obtaining a new charter, this does not change the number of DIs in the market. On the other hand, if either an out-of-market holding company or a completely new entity obtains a new charter and sets up a new bank or thrift in the market, this raises the number of DIs in the market by one.[10]

The actual numbers of mergers, failures, and new entries of DIs in the Twelfth District between 1982 and 1992 are somewhat difficult to pinpoint. For example, it is much easier to determine the number of bank and thrift mergers than the number of DI mergers and acquisitions, and the two are not necessarily the same. Two banks that are subsidiaries of the same bank holding company may merge, but this does not change the number of DIs. In addition, a bank holding company may merge with another bank holding company, and each of several target banks may be merged into separate subsidiaries of the surviving bank holding company. Such a transaction would eliminate only one DI, even if it generated several bank mergers. On the other hand, a bank holding company can *acquire* a bank without merging it into another bank, and a list of bank mergers would not include such acquisitions. If the acquired bank was not part of a holding company, or if its former holding company had only one bank, this reduces the number of DIs by one. If the acquired bank was part of a holding company that still has at least one bank subsidiary after the acquisition, the acquisition does not affect the number of DIs.

Other complications involve the number of DI failures and new entries. It is fairly straightforward to determine the number of liquidated banks and thrifts. However, some of the liquidated banks or thrifts may be subsidiaries of holding companies with other still solvent subsidiaries, in which case the disappearance of the bank or thrift does not constitute the disappearance of a DI. Finally, one can easily determine the number of new bank and thrift charters granted between 1982 and 1992, but it is much more difficult to know whether or not those charters were granted to existing DIs.

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8. Only bank and thrift organizations that held deposits in these years were counted.

9. This is consistent with the practice followed by the federal depository institution regulatory agencies in the analysis of the competitive effects of bank and thrift mergers and acquisitions.

10. Branching by established out-of-market DIs also can increase the number of DIs. Also, acquisition of only some of the branches of a DI in a market by an out-of-market DI will increase the number of DIs by one. Most states in the District permit nationally chartered out-of-state thrifts to branch into their state by setting up new branches or acquiring existing branches, but only two states in the District permit interstate branching by banks. Utah permits out-of-state banks to operate offices in Utah as branches, and Nevada permits out-of-state banks to set up new branches in Nevada counties with a population less than 100,000. However, it is likely that any interstate thrift or bank branching would have had a very minor effect on the change in the number of DIs in the District as a whole.

Given the above complications, the following numbers of bank and thrift liquidations, new charters, and mergers will only approximate the number of banking competitor and thrift competitor liquidations, mergers, and new formations. There were 13 bank liquidations and 13 thrift liquidations in the District between 1982 and 1992. There were 113 new thrift charters granted and 324 new bank charters. Finally, there were 333 mergers in which the acquirer was a Twelfth District bank and the target was a Twelfth District bank or thrift and 208 mergers in which the acquirer was a Twelfth District thrift and the target was a Twelfth District bank or thrift. Subtracting the total number of bank liquidations and mergers from the 631 bank competitors existing in 1982 and adding the number of new bank charters yields 609 bank competitors, which is close to but slightly less than the actual number in 1992, 612. Subtracting the total number of thrift liquidations and mergers from the 301 thrift competitors existing in 1982 and adding the number of new thrift charters yields 193 thrift competitors, which is close to but somewhat greater than the actual number in 1992, 180.

However, these estimates of the changes in the numbers of bank and thrift competitors, obtained by using the above numbers for failures, mergers, and new entries, is close enough to the actual change that two conclusions seem warranted. First, the complete disappearance of DIs through failure likely was relatively uncommon between 1982 and 1992. Many failing banks and thrifts may have been eliminated by way of merger or acquisition, but few were entirely liquidated. Second, the decrease in the number of DIs between 1982 and 1992 was caused by a massive number of mergers and acquisitions (about 541) that was not quite balanced by the very large number of new entries (about 437). The 15 percent net decrease in the number of DIs between 1982 and 1992 may be considered to be relatively modest, but the large gross numbers suggest that the underlying forces causing that decrease likely were not.

In addition, the disappearance of thrift competitors accounted for a much larger proportion of the net decrease in DIs than did the disappearance of bank competitors. Over the ten-year period, on net 121 thrift competitors disappeared, accounting for 86.4 percent of the 140 DIs eliminated on net.

As discussed in the last section, within-market mergers and acquisitions must raise market concentration if the not-involved firms' market shares do not change. On the other hand, unless shifts in the market shares of more than one preexisting bank accompany new entry, new entry will lower concentration, thereby increasing the likelihood of vigorous competition. It appears that there were more DI mergers and acquisitions than new entry of DIs between 1982 and 1992 in the Twelfth District. Therefore, taking into account only the changes in the number of DIs and not any shifts in market shares among existing competitors, it is likely that banking market concentration in the Twelfth District as a whole increased between 1982 and 1992.

To investigate this possibility, I calculated HHIs for 1982 and 1992 for the banking and thrift industry for the entire Twelfth District. I calculated the HHI the same way that the Federal Reserve does in its analysis of the competitive effects of DI mergers. Specifically, each DI's market share is the percent of total market deposits (in this case, total deposits in the Twelfth District) that it holds. In addition, thrifts are considered to be only partial competitors of banks. This is because thrifts usually are prohibited from engaging in all of the activities in which banks participate. For example, thrifts' commercial lending often is restricted. Therefore, it is customary to give only a 50 percent weight to thrift deposits when calculating the size of the market and market shares.[11] For example, say that a market is comprised of two banks and a thrift. The first bank has $500 million in deposits, the second bank has $300 million, and the thrift has $300 million. Weighting the thrift deposits at 50 percent and the bank deposits at 100 percent, total deposits in the market are $950 million. The first bank's percent market share is 52.6 percent, the second bank's share is 31.6 percent, and the thrift's share is 15.8 percent. Summing the squares of these market shares yields an HHI of 4,015.

Using deposits to measure market share and applying a 50 percent weight to thrift deposits, the HHI for the Twelfth District did indeed rise between 1982 and 1992, from 586 to 820. Apparently, the inequality effect either increased or did not decrease enough to outweigh the effect of the net decrease in DIs on concentration in the Twelfth District. This suggests that the competitiveness and productive efficiency of banking in the Twelfth District fell between 1982 and 1992.

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11. When a *bank* merges with or acquires a thrift, the pre-merger calculation of the HHI weights all thrift deposits at 50 percent, but the post-merger calculation of the HHI weights the merged or acquired thrift's deposits at 100 percent and the other thrifts' deposits at 50 percent. This procedure reflects the post-merger control of the acquired thrift's deposits by a bank. When a bank merges with or acquires another bank, both the pre- and post-merger calculations of the HHI weight all thrift deposits at 50 percent. Consistent with this, all HHIs and total deposit figures that are reported in this paper were derived by applying a 100 percent weight to all bank-*controlled* deposits and a 50 percent weight to all thrift-*controlled* deposits. Specifically, if a bank holding company has a thrift subsidiary, that thrift's deposits are weighted at 100 percent, not 50 percent. This, however, is relatively unusual.

IV. Changes in the Number of Depository Institutions and in Concentration in Local Urban Markets

My ultimate focus is on changes in the level of competition between banking organizations, and therefore changes in concentration in meaningfully defined banking markets are more important than changes at the District level. Because many banking services are supplied locally, and many bank customers find it very costly to look for alternatives outside their local area, the antitrust analysis of bank mergers typically defines banking markets to be local.

Therefore, I investigated changes in the structure of 65 local urban banking markets between 1982 and 1992 in the Twelfth Federal Reserve District states of Alaska, Arizona, California, Hawaii, Idaho, Nevada, Oregon, Utah, and Washington.[12] These urban banking markets are geographically defined to correspond to Rand McNally's "RaNally Metro Areas," or RMAs. The geographic boundaries of RMAs are delineated by Rand McNally to include the areas around important cities that are developed and economically integrated with the urban center. RMAs include satellite communities and suburbs as well as one or more central cities.[13] Every RMA in the Twelfth District is represented in my urban banking market sample.

Most of the Twelfth District population lives in RMAs, and most of the DI deposits reside in branches in RMAs. In 1980, 86.8 percent of the Twelfth District population lived in RMAs, and, in 1990, 86 percent lived in RMAs. In 1982, approximately 88.9 percent of the total deposits in the Twelfth District were held in branches located in RMAs, and in 1992 this percentage was about 88.3.

Tables 2a and 2b present rank order listings of the RMAs by the change in HHI between 1982 and 1992; 2a is ordered by HHI increases and 2b is ordered by HHI decreases. As described above, the HHIs are calculated using 100 percent of bank deposits and 50 percent of thrift deposits to calculate market sizes and market shares. To be consistent, total deposits are reported as 100 percent of bank deposits plus 50 percent of thrift deposits.

Tables 2a and 2b show that net increases in DIs were relatively rare; only 8 out of 65 urban markets (12.3 percent) showed a net increase in the number of DIs between 1982 and 1992. Data presented in Section III suggested that net decreases in the number of DIs in the Twelfth District were the result of very numerous mergers unmatched by a significant number of new DI charters. It is possible that mergers accounted for the elimination of fewer DIs in local markets than in the Twelfth District as a whole. This is because, unless the local markets of the DIs overlap, a merger or acquisition will not reduce the number of DIs, it will only change the target DI's name. In addition, the number of DIs in local markets can increase either through new charters *or* branching from outside of the market. However, the preponderance of markets with net decreases in DIs despite these factors suggests that many mergers may have been between DIs that operated in the same local urban market and that *de novo* branching into new local markets by established DIs may have been relatively uncommon.

As shown in Section II, a decrease in the number of firms need not necessarily increase concentration if the inequality effect decreases. However, the majority of urban banking markets in the Twelfth District also did experience an increase in concentration and a presumed decrease in competitiveness between 1982 and 1992. Concentration increased in 43 markets (66.2 percent) and decreased in 22 (33.8 percent). Overall, average concentration in these 65 urban markets increased between 1982 and 1992, from an HHI of 1,643 to 1,747. Section III showed that average concentration also increased at the District level, but both 1982 and 1992 HHIs were much lower than in local urban markets. This is because DIs tend to operate in geographically restricted areas, so market shares are diluted in moving from the local to the District level, and concentration falls.

The increase in average concentration also can be seen in Figure 1. Figure 1 shows that the number of markets in the second and third highest concentration categories increased, while the number of markets in the two lowest concentration categories decreased. The number of markets in the very highest concentration category stayed the same. However, note that the pattern of the distribution has remained roughly the same, with the largest number of markets having HHIs ranging from 1,200 to 1,499 in 1982 and 1992.

Relatively few banking markets went from being "unconcentrated" or "moderately concentrated" in 1982 to "highly concentrated" in 1992. Anchorage, Honolulu, Hilo, Provo, Bellingham, Portland, Porterville, Eureka, and Tucson are the nine urban banking markets in which concentration went from below 1,800 in 1982 to at least

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12. Bank regulators also review bank mergers affecting local rural markets for their competitive effects.

13. Geographic boundaries of RMAs are given in Rand McNally's *Commercial Atlas and Marketing Guide.* Rand McNally states that there are two basic criteria which determine inclusion within an RMA. In general, an area must have at least 70 people per square mile, and at least 20 percent of the labor force must commute to the central urban area of the RMA. RMAs have been defined for all areas with a population of at least 50,000 and selected areas of less than 50,000.

TABLE 2A

HHI, DIs, AND DEPOSITS IN TWELFTH DISTRICT RMAs WITH HHI INCREASES, RANKED BY CHANGE IN HHI

RMA	HHI Change[a]	1992 HHI	1992 DIs	DI Change[a]	1992 Deposits (in thousands)
Anchorage, AK	1,463	2,786	6	−6	1,846,818
Honolulu, HI	942	2,633	14	−2	13,471,008
Hilo, HI	860	2,579	9	−3	610,082
Provo, UT	828	2,043	12	−8	1,087,577
Santa Barbara, CA	736	1,544	18	−7	2,603,852
Bellingham, WA	707	1,958	12	−4	975,536
Portland, OR	538	1,959	25	−25	12,627,241
Porterville, CA	493	1,905	7	−4	409,257
Nogales, AZ	461	4,360	3	−1	396,583
Oxnard, CA	432	1,334	25	−6	3,078,416
Pocatello, ID	385	2,701	6	−2	343,774
Logan, UT	377	2,587	6	−4	367,505
Riverside, CA	359	1,698	45	6	6,065,474
Fairbanks, AK	337	2,382	5	−3	404,289
Fresno, CA	307	1,796	22	−7	4,285,529
Eugene, OR	306	1,643	15	−9	1,560,167
Bakersfield, CA	287	1,567	16	−6	2,216,097
Salem, OR	284	1,527	12	−7	1,520,888
Oceanside, CA	272	1,296	19	−6	1,238,270
Merced, CA	267	1,714	10	−7	616,317
Boise, ID	265	2,727	10	−3	2,002,730
Eureka, CA	262	1,986	9	−3	856,112
San Diego, CA	256	1,084	67	−4	20,296,121
Chico, CA	244	1,753	9	−4	755,132
Bremerton, WA	241	1,291	15	−4	789,754
Calexico, CA	222	3,697	5	0	264,730
Corvallis, OR	215	1,476	10	−6	682,661
Modesto, CA	207	1,178	19	−9	2,003,905
Salt Lake City, UT	192	1,518	26	−9	5,705,748
Medford, OR	184	1,645	13	−6	946,818
Los Angeles, CA	175	935	247	−1	142,715,994
Palm Springs, CA	170	1,294	25	−10	1,899,900
Ogden, UT	168	1,551	12	−7	1,035,804
Longview, WA	143	1,427	10	−6	407,076
Lancaster, CA	120	1,621	11	−1	876,243
Monterey, CA	120	1,459	15	−4	1,428,103
Nampa, ID	94	1,950	7	−2	509,264
Phoenix, AZ	86	1,970	37	12	20,789,450
Visalia, CA	74	1,349	15	−2	872,042
Davis, CA	55	1,760	8	−1	418,639
Hemet, CA	39	892	19	−4	1,267,005
Tucson, AZ	24	1,802	13	0	4,759,219
Olympia, WA	23	1,085	16	2	797,127

[a] 1992 level minus 1982 level

TABLE 2B

HHI, DIs, AND DEPOSITS IN TWELFTH DISTRICT RMAs WITH HHI DECREASES, RANKED BY ABSOLUTE VALUE OF CHANGE IN HHI

RMA	HHI CHANGE[a]	1992 HHI	1992 DIs	DI CHANGE[a]	1992 DEPOSITS (in thousands)
Stockton, CA	−2,168	1,217	22	−3	2,637,372
Watsonville, CA	−681	1,622	11	0	589,672
Santa Cruz, CA	−663	1,288	15	−6	1,555,037
San Francisco–Oakland, CA	−638	1,424	128	−6	87,220,301
Yuba City, CA	−462	1,408	13	−1	773,151
Las Vegas, NV	−379	1,822	15	1	6,763,318
Salinas, CA	−330	1,252	14	−3	1,319,883
Yuma, AZ	−329	1,866	8	1	575,167
Redding, CA	−279	1,624	13	−3	1,151,968
Idaho Falls, ID	−256	1,805	9	0	602,044
Fairfield, CA	−216	1,495	14	−2	850,920
Santa Rosa, CA	−213	878	29	2	2,525,034
Santa Maria, CA	−203	1,492	14	−1	904,191
Napa, CA	−125	1,296	15	−1	951,443
Lewiston, ID	−115	1,377	11	−1	428,995
Sacramento, CA	−106	1,241	45	−7	10,152,322
Reno, NV	−104	2,392	13	2	2,195,682
Lompoc, CA	−69	1,977	8	1	295,032
Yakima, WA	−59	1,388	10	−3	942,979
Seattle, WA	−43	1,589	61	−11	25,171,338
Pasco–Kennewick–Richland, WA	−14	1,894	11	−5	747,770
Spokane, WA	−13	1,722	13	−3	2,561,116

[a] 1992 level minus 1982 level.

1,800 in 1992. In Alaska, the largest bank's acquisitions of several of the mid-sized banks in the state were allowed due to consideration of the acquired banks' poor financial conditions, leading to the inclusion of Anchorage in the above list. There are at least two possible reasons for the increases in the other markets. First, the dynamics of competition may have caused shifts in market shares that would have increased concentration even in the absence of mergers. Second, the breach of the 1,800 level may be the result of the cumulative effect of multiple mergers, each of which passed the regulatory screen when considered on its own.[14]

Similar reasons may have played a role in the Nogales, Pocatello, Logan, Fairbanks, Boise, and Calexico markets. All of these markets were already highly concentrated

in 1982 and saw cumulative changes of at least 200 points over the following ten years.

Note that 7 of the 9 banking markets that went from being unconcentrated or moderately concentrated in 1982 to highly concentrated in 1992 rank in the top 8 banking markets in Table 2a in terms of increase in concentration. Accordingly, on average, the change in the HHI, at 680, for these 9 "crossover" markets, was considerably higher than the average change in the HHI of 203 for the other 36 markets that were unconcentrated or moderately concentrated in 1982.[15] However, it is also true that the crossover markets were, on average, more concentrated to begin with than the 36 noncrossover markets. The average HHI in 1982 in the crossover markets was 1,504 and in the other 36 unconcentrated or moderately concentrated markets it was 1,298.
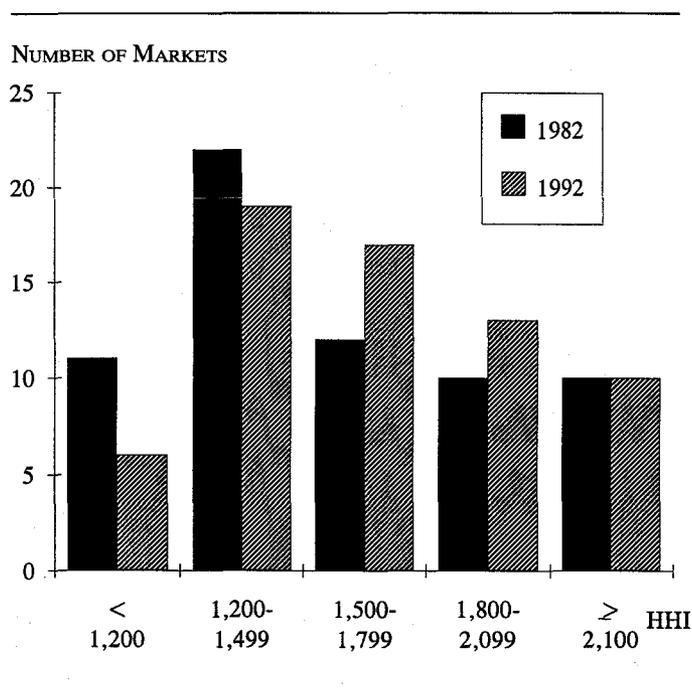
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14. For example, the market may start with an HHI of 1,650 and two separate mergers may be approved at different times, each of which increases the HHI by 100 points.

15. These 36 markets include 10 in which concentration decreased between 1982 and 1992.

FIGURE 1

HHI IN TWELFTH DISTRICT RMAS

NUMBER OF MARKETS

For the sample as a whole, however, there appears to be a *negative* correlation between initial concentration and change in concentration. In the 43 markets in which concentration increased, the average HHI in 1982 was 1,517, whereas, in the 22 markets in which concentration decreased, the average HHI in 1982 was 1,888. In addition, with an average HHI increase of 331 and an average HHI decrease of 339, the absolute values of the average changes for the increasing and decreasing concentration groups were about equal to each other and about equal to the difference between the groups' initial average concentration levels. As a result, on average, the group with concentration increases ended up with about the same level of concentration as the initially high concentration group had in 1982, and the group with concentration decreases ended up with about the same level of concentration as the initially low concentration group had in 1982.

Given the apparent tendency for concentration to increase in relatively unconcentrated markets and decrease in relatively concentrated markets, I tested whether there was in fact any statistical correlation. Using the urban banking market sample, I regressed the change in the HHI on a constant and the initial level of the HHI, using ordinary least squares. The coefficient on the 1982 HHI was indeed negative and highly statistically significant. This very simple fitted model indicated that, over a 10-year period, concentration increased about 596 points minus 29.9 percent of the initial HHI. This means that, according to the

model, markets in which the HHI is below about 1,985 tend to increase in concentration and markets in which the HHI is above that point tend to decrease in concentration.

However, the model is misleading in that it specifies that the higher the initial concentration, the higher the terminal concentration.[16] In other words, according to the model, although concentration will fall in the more concentrated markets and rise in the less concentrated markets, the ordering of markets by HHI will not change. The flip in average concentration between the initially low concentration group and the initially high concentration group suggests that this is not necessarily the case. Concentration in a given market may fluctuate within a band, tending to increase up to the ceiling of the band if it hits the floor of the band and tending to decrease down to the floor of the band if it hits the ceiling, thereby changing the concentration ordering of markets over time. The increase in the overall average indicates that any such band may have shifted up between 1982 and 1992. The model's specification of a decrease in concentration in the more concentrated markets along with an increase in concentration in the less concentrated markets and no change in the concentration ordering also erroneously suggests a decrease in the dispersion of concentration. In fact, the standard deviation of the HHI across urban banking markets barely changed between 1982 and 1992, increasing from 598 to 604.

The negative correlation between initial concentration and the change in concentration partially may be a consequence of the application of the DOJ's bank merger policy to individual mergers. Under a strict application of the policy, the farther below 1,600 is a pre-merger HHI, the larger an increase in the HHI will be permitted. This also is true for pre-merger HHIs between 1,600 and 1,800, but, here, 200 is the maximum change in the HHI allowed. (Under a strict application of the bank merger policy, for pre-merger HHIs of at least 1,800, there is no negative correlation between the level of the HHI and the permissible change in the HHI.) It may also be the case that the supracompetitive profits presumably found in very concentrated markets attract entry into those markets that helps to reduce concentration and restore competition.

Underlying Causes for Increases and Decreases in Concentration

Table 3 fills in the cells of Table 1 with the identities of urban markets in each category.[17] Table 3 thereby shows

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16. The 1992 HHI is approximately 0.7 times the 1982 HHI plus 596, according to the model.

17. There are 37 markets represented in Panel A of Table 3. These are the markets with initial variance of market shares above the critical value

TABLE 3

HHI Changes and their Causes in Twelfth District Urban Markets

Panel A: $V_0 > (10{,}000/N_0N_1)$

		N Increased		No Change in N	N Decreased	
NV Increased	V Increased	+ Riverside		+ Tucson	+ Honolulu Oxnard Eugene Oceanside San Diego Salt Lake City Palm Springs	Portland Fresno Bakersfield Boise Modesto Los Angeles
	V Decreased	+ Phoenix	− Reno	n.a.	n.a.	
NV Decreased	V Increased	n.a.		n.a.	+ Medford Ogden Monterey Visalia	− Sacramento Seattle Pasco/Kenne- wick/Richland Spokane
	V Decreased	− Las Vegas Santa Rosa		− Watsonville	− Stockton San Francisco/ Oakland Redding Santa Maria	Santa Cruz Yuba City Salinas Fairfield Napa

Panel B: $V_0 < (10{,}000/N_0N_1)$

		N Increased		No Change in N	N Decreased	
NV Increased	V Increased	+ Olympia	− Lompoc	+ Calexico	+ Anchorage Provo Bellingham Lancaster	Hilo Santa Barbara Bremerton
	V Decreased	−		n.a.	n.a.	
NV Decreased	V Increased	n.a.		n.a.	+ Portland Logan Merced Chico Longview	Pocatello Salem Eureka Corvallis Hemet
	V Decreased	− Yuma		− Idaho Falls	+ Nogales Fairbanks Nampa Davis	− Lewiston Yakima

Note: NV = inequality effect
      V = variance
      N = number of firms

underlying causes for increases and decreases in concentration in each market. For example, concentration increased in the Boise banking market because the number of DIs decreased and variance increased enough that the inequality effect also increased. On the other hand, concentration increased in the Riverside banking market because, even though the number of DIs increased, the variance of market shares increased, and initial variance was above the critical value of 10,000 divided by the product of the 1982 and 1992 number of DIs. Equivalently, concentration increased in the Riverside market because, even though the number of DIs increased, the variance of market shares also increased enough that the increase in the inequality effect outweighed the negative effect that an increase in DIs by itself would have had on concentration.

The experiences of the largest markets, those with over $10 billion in deposits in 1992, varied somewhat. These markets are Honolulu, Portland, San Diego, Los Angeles, Phoenix, Sacramento, Seattle, and San Francisco–Oakland. In the Honolulu, Portland, San Diego, and Los Angeles markets, concentration increased because the number of DIs decreased and the variance of market shares increased enough that the inequality effect also increased. In the Phoenix market, even though the number of DIs increased and the variance of market shares decreased, concentration increased because the inequality effect increased sufficiently. Note that the increase in the inequality effect in the Phoenix market was due solely to an increase in the number of DIs. The experience in the Sacramento and Seattle markets was the opposite of that in the Phoenix market. In these markets, even though the number of DIs decreased and the variance of market shares increased, concentration decreased because the inequality effect decreased sufficiently. The decreases in the inequality effects in the Sacramento and Seattle markets were due solely to decreases in the number of DIs. In the San Francisco–Oakland market, even though the number of DIs decreased, concentration decreased because variance also decreased, so that the decrease in the inequality effect outweighed the concentrating effect that a decrease in the number of DIs has by itself. Note that, because initial variance was above the critical value in the San Francisco–Oakland market, a decrease in the number of DIs had to decrease concentration if variance either did not change or decreased.[18]

The counts of markets in each cell also suggest general conclusions regarding underlying causes for changes in competitiveness and efficiency, as measured by concentration, in Twelfth District urban markets.

In 38 of the 53 markets in which the number of DIs decreased, concentration increased. In twenty of these markets, the change in the inequality effect reinforced the effect of the decline in the number of competitors. In the others, the change in the inequality effect partially mitigated the effect of the decrease in the number of DIs, but not enough to outweigh the concentrating effect that a decrease in the number of firms has if the inequality effect is held constant.

There were 15 markets that became less concentrated despite a decline in the number of DIs. Concentration decreased in these markets because the decrease in the inequality effect outweighed the concentrating effect of a decrease in the number of firms, holding the inequality effect constant.

In markets overall, increases in the variance of market share were more common than decreases (43 increases versus 22 decreases). However, due to the preponderance of markets in which the number of DIs decreased, decreases in the inequality effect were more common than increases (38 decreases versus 27 increases).

Average sizes of increases and decreases in concentration depended on whether the direction of change in the number of DIs, the variance of shares, and the inequality effect worked in the same direction or not. In the 33 markets in which, given only the *direction* of change of these factors, concentration *had to* increase, the average increase in the HHI was 382. In the 14 markets in which concentration had to fall, the average decrease in the HHI was 496.[19] For the 18 markets in which the effects worked in opposite directions, the average absolute change in the HHI was 118.

For markets in which the inequality effect and change in the number of DIs worked in the same direction, one can calculate the proportion of the change in concentration that was due to each factor. For the 3 such markets in which concentration decreased, on average 73.3 percent of the

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derived in Section II. There are 28 markets in Panel B of Table 3, with initial variance below the critical value.

18. Note, however, that, given the initial number of firms, the larger the decrease in the number of firms, the higher initial variance must be to exceed the critical value.

19. The Stockton, California market, which showed an HHI decrease of 2,168, may be considered to be an outlier. The large decrease in concentration in the Stockton market primarily was due to an outflow of deposits from the largest DI, a thrift. This thrift had been paying above market interest rates to attract deposits and held 56 percent of the deposits in the market in 1982. When it encountered financial trouble and stopped paying high rates, it lost deposits to other DIs in the market, greatly reducing the overall variance of market shares. If the Stockton market is excluded, the average decline in the HHI in markets in which concentration had to decrease was 367.

change in concentration was due to the decrease of the in-equality effect. For the 20 such markets in which concentration increased, on average 56 percent of the change in concentration was due to the increase of the inequality effect.[20] These percentages suggest that when the change in the inequality effect and in the number of DIs (holding the inequality effect constant) work together, the former is somewhat more important than the latter.

V. CONCLUSION

Both the Twelfth District as a whole and local urban banking markets in the District saw a widespread reduction in the number of DIs between 1982 and 1992. Nearly 82 percent of the 65 urban banking markets in the District saw a net decrease in the number of DIs. Although this trend need not necessarily have been accompanied by an increase in concentration, in most markets it was. As a result, concentration in the Twelfth District overall increased between 1982 and 1992. Concentration also increased in approximately two-thirds of the 65 urban banking markets in the Twelfth District. On the other hand, there is some evidence that if a market becomes concentrated enough, concentration will start to fall, thereby helping to strengthen competition and productive efficiency.

The preponderance of urban banking markets in which the number of DIs decreased likely was a consequence of numerous within-market mergers that were unmatched by significant numbers of new charters. District level data also suggest that a large proportion of the net decrease in DIs was accounted for by a net decrease in the number of thrifts. This likely also played a role in local urban markets. Given a slowdown in the disappearance of thrifts, the decreasing trend in the number of DIs should abate somewhat.

Shifts in market shares can reduce the effect of the inequality of shares on measured concentration. If this inequality effect decreases sufficiently, it can overcome the concentrating effect that a decrease in the number of firms has if the inequality effect is held constant. However, less than a third of the markets in which the number of DIs decreased showed decreases in concentration. This suggests that regulatory review of bank and thrift mergers and acquisitions has been and will continue to be important in assuring the competitiveness of banking markets.

REFERENCES

Commercial Atlas and Marketing Guide. 1992. 123rd edition. Skokie, Illinois: Rand McNally.

Holdsworth, David G. 1993. "Is Consolidation Compatible with Competition? The New York and New Jersey Experience." Federal Reserve Bank of New York Research Paper #9306.

Rhoades, Stephen A. 1993. "The Herfindahl-Hirschman Index." *Federal Reserve Bulletin* (March) pp.188-189.

Scherer, F.M. 1980. *Industrial Market Structure and Economic Performance.* 2nd edition. Boston: Houghton Mifflin.

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20. Markets counted exclude those in which the number of DIs did not change.