Federal Reserve Bank of Minneapolis
Research Department Working Paper

MARKET SHARE AND THE IMPACT OF MULTIBANK
HOLDING COMPANY AFFILIATION: A COUNTEREXAMPLE

William Roberds

Working Paper 264
PACS File 5025

Revised February 1985

NOT FOR DISTRIBUTION
WITHOUT AUTHOR'S APPROVAL

ABSTRACT _____

A popular method of investigating the market effects of multibank
holding company (MBHC) affiliation involves regression of banks'
local market share on a dummy variable for MBHC affiliation. The
usefulness of this procedure is called into question by means of a
theoretical counterexample.

0.1 Introduction

A question of considerable interest is to what extent banking market imperfection is reflected in observable market structure. The prevailing wisdom in this area is summarized in a proposition known as the structure-conduct-performance (SCP) hypothesis. Essentially, the SCP hypothesis states that anticompetitive practices are more likely to occur in markets characterized by a high degree of concentration, i.e., a relatively large market share is a prerequisite for "market power." Thus, the SCP hypothesis provides a rationale for the common regulatory practice of approving or denying bank merger applications, on the basis of projected changes in market share, concentration ratios, Herfindahl indices, etc.

An important, although narrow application of the SCP hypothesis has been as the basis for a number of statistical studies on the impact of multi-bank holding company (MBHC) affiliation on bank behavior.[1] These studies seek to determine whether MBHC affiliation leads to changes in market performance, other things being held constant. This issue is an important one from a policy perspective, as it frequently surfaces when the Federal Reserve Board must decide on bank merger cases.[2]

Among this class of studies, a popular research methodology can be summarized as follows: the typical study[3] begins with panel data on a large number of banks, which either were acquired by MBHC's during the sample period, or which remained unit banks over the given time span. The change in market share

of each bank over the sample period is regressed on a number of variables, including a dummy variable for MBHC affiliation. Should the estimated coefficient on this last variable prove not significantly different from zero, the conclusion is that MBHC affiliated banks behave no differently from unit banks. The implied reasoning is that an increase in market share must necessarily accompany an increase in market power.

In the theoretical example that follows, I demonstrate how such reasoning could lead to false conclusions. In particular, for a market with no outside entry and two identical banks, increasing the market power of one bank could lead to either a rise or fall in its market share. Even if one stacks the deck in favor of the statistical studies and assumes that the supposed increase in market power is always due to acquisition by a MBHC, the statistical effects of MBHC affiliation on market share, when averaged over a large number of markets, would be close to zero. This can happen because the banks are competing not only in terms of prices of their services, but along another dimension (such as quality or convenience of services) as well. Since analyzing only the banks' market shares ignores the heterogeneity of their services, misleading conclusions can result from this type of analysis.

Some care is needed in interpreting the counterexample provided below. This example was constructed with the purpose of abstractly depicting only a few of the features of nonprice competition in banking markets. The ease with which the counter-

example was constructed, however, suggests that more complicated and presumably more realistic models could be formulated to support the same conclusions. This, in turn, suggests that empirical studies that draw heavily upon the SCP hypothesis in their interpretation of the data will be of limited use in policy decisions.

The remainder of the paper is organized in the following fashion. Section 2 lays out the theoretical example. Section 3 provides some interpretation of the example in light of the empirical literature on MBHC affiliation. Section 4 concludes.

0.2 An Example

In this section I consider a theoretical example that is greatly simplified, but embodies some of the essential characteristics of competition in banking. In the models below, banks offer services that may differ in terms of two characteristics: price, and another characteristic, which will be called "quality," but could just as well be called "location," "convenience," or "diversity of services." Addition of more than one nonprice characteristic would no doubt enhance the realism of the example, but also greatly complicate its solution. It is unlikely that such modifications would overturn the major results presented below.

While highly stylized, the example of this section will be consistent with a number of empirical regularities reported in the literature on MBHC affiliation. These are:

1. Statistical studies of the type described above have concluded that the impact of MBHC affiliation on changes in market share is not significant.

2. MBHC affiliated banks, on the average, experience higher costs than unit banks.[4]

3. Banks in markets where MBHC affiliated banks are operating show higher levels of profitability, on the average, than do banks in markets with no MBHC affiliates present.[5] This is true whether or not the bank itself is owned by a MBHC.

4. Following acquisition by a MBHC, relatively small banks tend to experience an increase in market share, while larger banks tend to experience a decrease in their market share.[6]

On the other hand, the model does not attempt to address a number of widely reported empirical regularities associated with MBHC affiliation, including significant differences in balance sheet structure and lending practices.[7]

The models considered will differ only slightly from the duopoly model of price-quality competition proposed by Prescott and Visscher.[8] Two variants of the Prescott-Visscher model will be considered: a Nash model, intended to represent competition between two unit banks, and a leader-follower model, intended to depict competition between a MBHC affiliate (the market leader) and a unit bank (the follower). The assumption that MBHC affiliation and market leadership are synonymous is certainly extreme,

but is intended to bias things in favor of the researcher trying to determine whether such a connection exists.

In these models, the profits of bank i, i = 1,2 , are given by

$$\text{Profits}_i = [p_i - C(x_i)]q_i - F$$

where p_i is price, q_i is quantity (of services), $1 - x_i$ is a measure of quality of service, $x_i \in [0,1]$, F is fixed cost and $C(x_i)$ are the unit costs associated with quality $1 - x_i$, where $C(\ )$ is decreasing in x_i. The variable x may be viewed as a measure of customer inconvenience. It is cheaper for a bank to provide more inconvenient (lower quality) service. As in the Hotelling model of spatial competition, there is a continuum of consumers indexed by their quality preference $v \in [0,V_m]$, and who are distributed uniformly over this interval with density N. A customer of type v demands one unit of banking services, and will do business with the bank offering a lower "quality adjusted price"

$$p_i + vx_i$$

If bank 1 offers better service than bank 2, i.e., if x_1 is less than x_2, then bank 2's deposits will be given by

$$q_2 = N[(p_1 - p_2)/(x_2 - x_1)].$$

Bank 1's deposits are then necessarily given by

$$q_1 = NV_m - q_2$$

and vice versa if x_2 is less than x_1.

Initially assume that the quality and price of services offered by each bank are determined in a two-stage Nash game. Both banks believe that no entry will occur in the market. In the first stage of the game, each bank announces a level of service x_i. In the second stage, banks announce prices p_i for these services. The sequential nature of the equilibrium is meant to capture the notion that it is more costly for banks to vary quality levels than prices. Hence each bank must commit itself to a level of service (after observing the level of service offered by the other bank), but is free to change the price of its services in response to price changes by the other bank. The Nash equilibrium is found by backward induction. Assuming the banks offer levels of service (x_1, x_2), one can find equilibrium pricing functions $p_1(x_1, x_2)$ and $p_2(x_1, x_2)$. Given these equilibrium pricing functions one can then derive the equilibrium levels of service (x_1, x_2).

For the purpose of illustration, I use the same numerical example employed by Prescott and Visscher, with some additional restrictions. In particular, take $F = 0$, $V_m = 10$, and $N = 1$. Unit costs $C(x_i)$ are of form

$$C(x_i) + A/(A+Bx_i)$$

where $A = B = 2$. Prescott and Visscher also restrict x_i to lie in the interval $[0.04, 1.0]$. Here the model is restricted even further by the assumption that each bank can offer only one of

three quality levels: $x_i = 0.04$, $x_i = 0.52$, or $x_i = 1.0$.9/ In the appendix, the second stage equilibrium prices are derived for each of the nine possible pairs of quality levels (x_1, x_2). The profits of each bank that will result from a given pair of quality levels are given in Figure 1, with the profits of bank 1 listed first in each cell of the payoff matrix.

[Figure 1]

The percentage figures in parentheses represent the market shares of bank 1 (= $100q_1/(q_1+q_2)$ for each pair of quality levels. An asterisk indicates that market share is indeterminate. The zero payoffs and indeterminate market shares on the main diagonal of the payoff matrix occur because equal quality levels will result in each bank cutting the price of its services to marginal cost, as in the case of price competition between identical duopolists producing a homogeneous product.

Inspection of the above matrix reveals that two pairs of equilibrium quality levels are possible: (0.04, 1.00) and (1.00, 0.04). Since banks 1 and 2 are identical, there is no reason to prefer one equilibrium over the other, i.e., each outcome is "equally likely" in some sense. It should be noted, however, that the conclusions arrived at below do not depend on this nonuniqueness.

Keeping the cost functions of the banks as in the example above (i.e., identical across firms with constant returns to scale), now suppose that bank 1 is able to establish itself as a

"market leader."[10]   To be exact, at both stages of the game
described above, bank 1 is the first to announce its decision.
Chronologically, bank 1 announces a level of service, followed by
bank 2's announcement of the level of service it will offer. Bank
1 then announces a price for its services, followed by a pricing
announcement by bank 2. As in the Nash game, the equilibrium is
obtained by backward induction. The leader-follower model will
have a first stage payoff matrix given in Figure 2. Again, market
shares of bank 1 are given in parentheses.

[Figure 2]

    In contrast to the Nash model, the leader-follower model
will only have one equilibrium pair of quality levels, i.e.,
(0.04, 1.00). While the profits of both banks are higher in the
leader-follower model than in the Nash model (consistent with
empirical regularity (3) above), consumers are worse off in the
sense that the average price paid by consumers is higher (8.04 vs.
6.11) and average quality is lower (average 1-x is 0.49 vs. 0.63)
than in the Nash game. It is also important to note that the
market share of bank 1 in the leader-follower setup can be either
higher or lower than its market share in the Nash setup.[11] The
advantage of being the leader lies not so much in having the
ability to capture a large segment of the market, but the ability
to capture large rents in the more profitable, high quality seg-
ment of the market. Consistent with empirical regularity (2)
above, the costs of bank 1 (by assumption a MBHC affiliate) will
be higher than those of bank 2 (a unit bank).

0.3 Interpretation

One can interpret the above example by means of a hypothetical statistical exercise. Suppose that a researcher had data on a large number of banking markets of the type described above. Suppose further that each market in the data sample contained either two unit banks, or a unit bank and a bank recently acquired by a MBHC. By hypothesis, each bank in a two unit bank market behaves in a Nash fashion, while each market where a MBHC acquisition has occurred changes from a Nash to a leader-follower market. It is evident that a cross-sectional study of such markets would probably not uncover a systematic relationship between MBHC affiliation and changes in market share. If bank 1's (the bank acquired by the MBHC, and hence the market leader) market share were initially large, it would tend to fall over time. If its market share were initially small, it would would tend to rise as a consequence of MBHC affiliation, consistent with empirical regularity (4) above. Averaged over a large number of such acquisitions, the mean effect of MBHC affiliation on a market share time series would be close to zero. Thus the example is consistent with the statistical result (empirical regularity (1)) reported by most research in this area, that is, MBHC affiliation does not have an appreciable impact on market share.

On the other hand, it is clear that MBHC affiliation matters in the models above. If a MBHC affiliate is able to establish itself as a price-quality leader in a market, then market outcomes will change dramatically. While the simple demand

functions assumed above do not allow for formal welfare comparisons, the above analysis suggests that large welfare losses are possible under a leader-follower market structure, and that MBHC affiliation is not a variable that should always be ignored in bank merger cases.

0.4 Conclusion

The question of how MBHC affiliation affects banking market performance remains an interesting one. The preceeding analysis suggests, however, that the answer to this and related policy questions must await a better theoretical understanding of banking markets. In particular, the above example demonstrates the potential impact of nonprice competition on the interpretation of regression studies.[12/] Any consensus on the effects of MBHC affiliation would therefore seem to require some measure of theoretical agreement as to the impact of nonprice competition in banking markets.

Footnotes

[1]/An extensive survey of empirical work on this topic is provided in Curry, T. J. and J. T. Rose, "Multibank Holding Companies: Recent Evidence on Competition and Performance in Banking Markets," Journal of Bank Research 14, (1983), pp. 212-20.

[2]/See, for example, United Bank Corporation of New York, 67 Federal Reserve Bulletin 358 (1981), or Dacotah Bank Holding Company, 70 Federal Reserve Bulletin 347 (1984).

[3]/A good example is Rose, J. T., "Bank Holding Company Affiliation and Market Share Performance," Journal of Monetary Economics 9, 1982.

[4]/See, for example, Rhoades and Rutz, "Market Power and Firm Risk," Journal of Monetary Economics 9, 1982.

[5]/See Curry and Rose, "Bank Holding Company Presence and Banking Market Performance," Journal of Bank Research, Winter 1984, pp. 259-69.

[6]/See Burke, J., "Bank Holding Company Behavior and Structural Change," Journal of Bank Research, Spring 1978, pp.43-51.

[7]/See Rhoades and Rutz, op. cit.

[8]/"Sequential Location among Firms with Foresight," Bell Journal of Economics 8, (Autumn, 1977), pp. 386-87.

[9]/This restriction allowed me to solve for the equilibrium on a hand calculator. One could also allow for a continuum of quality levels and use a grid search program to compute equilibrium.

[10]/One rationale for this assumption could be that MBHC pricing and quality policies are determined by the central office of the MBHC, and that such policies are uniform across markets in which the MBHC participates.

[11]/Again, note this would occur even if there were a unique Nash equilibrium, as there is no reason a priori to specify that bank 1 will always be the acquired bank.

[12]/A number of empirical studies have alluded to the potential impact of nonprice competition on their conclusions, e.g. Rhoades and Rutz, "The Impact of Bank Holding Companies on Local Market Rivalry and Performance," Journal of Economics and Business 34(4), 1982, pp. 364-65. The counterexample above is meant to suggest that this impact may be nontrivial.

Numerical Solution for Equilibria of the Nash and Leader Follower
Games (Not for publication).

    A.   Leader-Follower Game

        This game involves four nodes.

        Node 1a: Firm 1 chooses location

              1b: Firm 2 chooses location

              2a: Firm 1 chooses price

              2b: Firm 2 chooses price

The equilibrium is found by backward induction. Begin with node
2b. Taking $\bar{p}_1$, $\bar{x}_1$, $\bar{x}_2$ as given, bank 2 seeks to maximize

$$\pi_2 = [p_2 - c_2] q_2 - F$$

by choice of p_2 where $c_2 = c(\bar{x}_2)$.

Case 1. $\bar{x}_1 = \bar{x}_2$. Trivial.

Case 2. $\bar{x}_2 = \bar{x}_1$. Then

$$q_2 = N\left[\frac{\bar{p}_1 - p_2}{\bar{x}_2 - \bar{x}_1}\right]$$

Simple calculus yields

$$p_2{}^* = \frac{1}{2}\left[\bar{p}_1 + c_2\right]$$

Case 3. $\bar{x}_1 > \bar{x}_2$. Then

$$q_2 = N\left[Vm - \frac{p_2 - \bar{p}_1}{\bar{x}_1 - \bar{x}_2}\right]$$

and

$$p_2^* = \frac{1}{2}[V_m(\overline{x}_1-\overline{x}_2)+\overline{p}_1+c_2]$$

Now consider node 2a. Bank 1 seeks to maximize π_1, subject to the reaction functions given above. Again, substitution and simple calculus yield

$$p_1^* = V_m(\overline{x}_2-\overline{x}_1) + \frac{c_1+c_2}{2}$$

$$\text{if } \overline{x}_2 > \overline{x}_1$$

and

$$p_2^* = \frac{1}{2}[V_m(\overline{x}_1-\overline{x}_2)+c_1+c_2]$$

$$\text{if } \overline{x}_1 > \overline{x}_2.$$

Since each bank may offer only one of three quality levels, solution of the nodes 1a and 1b can be solved by enumeration.

B. The Nash Game

Again, proceeding by backward induction, if $\overline{x}_1 > \overline{x}_2$

$$p_2^* = \frac{1}{2}[V_m(\overline{x}_1-\overline{x}_2)+\overline{p}_1+c_2]$$

$$p_1^* = \frac{1}{2}[\overline{p}_2+c_1]$$

Since, in equilibrium, $\overline{p}_1 = p_1^*$ and $\overline{p}_2 = p_2^*$,

$$p_2^* = \frac{2}{3}[V_m(\overline{x}_1-\overline{x}_2)+c_2+c_1/2]$$

$$p_1^* = \frac{1}{3}[V_m(\overline{x}_1-\overline{x}_2)+c_2] + \frac{5}{6}c_1$$

and vice versa if $\overline{x}_2 > \overline{x}_1$.

The first stage solution can be obtained by enumeration.

Table 1

Equilibrium Costs, Prices, Quantities, and Profits

Nash Game

x_1	x_2	c_1	c_2	q_1	q_2	p_1	p_2	π_1	π_2
.52	.04	.6578	.9615	3.315	6.685	2.469	4.060	6.004	20.72
1.00	.04	.5	.9615	3.450	6.550	3.937	7.250	11.86	41.18
1.00	.52	.5	.6578	3.356	6.644	2.236	3.847	5.826	21.18

Leader-Follower Game

x_1	x_2	c_1	c_2	q_1	q_2	p_1	p_2	π_1	π_2
.52	.04	.6578	.9615	2.658	7.342	3.210	4.486	8.564	25.87
1.00	.04	.5	.9615	2.62	7.38	5.531	8.046	13.18	52.28
1.00	.52	.5	.6578	2.582	7.418	2.98	4.218	6.401	26.411
.04	.52	.9615	.6578	5.158	4.842	5.61	3.286	23.97	13.55
.04	1.00	.9615	.5	5.12	4.88	10.3	5.646	47.97	25.11
.52	1.00	.6578	.5	5.082	4.918	5.379	3.018	23.99	12.38

Notes: Main diagonal entries (where $x_1 = x_2$) are excluded for reasons mentioned in the text. The Nash payoff matrix is symmetric, so that only entries below the main diagonal are listed.

Figure 1

	$x_2 =$			
0.04	0.52	1.00		
0,0 (*)	20.72 6.00 (66%)	41.18 11.86 (66%)	0.04	
6.00, 20.72 (34%)	0,0 (*)	21.18 5.83 (66%)	0.52	$= x_1$
11.86 41.18 (34%)	5.83 21.18 (34%)	0,0 (*)	1.00	

Figure 2

	$x_2 =$			
0.04	0.52	1.00		
0,0	23.98	47.98	0.04	
	13.55	25.11		
(*)	(51%)	(51%)		
8.56,	0,0	23.99	0.52	$= x_1$
25.87		12.38		
(26%)	(*)	(51%)		
13.18	6.40,	0,0	1.00	
52.28	26.41			
(26%)	(26%)	(*)		