AN EMPIRICAL ANALYSIS OF DETERMINANTS OF GEOGRAPHIC DIFFERENTIALS IN THE BANK CLOSING RATE IN THE UNITED STATES, 1989-1994, USING THE HETEROSKEDASTIC-TOBIT MODEL

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Abstract—This study empirically examines determinants of geographic (interstate) differentials in the bank failure rate in the United States for the period 1989-1994. The study uses the Heteroskedastic-TOBIT estimation technique because 20 percent of the observations on the dependent variable are zeros and because of the need to correct for heteroskedasticity. The findings indicate that the interstate bank closing rate differential is affected by the cost of deposits, the savings and loan failure rate, the percentage of gross state product deriving from oil and natural gas extraction, the tangible capital/asset ratio, and state regulations that restrict bank branching.

I. INTRODUCTION

Not since the Great Depression have regulatory authorities in the United States closed as many banks as they did during the 1980s and early 1990s. For the time period 1943 through 1981, relatively few banks were closed because of insolvency. Indeed, over this lengthy period, there were only two years (1975 and 1976) in which the number of federally insured bank closures exceeded ten. However, this situation changed dramatically beginning with the year 1982. During this year, 42 banks were closed, followed by 48 closings in 1983 and 79 closings in 1984. The number of closed banks increased sharply thereafter, surpassing 100 closings per year until early in the 1990s. For instance, there were 206 bank closings in 1989. As for the 1990s, there were 168 bank closings in 1990, followed by 124 in 1991, 120 in 1992, 41 in 1993, and 13 in 1994 (FDIC 1991, 1992, 1994).

As observed in the studies of the period 1982-88 by Amos (1992) and Loucks (1994), one clearly distinguishable pattern that emerges from examination of bank closing data is the substantial geographic variation in the distribution of closings. Moreover, large geographic differentials in the bank closing rate can also be detected in the post-1988 period. For instance, at the extrema, for the 1989-1994 period, ten states experienced zero closings, whereas in another ten states, *percentages* of banks that were closed reached double digits. In particular, there were zero closings over the 1989-1994 period in Alabama, Delaware, Idaho,

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Michigan, Nevada, Oregon, South Dakota, Utah, Wisconsin, and Wyoming. By contrast, the percentage bank failure surpassed 10 percent in Alaska, Arizona, California, Connecticut, Hawaii, Louisiana, Massachusetts, New Hampshire, Rhode Island, and Texas.

Given this widely divergent geographic pattern in the bank closing rate, it is important to determine whether regional factors played a role. It is widely recognized that banks may engage in excessively risky activities when they have access to federally insured deposits; but what is less understood is the reason some banks may engage in such behavior, while other banks may not. The fact that closing rates differ so widely among states enables one to go beyond bank-specific variables to examine the potential role of regional economic factors. This type of analysis also enables one to assess whether some states experienced bank closings because of their regulatory environment (e.g., some states permitted only unit banking, certain other states permitted limited bank branching, and a majority of the states permitted state-wide branching) or were simply fortunate enough to have avoided an adverse economic shock or circumstance. With this in mind, this study empirically analyzes interstate bank closing (failure) rate differentials for the period 1989 through 1994. In effect, this study extends the studies by Amos (1992) and Loucks (1994), first, by including three financial/financial-market variables and, second, by examining a more recent time period (1989-1994 versus 1982-88). Given that values for some (ten) of the observations on the dependent variable in the analysis are zero, and given the need to control for heteroskedasticity, we adopt the Heteroskedastic-TOBIT estimation technique.

II. FRAMEWORK

Studies of closing (failure) rates among different types of financial institutions in the United States have been conducted by a number of scholars (Amos 1992; Barth 1990 and 1991; Barth, Brumbaugh, and Litan 1992; Barth and Brumbaugh 1992; Brumbaugh 1988; Cebula 1993; Kane 1985; Loucks 1994; and Saltz 1994 and 1995). While many of these studies have focused on the problems of savings and loans (S&Ls), analysis of or about banks has certainly not been lacking (Amos 1992; Barth 1991; Barth, Brumbaugh, and Litan 1992; Loucks 1994; and Saltz 1994).

Based to some significant degree on Amos (1992); Barth (1991); Barth, Brumbaugh, and Litan (1992); Loucks (1994); and Saltz (1994), this study focuses on four categories of factors that have been identified as potentially influencing bank closing rates:

1. Financial market factors: the cost of deposits [COST] and the percentage failure rate of competing financial institutions [PFRSL]
2. Other economic factors: the average percentages of gross state product derived from oil and natural gas extraction [OILNG], from manufacturing [MAN], and from agriculture [AGR]
3. State regulations on bank branching: such as whether unit banking or limited branch banking is the regulation in a state versus whether unlimited branching is permitted [DUMMY]
4. Other financial or economic factors including, but not restricted to, the average ratio of tangible net worth to capital at the commercial banks in each state [NW/ASSET].

It is argued that the higher the cost of deposits over time [COST], the lower is the bank profit rate over time (Bradley and Jansen 1986 and Saltz 1994). Accordingly, the higher the cost of deposits to a bank, the greater the likelihood that over time the bank will fail (Barth, Brumbaugh, and Litan 1992 and Saltz 1994), *ceteris paribus*. In addition, the increased degree of competitiveness in the financial services industry, beginning in the 1980s, is well documented (Barth 1991; and Barth, Brumbaugh, and Litan 1992). This increased competition included, among other things, a greater degree of competition between banks and savings and loans (S&Ls). Accordingly, the greater the percentage failure rate of S&Ls in a state [PFRSL], the less competition faced by the banks in that state, *ceteris paribus*. Thus, it is expected that the greater the value of PFRSL, the lower the bank failure rate in that state, *ceteris paribus*. Furthermore, another potential explanation of the expected negative impact of the S&L failure rate on the bank failure rate is that in states where there were numerous S&L failures, commercial banks were often given the opportunity to purchase the more lucrative assets of failed S&Ls at a discount; this would likely enhance the profitability of the banks in those states, *ceteris paribus*.

The oil/energy situation during the 1980s and early 1990s may also have been an important factor affecting the performance of banks. Prices of crude petroleum, for example, dropped very significantly from 1980-1985 and were halved from 1985-1986. This contributed to economic stress in those areas of the nation (especially the Southwest, but elsewhere as well) where employment was very dependent on oil (and natural gas) extraction (and related activities). Moreover, to some significant extent, this stress continues, since the price per barrel of crude oil, expressed in constant dollars, remains in 1995 well below the level that prevailed in the early 1980s and very late 1970s. It follows that, *ceteris paribus*, the higher the percentage of state product derived from oil and natural gas extraction [OILNG], the more susceptible the state economy to the adverse fortunes of the oil industry and hence the greater the probability of loan defaults at

banks and ultimately of bank closings in the state (Amos 1992 and Loucks 1994); see also Barth (1991), who makes similar arguments regarding S&L closings]. Also following Amos (1992) and Loucks (1994), this study controls for the percentages of gross state product derived from manufacturing [MAN] and from agriculture [AGR] in each state.

Amos (1992) argues that bank closings may be significantly determined by "... differences in state branch banking regulations." Following Amos (1992) and Loucks (1994), a binary [0,1] dummy variable, DUMMY, is included to indicate the degree of branch banking permitted. In the present study, the variable DUMMY is associated with both unit branch banking rules and rules permitting only limited branch banking within the state; i.e., DUMMY=1 if a state permits only unit banking or permits only limited branch banking and DUMMY=0 if unlimited branch banking is permitted in the state. As argued in Amos (1992) and Loucks (1994), the restrictive variable, DUMMY, should be associated with more bank closings because of the limitations it imposes on the ability of banks to diversify geographically.

Finally, there is the issue of capital/asset ratios. It is argued in Barth (1991), as well as elsewhere, that "... the possibility of losing owners' capital is, without doubt, the strongest force in operation to prevent unsound banking." As Barth (1991) elaborates, given the existence of federal deposit insurance, "... inadequately capitalized institutions have every incentive to engage in high-risk activities or to gamble for resurrection. It is the 'heads I win, tails the federal insurer loses' scenario at work." Accordingly, following Barth (1991), Barth and Brumbaugh (1992), and others, it is argued here that the higher the ratio of capital to assets at commercial banks, the lower the bank closing (failure) rate is likely to be.

III. EMPIRICAL MODEL

In this study, determinants of geographic bank closing rate differentials over the 1989-1994 time period are empirically investigated. Given the nature of the available data, the 50 states serve as the measure of the geographic unit. Of the 50 observations on the dependent variable in this study, ten have a value of zero. Thus, 20 percent of the observations on the dependent variable in this analysis are zeros. This situation corresponds to a standard "censored" regression model. Consequently, the model is estimated using the TOBIT estimation technique, which is perhaps the oldest and best known econometric technique used for estimating relationships involving censored data. As Maddala (1991, p. 794) observes, "... the TOBIT model is a censored regression model where observations on the dependent variable ... are censored" The use of ordinary least squares tech-

niques is not appropriate when observations on the dependent variable are zeros (see also Loucks 1994 and Chao and Cebula 1996). Furthermore, we allow for a general error variance structure to account for the heteroskedasticity typically found in cross-section data; thus, our estimation adopts the Heteroskedastic-TOBIT model.

Based on the arguments in the preceding section of this study, the following equation is estimated:

$$\text{CBFR}_j = a + b \text{COST}_j + c \text{PFRSL}_j + d \text{OILNG}_j + e \text{MAN}_j + f \text{AGR}_j + g \text{DUMMY}_j + h (\text{NW/ASSET})_j + u \quad (1)$$

where:

CBFR_j = the percentage of banks in state j that were closed during the period 1989-1994; CBFR_j consists of the ratio of the number of bank closings in state j , 1989-1994, divided by the total number of banks in state j at the beginning of 1989, expressed as a percent;

a = constant;

COST_j = the average cost of deposits for commercial banks in state j , 1989, as a percent per annum;

PFRSL_j = the percentage of the S&Ls in state j that failed during the period 1985-88;

OILNG_j = the percentage, in 1989, of state j 's gross state product that derived from oil and natural gas extraction;

MAN_j = the percentage, in 1989, of state j 's gross state product that derived from manufacturing;

AGR_j = the percentage, in 1989, of state j 's gross state product that derived from agriculture;

DUMMY_j = a binary [dummy] variable indicating whether, as of January 1, 1989, unit banking or limited branch banking regulations prevailed in state j ; $\text{UNIT}_j = 1$ in those states having unit banking regulations or regulations permitting only limited branch banking and $\text{UNIT}_j = 0$ otherwise, i.e., if unlimited branch banking is the rule;

$(\text{NW/ASSET})_j$ = the average ratio of tangible net worth (capital) to assets at banks in state j as of January 1, 1989;

u = stochastic error term.

The time period studied runs from 1989 through 1994. This represents the time period following that analyzed previously by Amos (1992) and Loucks (1994).

The dependent variable, CBF_{Rj}, represents the percentage of the total number of commercial banks in state *j* that were closed over the 1989-94 period. "Closed banks" are banks that were either closed outright or forced to merge with another bank; voluntary mergers are not treated as closings. These data were obtained from the *FDIC Annual Reports*, 1989-94. The average commercial bank cost of deposits, COST_j, was obtained from the Federal Reserve Bank of Atlanta Research Department. The data for the variables OILNG_j, MAN_j, and AGR_j were obtained from the Bureau of Economic Analysis. The data for the (NW/ASSET)_j variable were obtained from Barth, Brumbaugh, and Litan (1992), while the data for SLFR were obtained from Barth (1990).

Based on the arguments in the preceding section of this study, the following signs on the coefficients are expected:

$$b > 0, c < 0, d > 0, e > 0, f < 0, g > 0, h < 0 \quad (2)$$

The results of the Heteroskedastic-TOBIT estimation of equation (1) are reported in equation (3):

$$\begin{aligned} \text{CBFR}_j = & -2.1 + 6.15 \text{COST}_j - 0.21 \text{PFRSL}_j + 0.465 \text{OILNG}_j \quad (3) \\ & (-0.76) \quad (+2.14) \quad (-2.68) \quad (+4.18) \\ & - 0.003 \text{MAN}_j - 0.17 \text{AGR}_j + 5.15 \text{DUMMY}_j - 3.34 (\text{NW/ASSET})_j, \\ & (-0.02) \quad (-0.56) \quad (+2.15) \quad (-2.72) \\ \text{llr} = & 15.83 \text{ (pvalue}=0.01) \end{aligned}$$

where terms in parentheses are *t*-values and *llr* is the log likelihood ratio.

In equation (3), five [COST_j, PFRSL_j, OILNG_j, (NW/ASSET)_j, and DUMMY_j] of the seven estimated coefficients are statistically significant at the 5 percent level or beyond and have the expected signs. The estimated coefficients for variables MAN_j and AGR_j are not significant at even the 10 percent level.

The estimated coefficient on variable COST_j is positive and significant at the 4 percent level, implying that the bank closing rate in a state is an increasing function of the cost of deposits in that state (Barth, Brumbaugh, and Litan 1992), and Saltz (1994). The coefficient on variable PFRSL_j is negative and significant at the 1 percent level, implying that the bank closing rate is a decreasing function of the earlier S&L failure rate.¹ The estimated coefficient on variable OILNG_j is positive and significant at the 1 percent level. This finding implies that the bank closing rate is an increasing function of the percent of a state's GSP that derives from oil and natural gas extraction (Amos 1992 and Loucks 1994). Next, the estimated coefficient on the capital/asset variable, (NW/ASSET)_j, is negative and significant at the 1 percent level, implying that the higher the tangible capital/asset ratio, the lower the bank failure rate tends to be. The dummy variable for unit

banking and limited branch banking is positive and statistically significant at the 5 percent level; thus, it appears, as argued in Amos (1992), that restrictive branch banking regulations may lead to an increased bank closure rate. Finally, the coefficients on variables MAN_j and AGR_j are not significant at even the 10 percent level, a result consistent with Amos (1992).²

The estimate shown in equation (3) draws from a number of earlier studies, including Amos (1992), Barth (1991), Barth, Brumbaugh, and Litan (1992), Loucks (1994), and Saltz (1994). These studies have suggested a small number of other variables that also may impact upon the differentials in interstate bank closings. For example, it is suggested in the studies by Amos (1992) and Loucks (1994) that the level of gross state product (GSP) and the percentage growth rate of gross state product (AGGSP) may impact on the bank failure rate differential among states.

To test for these two possibilities, we now estimate the following reduced-form equation:

$$CBFR_j = i + k COST_j + l PFRSL_j + m OILNG_j + n MAN_j + o AGR_j + p DUMMY_j + q (NW/ASSET)_j + r GSP_j + s AGGSP_j + u' \quad (4)$$

where:

GSP_j = the gross state product in state j , 1989, expressed in millions of dollars;

$AGGSP_j$ = the average annual percentage growth rate in gross state product in state j , 1985-88.

Clearly, equation (4) adds the variables GSP_j and $AGGSP_j$ to those already found in equation (1). The data for GSP_j and the data for computing $AGGSP_j$ were obtained from the Bureau of Economic Analysis.

The Heteroskedastic-TOBIT estimate of equation (4) is:

$$CBFR_j = -1.41 + 6.95 COST_j - 0.22 PFRSL_j + 0.427 OILNG_j - 0.008 MAN_j - 0.27 AGR_j + 3.8 DUMMY_j - 4.68 (NW/ASSET)_j + 0.00001 GSP_j - 0.032 AGGSP_j, llr = 14.19 \quad (5)$$

(-0.55) (+2.05) (-2.73) (+3.44)
 (-0.05) (-0.86) (+1.90) (-2.74)
 (+1.83) (-1.61)

In this estimate, the variables $COST_j$, $PFRSL_j$, $OILNG_j$, $DUMMY_j$, and $(NW/ASSET)_j$ all seem to explain $CBFR_j$ much as they did in estimate (3), although the estimated coefficient on variable $DUMMY_j$ is now significant at only the 6.5 percent level rather than the 5 percent level. The variables MAN_j and AGR_j , not surprisingly, remain insignificant (as in Amos 1992). The variable

GSPj has a positive coefficient and is significant at the 8 percent level. This finding is reasonably consistent with Amos (1992) and Loucks (1994). The coefficient on variable AGGSPj is negative but significant at only the 12 percent level, a finding consistent with Loucks (1994) as well as Amos (1992).

Naturally, there are other variables that could potentially be considered. For example, it can be argued that federally chartered institutions were less likely to fail than state-chartered institutions (Chao and Cebula 1996). To account for this possibility, the percentage of banks in each state that was federally chartered as of January 1, 1989 (FEDCHj) was introduced into the system. Across a wide variety of estimates, this variable was found, without exception, to be statistically insignificant; moreover, FEDCHj was found to introduce multicollinearity problems into the system, especially with respect to variables COSTj and GSPj.³

IV. CONCLUSIONS

This study empirically examines determinants of geographic (interstate) differentials in bank closing rates in the United States over the period 1989 through 1994. Several potential causal factors are examined in this analysis. The Heteroskedastic-TOBIT estimation technique was adopted (1) because ten out of the 50 observations on the dependent variable are zeros; and (2) to allow for heteroskedasticity of these cross-section data.

The findings indicate, among other things, that the cost of deposits, the failure rate of S&Ls, the percent of gross state product deriving from oil and natural gas extraction, the tangible capital/asset ratio, and regulations that restrict bank branching all significantly impact on the interstate bank closing rate differential. Thus, regional economic factors do apparently affect bank performance to a significant extent. Regulatory authorities should therefore focus not only on bank-specific factors when assessing the likelihood of bank failures, but also on the broader economic environment in which banks operate. They should also consider the potentially adverse effects that limitations on geographic diversification can have on bank performance.

ENDNOTES

1. In this study, the percentage of failed S&Ls (PFRSLj) is one of the factors being used to help explain the bank failure rate. The PFRSLj variable refers to the S&L failure rate for a period (1985-88) that *completely preceeds* the period for which the bank failures are measured (1989-1994). In addition, the other right-

hand-side variables in equations (1)-(3) all correspond to the year 1989. Accordingly, there is no possibility of simultaneity and no need for a two-stage estimation procedure.

2. Interestingly, the correlation between MAN_j and AGR_j is only -0.28, so that there does not appear to be a serious multicollinearity problem involving these two variables. In addition, estimating the system with AGR_j but without MAN_j , or with MAN_j but without AGR_j , does not change the conclusions. Indeed, each of these two variables is consistently insignificant across a wide variety of specifications.

3. To illustrate the impact of variable $FEDCH_j$ on the 1989-94 interstate bank failure rate, consider the following estimate, which corresponds to equation (1) with variable $FEDCH_j$ included:

$$\begin{aligned}
 CBFR_j &= -1.74 + 5.89 COST_j - 0.21 PFRSL_j + 0.474 OILNG_j \\
 &\quad (+1.74) \quad (-2.65) \quad (+4.93) \\
 &\quad -0.002 MAN_j - 0.13 AGR_j + 5.13 DUMMY_j - 3.67 (NW/ASSET)_j \\
 &\quad (-0.01) \quad (-0.43) \quad (+2.16) \quad (-3.33) \\
 &\quad + 0.0004 FEDCH_j, \text{ llr} = 9.55 \text{ (pvalue}=0.05) \\
 &\quad (+0.55)
 \end{aligned}$$

As shown in this estimate, the $FEDCH_j$ variable is statistically insignificant. In addition, the $COST_j$ variable is now less robust than in equation (3).

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