Empirical Analysis of Determinants of Geographic Differentials in the Bank Failure rate in the U.S.: A Heteroskedastic-Tobit Estimation

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ABSTRACT

Using the Heteroskedastic-TOBIT model to deal with both censored data and a heteroskedasticity problem, this study address determinants of interstate differentials in bank closing rates over the 1982-91 period. It is found that the bank closing rate in a state is an increasing function of the cost of deposits, the percentage of state employment derived from oil and natural gas extraction, and the existence of unit banking regulations, while being a decreasing function of housing price inflation in the state, the average percentage growth rate of the GSP in the estate, and the percentage of banks in the state having federal charters. (JEL codes: G2, G20, G21)

I. INTRODUCTION

For the time period from 1943 through 1981, relatively few banks failed because of insolvency. This situation changed dramatically beginning with the year 1982, during which 42 banks were closed, followed by 48 closings in 1983 and 79 closings in 1984. The number of closed banks increased sharply thereafter, hitting 200 closings in 1988 and 206 in 1989 and surpassing 119 closings per year through 1992. Indeed, the bank closing rate in the U.S. did not decline significantly until after the implementation of provisions (such as risk-related deposit insurance and stricter capital requirements) of FDICIA, the Federal Deposit Insurance Corporation Improvement Act of 1991 [Cebula (1999)]. Commercial bank failure data in the U.S. reveal a very large interstate variation in bank failure rates. Indeed, the bank failure rate by state, especially during the 1980s and very early 1990s, differs widely among the various states. For example, for the 1982-91 study period (when the number of bank closings had especially intensified), there were eight states that experiences zero closings, whereas there were ten states in which the percentages of banks that failed reached double digits. In view of this widely varied interstate pattern in the bank failure rate and given the implications to depositors and taxpayers of bank closings/failures, it is important to determine whether regional factors played a role, especially if policymakers are to be properly prepared to prevent such closing problems in the future. Banks may engage in riskier activities when they have access to higher levels of federally insured deposits while having very low if not negligible or even negative net worth, as was so often the case in the 1980s and very early 1990s [Barth (1991), Barth and Brumbaugh (1992), Cebula (1993; 1999)] What is less understood is the reason some banks may engage in such behavior, whereas others may not. Given that closing rates differ so widely among states permits analysis beyond bank-specific variables to assess the impact of regional economic factors. This analysis permits analysis of whether some states experienced bank failures because of their regulatory environment or were simply lucky to have avoided so adverse economic circumstance. This study empirically analyzes bank closings by state for the period 1982-91. Given (1) that values for seven of the observations on the dependent variable in the analysis are zero and (2) the need to control for heteroskedasticity, we adopt the Heteroskedastic-TOBIT estimation technique [ef. Cebula, Barth, and Belton (1995)].

II. CONTEXT FOR THE ANALYSIS

Investigations of insolvencies among various types of financial institutions in the U.S. have been conducted by a number of scholars [for example, Amos (1992), Barth (1991), Barth Brumbaugh, and Litan (1992), Barth and Brumbaugh (1992), Brumbaugh (1988), Cebula (1993, 1999), Chao and Cebula (1996), Kane (1985), Loucks (1994), and Saltz (1994; 1995)]. While many of these studies have focused on the problems of savings and loans (S&Ls), the empirical analysis of banks has certainly not been lacking [Amos (1992), Barth, Brumbaugh, and Litan (1992), Loucks (1994), and Saltz (1994)]. Based to some significant degree on Amos (1992), Barth, Brumbaugh, and Litan (1992), Cebula, Barth, and Belton (1995), Loucks (1994), and Saltz (1994), this study focuses on four categories of factors that have been isolated as potentially influencing bank failures:

1. Purely financial market factors: the cost of deposits [ACBCD];
2. Other economic factors: unemployment rates [UN], the average growth rate of gross state product over time [AGSP], the inflation rate of housing [HINFL], and the percentage of gross state product derived from oil and natural gas extraction[OH, NG];
3. State regulations on branching: such as whether unit banking is the regulation in a state [UNIT];
4. Bank charters: the extent to which banks in each state have federal charters [PFEDCH] rather than state charters.

In this study, it is hypothesized that the higher the cost of deposits over time [ACBCD], the lower is the bank profit rate over time [Bradley and Jansen (1986) and Saltz (1994)]. Accordingly, the higher the cost of deposits to the bank, the greater the likelihood that over time the bank will fail [Barth, Brumbaugh, and Litan (1992), and Saltz (1994)], ceteris paribus. Arguably, the higher the unemployment rate in a state [UN], the greater the probability of loan defaults and (perhaps) foreclosures [Saltz (1994)] and hence of bank financial stress and, ultimately, of bank closings, ceteris paribus. Next, states with more rapidly growing levels of gross state product [AGSP] are more likely to be environments with both (1) fewer loan defaults over time and (2) more rapidly growing demand for bank services and, as a result fewer bank closings [Amos (1992)], ceteris paribus. In addition, more rapid inflation rate of housing prices [HINFL] would tend to reflect a more vibrant housing market and potentially therefore a more vital economic environment [Chao and Cebula (1996)]. Such an environment would be likely to be associated with fewer bank failures, ceteris paribus. The oil-price situation during the 1980s may also have been an important factor in affecting the performance of banks. Prices of crude petroleum, for example, dropped significantly during the period 1980-1985 and indeed were halved from 1985-1986. This pattern of declining crude oil prices contributed to economic stress in a variety of geographic areas of the U.S. (especially the Southwest, which depended so much more than most other states on crude oil and natural gas extraction activities) but elsewhere as well, where employment also was quite dependent on oil and natural gas extraction of related activities such as providing equipment and supplies or oil refining. It follows that, ceteris paribus, the higher the percentage of state product derived from oil and natural gas extraction [OILING] in any given state, the grater the probability of loan defaults and foreclosure proceedings at banks – especially in that state – and hence, over time, the greater the probability of bank closings in the state [Amos (1992) and Loucks (1994), interestingly, Barth (1991) and Barth and Brumbaugh (1992), make similar arguments regarding factors contributing to S&L failures].

Amos (1992, P. 812) takes the view that bank failures may be determined by "…differences in state brank banking regulations." Following Amos (1991), a binary dummy variable is included to indicate whether branch banking is permitted (UNIT). As alleged in Amos (1992), the restrictive variable, UNIT, should be associated with more bank closings because of the limitations it imposes on the ability of banks to compete as well as diversify geographically. There is also the issue of the source of bank charters. Historically, banks chartered by states have often been subject to less stringent regulations/restrictions than those that were federally chartered. Indeed, some state-chartered institutions enjoyed greater asset power than federally-chartered institutions. Since regulations on many state-chartered institutions have been less stringent than those applying to federally-chartered institutions, it can argued that state-chartered institutions have tended to be exposed to a higher default risk than federally-chartered institutions. Thus, it is hypothesized that the greater the percentage of banks in a state having federal charters [PFEDCH], the lower the bank closing rate in the state, ceteris paribus.

III. THE EMPIRICAL FRAMEWORK

In the present analysis, determinants of geographic bank failure rate differentials over the 1982-91 time period are empirically investigated. Given the nature of the available data, the 50 states in the U.S. serve as the measure of the geographic unit, although the results are effectively the same even if Alaska, with its 50 percent bank closure rate over the 1982-91 period, is dropped from the model. Of the 50 observations on the dependent variable in this study, seven have a value of zero, so that 14 percent of the observations on the dependent variable in this analysis are zeros. This situation clearly corresponds to a standard "censored" regression model. Consequently, the model is estimated using the TOBIT estimation technique. As Maddala (1991, p. 794) has observed, "…the TOBIT model is a censored regression model where observations on the dependent variable…are censored…" The use of (OLS) ordinary least squares techniques 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.

Predicted on the arguments provided and summarized above, the reduced-form eq1uaiton to be estimated is given by: [1]

$$(1)\quad CBCR_j = a + b\,ACBD_j + c\,HINFL_j + d\,OILNG_j + e\,UN_j + f\,AGSP_j + g\,UNIT_j + h\,PFEDCH_j + u$$

where:

$CBCR_j$ = percentage of commercial banks in state j, 1982-90, as a percent per annum;

a = constant term;

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

$HINFL_j$ = the inflation rate of single family dwellings, in state j, 1980-90, expressed as a percent;

$OILNG_j$ = the average annual percentage, 1980-90, of state j's gross state product that derived from oil and natural gas extraction;

UN_j = the average unemployment rate in state j, 1980-90, as a percent;

AGSPj = the average annual percentage rate of growth of state product (GSP) in state j, 1980-90;

UNITj = a binary [dummy] variable indicating whether unit bank regulations prevail in state j over the study period; UNITj = 1 in those states having unit banking regulations and UNITj = 0 otherwise;

PFEDCHj = the percentage of the banks in state j having a federal charter at year's end, 1982;

u = stochastic error term.

The study period is 1982-1991. The year 1982 represents the beginning of the time period during which the number of bank closings rose dramatically, surpassing any prior equivalent experience in the post-Great Depression period. The choice of end-point for the study period is due to the passage of FDICIA [the Federal Deposit Insurance Corporation Improvement Act] in 1991 and the fact that major implementation of its provisions essentially began in 1992. The variable CBCRj represents the percentage of the total number of commercial banks in state j that were closed over the 1982-91 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, along with the data for variable PFEDCHj, were obtained from the FDIC Annual Reports, 1982-92. The average commercial bank cost of deposits, ACBCDj, was obtained from the Federal Reserve Bank of Atlanta Research Department. The data for computing HINFL were obtained from various issues of the Statistical Abstract of the United State. The date for the unemployment rate, UNj, was obtained from various issues of the Statistical Abstract of the United States. Predicated on the arguments in the preceding section of this study, the following signs on the coefficients are expected:

(2) $b > 0, c < 0, d > 0, e > 0, f < 0, g > 0, h < 0$
The empirical results of the Heteroskedastic-TOBIT estimation of equation (1) are reported in equation (3). [2]

(3) $CBCRj = -193.19 + 1.675\ ACBCDj - 0.04\ HINFLj + 0.379\ OILNGj + 1.16\ UNj - 3.77\ AGSPj +$
$(-1.57)\ (+3.37)\quad (-2.98)\quad (+3.35)\quad (+1.54)\ (-3.73)\ (+2.26)$
$0.036\ UNITj - 0.35\ PFEDCHJ$
(-2.50)
$LR = 16.45$ (pvalue = 0.00011)

where terms in parentheses are t-values and LR is the likelihood ratio in this Heteroskedastic-TOBIT estimation.

In equation (3), six of the seven estimated coefficients are statistically significant at the five percent level or beyond and have the expected signs. One estimated coefficient, that corresponding to the variable UNj, is not statistically significant at even the ten percent level. Finally, the LR (likelihood ratio) is statistically significant at the one perecnet level. The estimated coefficient on variable ACBCDj is positive and significant at the one percent level, implying that the bank closing rate in a state is an increasing function of the cost of deposits to banks in that state [Barth, Brumbaugh, and Litan (1992) and Saltz (1994)]. The estimated coefficient on the variable HINFLj is negative and significant at the one percent level, implying that the bank closing rate in a state is a decreasing function of the housing inflation rate in that state. The coefficient on the variable OILNGj is positive and significant at the one percent level; this finding implies that the bank closing rate in a state is an increasing function of the percent of that state's GSP that derives from oil and natural gas extraction [see also Amos (1992) and Loucks (1994)]. Next, although the estimated coefficient on the unemployment rate variable is positive, as expected, it fails to be significant at the even ten percent level. This, it appears that interstate unemployment rate

differentials may not have significantly impacted bank closing rate differentials over the study period. The variable measuring the average growth rate of GSP is significant at the one percent level and negative, implying that states experiencing greater economic growth rate of GSP is significant at the one percent level and negative, implying that states experiencing greater economic growth tend to have fewer bank closings. This result is consistent with arguments in Amos (1992) and Loucks (1994).[3] This particular finding may also imply that, in terms of understanding interstate bank closing rate differentials, the growth rate of GSP is a better indicator of economic prosperity or at least favorable economic conditions for commercial banks in a state that the unemployment rate is. This dummy variable for unit banking is positive and statically significant at the five percent level; thus, it appears, as argued in Amos (1992), that restrictive unit banking regulations may lead to an increased bank closure rate. Finally, the coefficient on the bank charter variable, PFEDCHj, is negative and significant at the five percent level, implying that the greater the percentage of banks in a state having federal (as opposed to state) charters, the lower the commercial bank closing bank closing rate in the state.

IV. CONCLUSION

This empirical analysis investigates determinants of interstate differentials in commercial bank failure rate in the U.S. over the 1982-91 period. The Heteroskedastic-TOBIT estimation technique was adopted (1) because seven (i.e., 14 percent) of the 50 observations on the dependent variable are zeros, which constitutes a case of censored data, and (2) to allow for heteroskedasticity of the cross-section data. The findings indicate that the cost of deposits to commercial banks, the percent of gross state product derived from oil and natural gas extraction, the average growth rate of gross state product, unit banking regulations, and the percentage of banks having federal (as opposed to state) charters all significantly influence interstate differentials in bank closing rates. 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. Presumably, the potentially adverse effects that limitations on geographic diversification can have on bank performance have already been recognized.

Notes

1. The Heteroskedastic-TOBIT model actually consists of more than simply equation (1). Regarding the specification of the **full** Heteroskedastic-TOBIT model, see Harvey (1979) and Chao and Cebula (1996, esp. pp. 9-10).
2. For the interested reader, the Homoskedastic-TOBIT estimate of equation (1) is given by:

$$CBCR_j = -111.5 + 1.768\,ACBCD_j - 0.04\,HINFL_j + 0.299\,OILNG_j + 1.10\,UN_j - 3.85\,AGSPJ + 0.015$$
$$\quad (-0.80)\ (+2.78)\qquad (-1.08)\ (+2.91)\ (+0.75)\ (-1.91)\ (+1.35)$$
$$UNIT_j - 0.40\,PFEDCH_j$$
$$\quad (-2.59)$$

In this estimate, there are only three [rather than the six in equation (3)] coefficients that are significant at the five percent level. Thus, the Heteroskedastic adjustment translates into very different results. This fact of course implies that the Cebula, Barth, and Belton (1995) Homoskedastic-TOBIT analysis, which involves a somewhat different time period and a somewhat different model, might benefit from re-estimation and may indeed be somewhat flawed.

3. The majority of the explanatory variables in this analysis differ from those in Amos (1992) and Loucks (1994). A different time period, 1982-91, is examined here, rather that the period 1982-88, which is considered in Amos (1992) and Loucks (1994).

REFERENCES

Amos, Orley M., Jr., "The Regional Distribution of Bank Closings in the United States from 1982 to 1988," Southern Economic Journal, Vol. 58, January, 1992, 805-815.

Barth, James R., The Great Savings and Loan Debacle, Washington, D.C.: AEI Press, 1991.

Barth, James R., and R. Dan Brumbaugh, Jr., The Reform of Federal Deposit Insurance, New York: Harper Business, 1992.

Barth, James R., R. Dan Brumbaugh, Jr., and Robert E. Litan, The Future of American Banking, Armonk, NY: M.E. Sharpe, Inc., 1992.

Bradley, Michael D., and Dennis W. Jansen, "Deposit Market Deregulation and Interest Rates," Southern Economic Journal, Vol. 53, October, 1986, 478-489.

Brumbaugh, R. Dan, Jr., Thrifts under Siege. Cambridge, MA: Ballinger Publishing Co., 1988.

Cebula, Richard J., "The Impact of Federal Deposit Insurance on Savings and Load Failures," Southern Economic Journal, Vol. 59, April, 1993, 620-628.

Cebula, Richard J., "An Updated Evaluation of U.S. Banking Legislation: The Federal Deposit Insurance Corporation Improvement Act of 1991 and Its Performance in Terms of the Financial Services Industry," Swiss Journal of Economics and Statistics, Vol. 112, June, 1999, 145-164.

Cebula, Richard J., James R. Barth, and Willie J. Belton, "A TOBIT Analysis of Determinants of Geographic Differentials in the Commercial Bank Closing Rate in the United State," Rivista Internazionale di Scienze Economiche e Commerciali, 1995, 863-869.

Chao, Ray Y., and Richard J. Cebula, "A Heteroskedastic-TOBIT Analysis of the S&L Closing Problem," Journal of Financial Services Research, Vol. 10, January, 1996, 5-25.

Federal Deposit Insurance Corporation, Annual Report, 1980-1992. Washington, D.C.: FDIC, 1980-1992.

Harvey, Andrew, "Estimating Regression Models with Multiplicative Heteroskedasticity," Econometric a, Vol. 44, July, 1979, 461-465.

Kane, Edward, The Gathering Crisis in Federal Deposit Insurance, Cambridge, MA: M.I.T. Press, 1985.

Loucks, Christine, "The Regional Distribution of Bank Closings in the United States from 1982 to 1988: A Brief Note," Southern Economic Journal, Vol. 61, July, 1994, 191-194.

Maddala, G.S., "A Perspective on the Use of Limited-Dependent and Qualitative Variable Models in Accounting Research," Accounting Review, Vol. 66, December, 1991, 788-807.

Saltz, Ira S., “The Impact of Federal Deposit Insurance on Savings and Load Failures: Comment,” Southern Economic Journal, Vol. 62, July, 1995, 253-255.

Saltz, Ira S., “On Regulation Q and the Bank Failure Rate in the United States,” International Review of Economics and Business, Vol. 41, February, 1994, 185-191.