JRAP (1997) 27, 1: 55-62

An empirical analysis of determinants of geographic differentials in the savings and loan failure rate, 1989-1991, using the heteroskedastic-Tobit model

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Abstract. This study empirically examines determinants of geographic (interstate) differentials in the savings and loan failure rate in the United States from 1989 to 1991. The study uses the heteroskedastic-Tobit estimation technique because 12 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 S&L failure rate differential is affected by the average annual growth rate in gross state product, the percentage of gross state product deriving from oil and natural gas extraction, the S&L cost of deposits, the volatility of the S&L cost of deposits, and the remaining average balance on outstanding fixed-rate mortgage loans at S&Ls.

1. Introduction

Not since the Great Depression have regulatory authorities closed as many savings and loans (hereafter, S&Ls) as they did during the 1980s and early 1990s. From 1943 through 1980 relatively few S&Ls were closed because of insolvency. Over this period there were only three years (1966, 1970, and 1980) in which the number of failed federally insured S&Ls was ten or more.

This situation changed dramatically, however, in 1981 when 28 S&Ls failed, followed by 63 failures in 1982, 36 in 1983, and 22 or more each year until 1988 when 205 S&Ls failed. After a brief decline in S&L failures to 37 in 1989 when the Federal Savings and Loan Insurance Corporation (FSLIC) went bankrupt and Congress passed the Financial Institutions Recovery, Reform and Enforcement Act (FIRREA), S&L failures hit 315 in 1990 and 232 in 1991.

After 1991 S&L failures per year began to fall noticeably, as did bank failures, possibly reflecting the Federal Deposit Insurance Corporation Improvement Act of 1991 (FDICIA).

One pattern that emerges from examination of the S&L failure data is the substantial geographic variation in the distribution of S&L failures. Moreover, large geographic differentials in the S&L failure rate also can be detected in the post-

* Mike Bradley and Dennis Jansen provided helpful comments and suggestions that improved this paper.

FIRREA enactment and pre-FDICIA implementation period from 1989 through 1991. At the extrema, there were six states that experienced zero S&L failures from 1989 to 1991, whereas there were more than ten states in which the percentages of S&Ls that failed reached double digits.

Given this widely divergent geographic pattern in the S&L failure rate, it is important to determine whether regional factors played a role. S&Ls may engage in excessively risky activities when they have access to federally insured deposits. But why do some S&Ls engage in such behavior, while others do not? Widely differing closing rates among states enables one to go beyond S&L-specific variables to examine the potential role of regional economic factors. This type of analysis allows us to assess whether some states avoided S&L closings because these state simply avoided an adverse economic shock or circumstance.

This study empirically analyzes interstate S&L failure rate differentials from 1989 through 1991. The 1989-1991 period is when the public first became aware of the S&L problem, partly because of the failure of the FSLIC and partly because of Congress enacting FIRREA. Both of the latter events occurred in 1989. We stop at 1991 in this study because provisions of the FDICIA were being implemented[1] by 1992, and these provisions may have distorted the geographic S&L failure pattern.

This study extends the works of Amos (1992) and Loucks (1994) on interstate bank failure differentials to the S&L industry and also combines them with the well-known work by Barth (1991). Given that values for some of the observations on the dependent variable in this analysis are zero and the need to control for heteroskedasticity, we adopt the heteroskedastic-TOBIT estimation technique.

2. Framework

Studies of failure rates among different types of financial institutions (banks as well as S&Ls) in the United States have been conducted by a number of scholars (Amos 1992; Barth 1990 and 1991; Barth and Bartholomew 1992; Barth, Brumbaugh, and Litan 1992; Barth and Brumbaugh 1992; Belton and Cebula 1995; Brumbaugh 1988; Cebula 1993; Loucks 1994; and Saltz 1994; 1995; 1996). Based on Amos (1992), Barth (1991), Barth and Bartholomew (1992), Belton and Cebula (1995), Loucks (1994), and Saltz (1994 and 1995), this study focuses on three categories of factors that potentially influence S&L failure rates:

- Purely financial market factors: the cost of deposits to S&Ls (COST); the mortgage rate at S&Ls (MORT); the volatility of the S&L cost of deposits (COSTVAR); and the volatility of the S&L mortgage rate (MORTVAR);
- Other economic factors: the average percentage of gross state product derived from oil and natural gas extraction (OILNG); the average annual growth rate of gross state product (AGRSP); and the volatility of the average annual growth rate of gross state product (AGRSPVAR); and

[1] Such implemented provisions include that of "prompt corrective action."

- Potential loan portfolio risk: this category is reflected in the average time to maturity (average remaining balance) of the outstanding mortgage loans at S&Ls (DUR).

It is argued that the higher the average S&L cost of deposits (COST), the lower is the S&L profit rate and the faster the potential deterioration of S&L capital [in principle, following Barth (1991 pp. 38, 40), Barth and Bartholomew (1992 p. 39), Belton and Cebula (1995), and Saltz (1994; 1995; 1996)]. In addition, the higher the average mortgage rate (MORT), the higher the S&L profit rate and the slower the potential deterioration of S&L capital [see again Barth (1991 pp. 38, 40), Barth and Bartholomew (1992, p. 39), Belton and Cebula (1991)]. Accordingly, the higher the S&L cost of deposits, the greater the likelihood of S&L failures [Barth (1991 p. 40), Barth and Bartholomew (1992 p. 39), Belton and Cebula (1995), and Saltz (1995)], *ceteris paribus*. Moreover, it follows that the higher the average mortgage rate, the lower the likelihood of S&L failures (Barth 1991; Barth and Bartholomew 1992; Belton and Cebula 1995), *ceteris paribus*.

Barth (1991), Barth and Bartholomew (1992), and Saltz (1996) argue that increased interest rate volatility also has contributed to S&L financial problems. As Barth (1991 p. 40) observes, "...another cause of the current savings and loan misfortune is unexpectedly high interest rates [as noted above] and volatile interest rates." Barth (1991, p. 38) notes that the sharp volatile movements of interest rates "...severely affected the financial condition of the savings and loan industry" which was unaccustomed to, and inexperienced in, markets with highly volatile interest rates. According to Barth (1991), Barth and Bartholomew (1992), and Saltz (1996), the S&L failure rate is expected to be an increasing function of interest rate volatility (represented in this study by COSTVAR and MORTVAR), *ceteris paribus*.

The oil/energy situation during the 1980s and early 1990s may have been an important factor affecting the performance of S&Ls. Prices of crude petroleum, for example, dropped significantly from 1980 to 1985 and were halved from 1985 to 1986. This contributed to economic stress in those areas of the nation (especially the southwest) where employment was is dependent on oil and natural gas extraction and related activities. Moreover, to a significant extent this stress has continued through the 1980s and into the 1990s because the price per barrel of crude oil in 1996, expressed in constant dollars, is below levels of the early 1980s and late 1970s.

Ceteris paribus, the higher the percentage of gross state product derived from oil and natural gas extraction (OILNG), the more susceptible is the state economy to adverse fortunes of the oil industry and hence the greater is the probability of loan defaults at S&Ls and S&L closings in the state. Barth (1991 p. 40), Barth and Bartholomew (1992 p. 39), and Belton and Cebula 1995) make such arguments regarding S&Ls, and Amos (1992) and Loucks (1994) argue similarly regarding banks.

Aside from the factors impounded in variable OILNG, other economic conditions such as the growth rate of gross state product and/or its volatility may affect the performance of financial institutions. [See Barth (1991) and Saltz (1995) regarding S&Ls per se and Amos (1992) and Loucks (1994) regarding banks per se.] These studies suggest that the greater the average annual growth rate of gross state product

(AGRSP)], the healthier is the economic environment and hence the less likely S&L failures will be, *ceteris paribus*. More volatile economic growth (measured in this study by variable AGRSPVAR) may create financial stress that will be reflected in reduced S&L profits and increased S&L failures, *ceteris paribus*.

Finally, the longer is the average remaining balance on existing fixed rate mortgages in S&L portfolios, the greater may be the riskiness of those mortgages (Barth 1991). In particular, when interest rates rise, holders of fixed rate mortgages are susceptible to greater capital losses. The longer the average maturity (average remaining balance) of the fixed rate mortgage portfolio, the greater is the capital loss potential. Hence, the longer the average maturity (average remaining balance) of the mortgage portfolio (DUR), the greater is the risk of capital loss and hence the greater is the likelihood of S&L insolvency, *ceteris paribus*.

Based on the arguments provided above, the basic model is given by:

$$(1)\ SLF_j = f(COST_j, MORT_j, COSTVAR_j, MORTVAR_j, OILNG_j, AGRSP_j, AGRSPVAR_j, DUR_j)$$

where it is expected that:

$$(2)\ f_{COST_j} > 0,\ f_{MORT_j} < 0,\ f_{COSTVAR_j} > 0,\ f_{MORTVAR_j} > 0,\ f_{OILNG_j} > 0,\ f_{AGRSP_j} < 0,\ f_{AGRSPVAR_j} > 0,\ f_{DUR_j} > 0$$

where:

SLF_j = The S&L failure rate in state j from 1989 to 1991 expressed as the number of S&L failures in state j from 1989 to 1991 divided by the number of S&Ls in state j at the beginning of 1989, as a percent;

$COST_j$ = The average cost of deposits to S&Ls in state j in 1989 as a percent per annum;

$MORT_j$ = The average effective mortgage rate (principally the contract interest rate, but also including other fees and charges amortized over a ten year period) at S&Ls in state j as a percent per annum on conventional fixed rate first mortgage loans used for the purchase of single family homes 1989;

$COSTVAR_j$ = The variance in the average cost of deposits to S&Ls in state j from 1979 to 1988;

$MORTVAR_j$ = The variance in the average mortgage rate at S&Ls in state j from 1979 to 1988;

$OILNG_j$ = The percentage of gross state product in state j that derived from oil and natural gas extraction 1989;

$AGRSP_j$ = The average annual percentage growth rate of gross state product in state j 1979 to 1988;

$AGRSPVAR_j$ = The variance in $AGRSP_j$ from 1979 to 1988;

DUR_j = The average mortgage maturity (average remaining balance), in years, on outstanding mortgages at S&Ls in state j, 1989; the mortgage loans are conventional fixed rate first mortgages on single family homes.

A failed S&L is one that was closed outright by the regulators or was forced to merge with another institution; S&Ls that voluntarily merge with another institution are not treated as failed institutions. On average, the S&Ls that failed over the study period had been insolvent for about 38 months. The average asset size of these failed S&Ls was approximately $457 million. Finally, roughly 57 percent of these failed institutions were stock (as opposed to mutual) institutions, while a majority of the failures had state charters.

The volatility of the cost of deposits, of the mortgage rate, and of the annual average growth rate of gross state product are proxied by the variance of the cost of deposits, the variance of the mortgage rate, and the variance of the average annual growth rate of gross state product, respectively. The variance as a proxy for volatility follows related studies by Loucks (1994), Amos (1992), and Cebula (1993). The average annual growth rate of gross state product (AGRSP) and the variables measuring volatility (COSTVAR, MORTVAR, AGRSPVAR) deal with the time period ending December 31, 1988; this specification avoids simultaneity problems. For the same reason, the values for variables COST, MORT, OILNG, and DUR correspond to the beginning of the study period, 1989. The principal data sources are the Office of Thrift Supervision (1979...1989) for COST, MORT, COSTVAR, MORTVAR, SLF, and DUR and the Bureau of Economic Analysis for OILNG, AGRSP, and AGRSPVAR.

3. Empirical model

This study empirically examines determinants of geographic S&L failure rate differentials from 1989 to 1991. 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, six have a value of zero. Thus, 12 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, the oldest and best-known econometric technique for estimating relationships involving censored data. The use of ordinary least squares techniques is not appropriate when observations on the dependent variable are zeros. [See Loucks (1994)]. 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. The parameters in the heteroskedastic-Tobut model are estimated using the maximum likelihood method.

The first issue we address is the specification of the variance structure. In the estimate below, all of the independent variables are included in the variance equation. This is the model with the highest log likelihood ratio. In the estimate reported, the likelihood ratio test overwhelmingly rejects the homoskedastic error model, with the

p-value equal to 0.00004. Thus, addressing the problem with the heteroskedastic-Tobit model is appropriate. Accordingly, the heteroskedastic-Tobit estimate of the linear version of equation (1) above is given by:

$$\begin{aligned}(3)\ SLF_j = {} & -85.398 + \underset{(+3.47)}{10.981}\ COST_j - \underset{(-0.863)}{4.5607}\ MORT_j + \underset{(+2.89)}{11.819}\ COSTVAR_j \\ & + \underset{(+0.952)}{1.0083}\ MORTVAR_j + \underset{(+4.17)}{1.6723}\ OILNG_j - \underset{(-2.58)}{2.6162}\ AGRSP_j \\ & - \underset{(-0.77)}{0.0984}\ AGRSPVAR_j + \underset{(+2.37)}{1.9262}\ DUR_j\end{aligned}$$

$$llr = -135.6464,\ p\ value = 0.00004$$

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

As shown in equation (3), the estimated coefficients on four of the explanatory variables (COST, COSTVAR, OILNG, AGRSP) are significant at the 1.0 percent level with the expected signs, and the estimated coefficient on one more explanatory variable (DUR) is significant at the 2.0 percent level with the expected sign. Meanwhile, the estimated coefficients for MORT and MORTVAR, while having the expected signs, are not significant at the 0.05 level. Finally, the estimated coefficient on variable AGRSPVAR is negative but insignificant.

According to the estimate, it appears that the S&L failure rate at the state level is an increasing function of both the S&L cost of deposits and their volatility. These findings are consistent with arguments in Barth (1991) and Barth and Bartholomew (1992) and findings in the times-series analysis in Belton and Cebula (1995) and Saltz (1995).

The S&L failure rate at the state level is an increasing function of the percentage of gross state product deriving from oil and natural gas extraction. This result is similar to Amos (1992) and Loucks (1994) for the case of commercial banks. It also substantiates arguments regarding S&Ls in Barth (1991) and Barth and Bartholomew (1992).

The average annual growth rate of gross state product seems to reduce the S&L failure rate at the state level, a result that is similar to, but more robust than, the corresponding finding for banks in Loucks (1994). In addition, the S&L failure rate at the state level is an increasing function of DUR, implying that the longer the average remaining balance in the S&L mortgage portfolio, the more likely it will be injurious to the S&L. By contrast, it appears that the average mortgage rate, its variance, and the variance in the average annual growth rate of gross state product have little impact on the interstate S&L failure rate differential.[2]

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[2] Following Amos (1992) and Loucks (1994), we have experimented with dummy variables to reflect states that in 1989 had either unit banking regulations or regulations that permitted limited branch banking. Such variables were insignificant in all our heteroskedastic-TOBIT S&L estimates; hence, we do not report these results. The results are available upon written request.

The geographic S&L closing-rate differential is most sensitive to the cost of deposits, the volatility of the cost of deposits, the percent of gross state product deriving from oil and natural gas extraction, and the average annual percent growth in gross state product. To a lesser degree, it also is sensitive to the average maturity on outstanding mortgages. Thus, given the nature of most of these variables, these findings are potentially consistent with the conclusion in a recent study by Barth, Hudson, and Jahera (1995 p. 24) that "...the results of this and several other studies do not support the view that the S&L industry's problems were due to deregulation at either the federal or state level in the early 1980s." On the other hand, the recent study by Cole, McKenzie, and White (1995 p. 52) finds that "...moral hazard-laden behavior was [the] critical factor explaining the failures and liquidation costs of more than 600 thrifts during the late 1980s." However, even Cole, McKenzie, and White (1995 p. 52) concede that "It does appear that there was a regional aspect to the thrift crisis."

4. Conclusions

This study empirically examines determinants of geographic (interstate) differentials in S&L failure rates in the United States from 1989 through 1991. Several potential causal factors are examined in this analysis. The heteroskedastic-Tobit estimation technique is adopted because six of the 50 observations on the dependent variable are zeros and to allow for heteroskedasticity of these cross-section data.

The findings indicate that the average S&L cost of deposits, the volatility of (variance in) the average S&L cost of deposits, the percent of gross state product deriving from oil and natural gas extraction, the average annual growth rate in gross state product, and the average remaining balance on S&Ls' fixed rate mortgage portfolios significantly impact the geographic differential in the S&L failure rate. Thus, regional economic factors affect S&L performance to a significant extent. Regulatory authorities should focus not only on S&L-specific factors when assessing the likelihood of S&L failures (and when assigning federal deposit insurance premiums to S&Ls),[3] but also on the broader economic environment in which S&Ls operate. For example, given that economic reality suggests systematic geographic differentials in S&L risk, geographic differentials in regulatory policy could be used to mitigate certain risky behaviors and thereby to reduce the likelihood of insolvencies. For example, the use of either geographically different risk-related deposit insurance premiums or geographically different risk-related capital requirements could mitigate risky behavior in the most risk-rich states or regions.

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