The Regional Distribution of Bank Closings in the United States: An Extension of the Amos Analysis

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I. Introduction

In a recent study, Amos [1, 805] empirically ". . . seeks to identify the critical factors causing the regional differentiation of bank closings between 1982 and 1988." According to Amos [1, 805], the study is motivated by ". . . the ultimate objective of preventing future bank closings." The Amos analysis is original in its addressing of the heretofore largely ignored issue of the causes of interregional bank closing rate differentials. The analysis is well written, well motivated, and certainly very relevant to contemporary public economic policy. Moreover, it provides useful intitial insights into the issue at hand.

The present study seeks to extend the analysis initiated by Amos to make an even more useful product. To achieve this goal, the present study examines a variety of alternative variables to most of those chosen by Amos. In addition, we extend the empirical technique adopted by Amos, which is an OLS estimation, by correcting for heteroskedasticity. Finally, we also update (extend) his analysis to run through the year 1992.

II. The Amos Analysis

Amos estimates a reduced-form equation in which the percentage of banks that were closed in a state over the 1982–88 period, *BCPB*, is treated as a function of *GSP* (the level of gross state product in 1980), *DMUN* (a binary dummy variable for states with unit branch banking regulations in effect in 1980), *DMST* (a binary dummy variable for states with state-wide branch banking regulations in effect in 1980), *EGP* (the percentage of state product derived from oil and natural gas extraction in 1980), *AGP* (the percentage of gross state product derived from agriculture in 1980), *MGP* (the percentage of gross state product derived from manufacturing in 1980), *GAR* (the average annual growth rate of gross state product over the period 1963–1986), *GDR* (the difference between the average annual growth rates of gross state product for 1975–1980 and 1980–1985), and *GVR* (the variance of the average annual growth rate of gross state product for the period 1963–1986).

According to Amos [1, 813–14], variable *GSP* is intended to capture the impact of larger, more robust state economies, *DMST* and *DMUN* test for state branch-banking regulations, and *EGP*, *AGP*, and *MGP* test for the economic base effect. The variables *GAR*, *GDR*, and *GVR* are intended to test for instability in the states' economies.

The resulting reduced-form equation is estimated by OLS. The results are mixed. The *GSP* variable is significant but with the *wrong* sign. The two dummy variables, *DMUN* and *DMST*, are both positive but *not* significant at the five percent level. *EGP is* significant with the expected

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sign, implying that states with a larger proportion of their state product deriving from oil and natural gas extraction had a higher bank closing rate. This is logical in view of the severe oil price declines during the 1980–1986 time period and the economic havoc resulting therefrom, especially in the Southwest. Variables *AGP*, *MGP*, and *GAR* are *not* statistically significant, with *GAR* having the *wrong* sign. Variables *GDR* and *GVR* *are* significant, implying that states with relatively more rapid growth in the early 1980s than in the late 1970s had fewer bank closings whereas states with more volatile gross state product growth rates had more bank closings.

The present study makes three extensions of the Amos analysis. The first involves extending the time period examined in the study through the end of 1992 in order to make the time frame more current. We observe that for the time period examined in the Amos study, 1982–1988, there are 50 observations on the dependent variable (*BCPB*). Of these 50 observations on the dependent variable, ten had a value of zero, so that the model in Amos is dealing with "censored data." To deal with censored data, it technically is appropriate to estimate using the TOBIT model rather than OLS. However, in extending Amos, the present study deals with a longer and more current time period: 1982–1992. Over this longer time period, there were one or more bank closings in all 50 states; therefore, in our estimation, we can in fact appropriately use the OLS estimation technique. The second extension of Amos involves correcting for heteroskedasticity; this is accomplished using the White [7] correction.

The third, and most important, extension of the Amos study deals with the choice of explanatory variables. Amos [1, 806] endeavors to integrate variables into his analysis to reflect ". . . the regional nature of financial activity that may lie at the heart of regionally differentiated bank closings." Yet, except for two dummy variables (*DMUN* and *DMST*), there are no strictly *financial* variables (such as the cost of funds to commercial banks or commercial bank capital [net worth]-to-asset ratios or charge-offs) included in his model. In addition, given the sometimes very weak and in some cases even perverse findings for his economic variables (such as for *GSP* and *GAR*), we suggest certain alternative variables to some of those used by Amos.

For example, consider the inclusion in Amos of variable *GSP* (the *level* of gross state product). On the one hand, it is argued by Amos [1, 814] that ". . . more robust state economies . . ." are reflected by larger *GSP* values. On the other hand, we argue that *GSP* is merely a measure of the *level* of aggregate production within a state; the *level* of *GSP* in a state in 1980 does not necessarily indicate anything about the dynamics or pattern of economic growth and/or economic prosperity/health in the state. For instance, states with lower *GSP* values at a given point in time might well be economically much healthier and economically more vibrant and more economically viable than those with higher *GSP* values. Indeed, such is the apparent finding obtained by Amos [1, 814] himself, where he concludes, based on a statistically significant but incorrectly signed (in his view) coefficient for variable *GSP*, that "States with more *GSP* in 1980 also have a significantly higher probability of bank closings . . ." Thus, we argue that the variable *GSP* should be dropped from the model.

Moreover, since data are available at the state level that indicate the approximate average cost of funds for banks and average capital (net worth)-to-asset ratios at commercial banks, as well as the average percentage of outstanding loans that banks "charge-off," our estimates in section III include such factors. We also offer other variables for consideration, including a variable to indicate those states in which, by state statute, no interstate banking is allowed, and a variable to replace the two dummy variables (*DMUN* and *DMST*) adopted in Amos to reflect intra-state bank branching regulations. Other modifications of the model in the Amos paper are also provided in the analysis in section III.

III. The Extended Analysis

To extend the model provided by Amos, we initially estimate the following reduced-form equation:

$$BCPB_s = a + bEGP_s + cAGP_s + dVGSP_s + eCOST_s + fCAPASSET_s + gCHARGEOFF_s + hLIMBR_s + iNIBA_s + u \quad (1)$$

where:

$BCPB_s$ = the ratio of the number of bank closings in state s from 1982 through 1992 to the number of banks in state s in 1980, expressed as a percent;
a = constant term;
EGP_s = the percentage of state product in state s in 1982 that derived from oil and natural gas extraction;
AGP_s = the percentage of state product in state s in 1982 that derived from agricultural production;
$VGSP_s$ = the variance of the annual percentage rate of growth in gross state product in state s, 1982–1990;
$COST_s$ = measure of the average net cost of funds to commercial banks in state s, 1984–1989, expressed as a percent per annum;
$CAPASSET_s$ = the average ratio of net worth to assets at commercial banks in state s, 1982–1990, as a percent per annum;
$CHARGEOFF_s$ = the average ratio of net charge-offs to outstanding loans at commercial banks in state s, 1985–1991, expressed as a percent;
$LIMBR_s$ = a binary dummy variable that indicates whether limited intra-state branch banking was permitted within state s; $LIMBR_s = 1$ if limited intra-state branch banking was permitted within state s and $LIMBR_s = 0$ otherwise;
$NIBA_s$ = a binary dummy variable that indicates whether interstate branch banking was permitted in state s; $NIBA_s = 1$ if no interstate bank branching was allowed in state s and $NIBA_s = 0$ otherwise;
u = stochastic error term.

The variable $BCPB_s$ above differs from its counterpart in [1] only insofar as it covers the period 1982–1992 rather than 1982–1988. Variables EGP_s, AGP_s, and $VGSP_s$ are nearly identical to their counterparts in Amos; the only differences involve the choice of time period studied. Here, EGP_s and AGP_s refer to the year 1982 rather than 1980, and $VGSP_s$ here refers to the period 1982–1990 rather than 1963–1986. The dummy variable $LIMBR_s$ in the present study logically replaces the two dummy variables $DMUN$ and $DMST$ found in Amos.

This study includes, consistent with the suggestion in Amos, genuine financial variables: $COST_s$, $CAPASSET_s$, and $CHARGEOFF_s$. These three variables reflect financial conditions prevailing within each individual state. A higher value for $COST_s$ implies reduced profits [3], ceteris paribus, and hence *over time* a greater probability of insolvency. Next, regarding variable $CAPASSET_s$, the greater the ratio of net worth to assets, the greater the "cushion" banks have in the event of a financial/economic crisis and hence the less likely insolvency will occur. Finally, regarding the variable $CHARGEOFF_s$, the larger the percentage of its outstanding loans that a bank "charges-off," the greater the likelihood of the bank's being closed [2]. In principle following Amos [1], we use the variance in the growth rate of gross state product ($VGSP_s$) to measure the volatility/stability of each of the state economies. Following [1], we expect that a more volatile/unstable economic environment will tend to increase the likelihood of bank failures. The inclusion/retention of variable EGP_s permits us to evaluate to what extent the sharp decline in crude oil prices during the 1980–1986 period impacted on the state economies and hence on the health of the commercial banks in the various states. Given the problems in the oil and natural gas industry during the period under examination and the adverse economic effects thereof, we would, like Amos [1], expect that states having a higher percentage of gross state product deriving from oil and natural gas extraction to have higher rates of bank closings. Similarly, the inclusion/retention of variable AGP_s allows us to assess whether changes in the health of the agriculture sector in the various state economies impacted on bank closings in the various states. Variable MGP_s (corresponding to the manufacturing sector) was excluded from the analysis because it was altogether insignificant in all estimates, having a t-value of generally less than 0.1, and it added nothing to the explanatory power of the model; Amos [1] had the same experience with variable MGP_s.[1] The variable $LIMBR_s$ indicates those states that permit limited intra-state branch banking; variable $LIMBR_s$ replaces the two dummy variables *DMUN* and *DMST* in Amos since $LIMBR_s$ in effect measures exactly what *DMUN* and *DMST combined* measure. The variable $NIBA_s$ indicates those states where interstate banking was not allowed; presumably, prohibiting interstate banking would limit the ability of out-of-state banks to assimilate in-state banks, including banks that were "troubled" or technically insolvent but not yet closed. In theory, we might expect $NIBA_s$, as defined, to be associated with a higher rate of bank closings. Variable $NIBA_s$ is intended to supplement the dummy variable $LIMBR_s$ in the present study (or, in terms of the Amos study, the two dummy variables *DMUN* and *DMST*). The data used in this study were principally obtained from [1; 2; 4; 5; 6].

Estimating equation (1) by OLS, using the White [7] procedure to correct for heteroskedasticity, yields:

$$\begin{aligned} BCPB_s = 35.7 &+ \underset{(+4.11)}{0.68EGP_s} - \underset{(-1.07)}{0.38AGP_s} + \underset{(+2.34)}{0.16VGSP_s} + \underset{(+2.23)}{4.59COST_s} \\ &\underset{(-3.35)}{-3.31CAPASSET_s} + \underset{(+2.98)}{6.17CHARGEOFF_s} - \underset{(-1.98)}{3.52LIMBR_s} \\ &\underset{(+1.86)}{+8.52NIBA_s}, \quad R^2 = 0.61, \quad adjR^2 = 0.54, \quad F = 8.12 \end{aligned} \tag{2}$$

where terms in parentheses are t-values.

In equation (2), three of the estimated coefficients are significant at the one percent level with the expected signs (those for variables EGP_s, $CAPASSET_s$, and $CHARGEOFF_s$); in addition, three others (those for variables $VGSP_s$, $COST_s$, and $LIMBR_s$) are significant at the five percent level or beyond with the expected signs. Although the sign on the estimated coefficient for $NIBA_s$ is as expected, the coefficient is significant at only the seven percent level. Meanwhile, the estimated coefficient on variable AGP_s fails to be significant at even the ten percent level.

Our findings indicate that the bank closing rate, by state, is an increasing function of EGP_s. Thus, as hypothesized, it appears that the higher the percentage of a state's gross state product deriving from oil and natural gas extraction, the higher that state's bank closing rate. It also appears that the bank closing rate is an increasing function of $VGSP_s$; this implies that the more

1. In point of fact, including the MGP_s variable does not alter our basic findings and conclusions.

Table I. Alternative Estimations

	Estimated Equations*				
Variable	(A)	(B)	(C)	(D)	(E)
Constant	35.2	34.5	26.7	26.0	32.1
EGP_s	+0.71	+0.72	+0.71	+0.73	+0.66
	(+4.39)	(+4.63)	(+4.60)	(+4.04)	(+3.78)
$VGSP_s$	+0.15	+0.14	+0.15	+0.17	+0.14
	(+2.27)	(+2.18)	(+2.32)	(+2.29)	(+2.02)
$COST_s$	+3.94	+3.16			
	(+2.03)	(+1.86)			
$CAPASSET_s$	−3.73	−3.66	−3.68	−4.13	−3.40
	(−3.61)	(−3.58)	(−3.48)	(−3.97)	(−2.96)
$CHARGEOFF_s$	+6.38	+5.50	+4.88	+6.22	
	(+2.93)	(+2.66)	(+2.57)	(+3.32)	
$LIMBR_s$	−3.32	−4.26	−4.22		−6.96
	(−1.96)	(−2.31)	(−2.27)		(−3.57)
$NIBA_s$	+8.19			+7.85	
	(+1.68)			(+1.90)	
R^2	0.61	0.59	0.58	0.57	0.49
$adjR^2$	0.54	0.54	0.53	0.52	0.45
F	9.25	10.43	12.05	11.65	10.84

*Terms in parentheses beneath coefficients are t-values; t-values reflect the White [7] correction for heteroskedasticity.

volatile/unstable the growth rate of a state's gross state product, the higher the bank closing rate in the state. These results for EGP_s and $VGSP_s$ are very similar to those found in Amos. The results shown above also imply that the bank closing rate may be an increasing function of $COST_s$; thus, it appears that the higher the average cost of funds in a state, the higher the bank closing rate. Next, it appears, as hypothesized, that the higher the average ratio of net worth to assets at the banks in a state, the lower the bank closing rate. It also appears that the bank closing rate is an increasing function of $CHARGEOFF_s$; thus, the larger the average percentage of their outstanding loans that banks charge-off, the greater the likelihood of bank closings. The dummy variable $LIMBR_s$ is negative and significant at roughly the five percent level; this supports the hypothesis that Amos provided (but could not empirically verify) that states with limited branch banking regulations tend to have a lower likelihood of bank closings. Finally, the sign on the dummy variable $NIBA_s$ is positive but significant at only the seven percent level; this finding provides support, albeit weak, for the idea that states with statutes that prohibit interstate banking tend to experience a greater incidence of bank closings. To some extent, the relative weakness of variables $LIMBR_s$ and $NIBA_s$ may reflect the moderate degree of multicollinearity that exists between these two variables. This conjecture is supported by some of the additional results provided in Table I.[2]

2. Estimating equation (1) by OLS *without* using the White [7] procedure to correct for heteroskedasticity yields:

$$BCPB_s = 35.7 + \underset{(+3.43)}{0.68EGP_s} - \underset{(-0.83)}{0.38AGP_s} + \underset{(+1.93)}{0.16VGSP_s} + \underset{(+1.69)}{4.59COST_s}$$

Alternative versions of the basic model shown in equation (1) have also been estimated. Several of these estimates are provided in Table I. The results shown in Table I are generally consistent with those in equation (2). Certain variables, especially EGP_s, $VGSP_s$, $CAPASSET_s$, $CHARGEOFF_s$, and $LIMBR_s$, seem very resilient.

IV. Conclusion

Amos provides a well written and very relevant empirical study of the determinants of geographic differentials in bank closing rates. The present study extends the Amos analysis and generates a number of potentially very useful conclusions for the 1982–1992 time period, including:

(1) states where the proportion of state product deriving from oil and natural gas extraction is higher tend to have higher bank closing rates;
(2) states having greater volatility in the growth rate of gross state product tend to have higher bank closing rates;
(3) states permitting limited branch banking appear to be less prone than other states to bank closings;
(4) states where the average ratio of net worth to assets is higher tend to have lower bank closing rates; and
(5) states where the average proportion of outstanding loans that banks charge-off is higher tend to experience higher bank closing rates.

There is also limited evidence that:

(6) the higher the average cost of funds to commercial banks within a state, the higher the bank closing rate in that state tends to be.[3]

Findings (1) and (2) are consistent with Amos; finding (3) confirms an argument made in Amos. The remaining findings extend beyond those obtained by Amos.

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$$\begin{array}{llll} -3.31CAPASSET_s & + 6.17CHARGEOFF_s & - 3.52LIMBR_s \\ (-2.63) & (+3.34) & (-1.24) \\ +8.52NIBA_s, & R^2 = 0.61, & adjR^2 = 0.54, & F = 8.12. \\ (+1.25) & & & \end{array}$$

Note that there are several differences between this estimate and the one shown in equation (2), where heteroskedasticity has been corrected for. The differences are especially noteworthy in the cases of the variables $VGSP_s$, $COST_s$, and $LIMBR_s$.

3. The evidence regarding variable $NIBA_s$, while not negligible, is uncompelling.

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