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Economic Review

Federal Reserve Bank of Dallas
September 1987

The result of the new branch banking legislation in Texas, effective since 1 January 1987, will be to decrease the number of banking offices. By year-end 1988, Texas multibank holding companies are forecasted to reduce the number of their subsidiary banks by over 300, primarily through conversions to branch offices. The initial effect on the number of independent banks is expected to be minor. The long-run effects of branch banking, isolated from other factors, will be to decrease the total number of banks by 60 percent and increase the number of banking offices by 85 percent.

Deregulation of portions of the electric utility industry is a policy issue that is gaining momentum, both because deregulation is now considered more feasible and because the cost of not deregulating may be rising. Technological advances in power transmission and the apparent exhaustion of scale economies in production may have rendered moot many of the traditionally claimed benefits of regulation. Moreover, growing concern about utilities' reluctance to build new power plants for use around the turn of the century highlights the rising cost of continued regulation. Heightened uncertainty caused by fluctuating fuel prices and consumption patterns argues for increased use of competitive forces—particularly in power production—to allow the industry to respond with greater flexibility to changing conditions.

In states that have restricted-branching laws, banks lending to agriculture are at greater risk of closure than those in states that permit statewide branching. This article finds that diversification prevented any particular category of loans from affecting the probability of bank closure in states with statewide branching. In contrast, in restricted-branching states, banks with asset portfolios concentrated in either agricultural loans or business loans experienced higher than average failure rates.

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Branch Banking in Texas: Implications for Bank Structure

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The recent passage of legislation permitting limited branch banking in Texas will reduce the number of banks in the state but will increase the number of banking offices.[1] The magnitude of these changes and the speed with which they will occur are crucial to bankers in formulating their strategic responses. The long-run effects of the legislation, isolated from other factors, are expected to reduce the number of banks by 60 percent and increase the number of banking offices by 85 percent. The amount of change that will actually occur in the near term, however, will be far less than that for the long run. The immediate changes in bank structure are expected to be in the conversion of subsidiary banks of multibank holding companies into countywide branch networks. In the first two years following the change in banking law, the number of subsidiary banks is expected to decline approximately 35 percent.

These predictions about the future structure of the Texas banking industry for this study are based upon two separate analyses. The short-run predictions are drawn from an analysis of the Florida banking industry following the change in 1977 from unit to limited branch banking in that state. The long-run predictions are based upon a comparison of the current structure of the Texas banking industry with the structure that exists in several states that have permitted limited branch banking for many years.

This article, which is composed of five sections, first summarizes the changes in the Texas banking law. Second, it calculates the potential for the multibank holding companies to consolidate their subsidiary banks into branch networks. Third, the rate at which these conversions will reduce the number of banks is estimated. Fourth, the long-run effects of the branch law change in Texas are then estimated by comparing the structure of banking in Texas with the structure of banking in several states that have permitted limited branch banking for many years. Fifth, the article examines potential and likely effects on independent banks in Texas.

Legislative changes in the Texas branch banking laws

Historically, Texas law has permitted banks to operate at only one location, with a few minor exceptions for facilities, such as drive-in facilities. The legislation to change branch banking laws was passed by the Texas Legislature in August 1986 and required a voters' referendum, held in November 1986, which amended the Texas Constitution. The new legislation permits banks to operate a limited number of branches so long as those branches are located in the same county as the bank.

As of 1 January 1987, banks in Texas are permitted to establish up to three new branch offices, referred to as *de novo* branches, located within the same county as the principal bank building. The branch banking legislation also permits bank holding companies to convert their subsidiary banks into branches of a bank so long as the bank and the branches are located in a single county. In addition, bank holding companies can acquire independent banks and convert these banks into branches of previously existing subsidiary banks located in the same county. Branches established through the conversion of either existing subsidiary banks or newly acquired independent banks are not counted in the three *de novo* branch limit.

The requirement that branches must be located in the same county as the bank has one exception. If a bank acquires a failing bank located in another county, it can convert that acquired bank into a branch of the acquiring bank. This is the only method under which branching across county lines appears to be possible, and these branches established from failed banks will not be counted in determining the three-branch limit.[2]

Potential consolidation within Texas multibank holding companies

An initial effect of this legislation will be the consolidation of the subsidiary banks within multibank holding companies into branch networks. The conversion of subsidiary banks into branches is expected to permit these banking organizations to consolidate and streamline their operations. In addition, the consolidation will increase convenience to the customer—an important marketing tool. Prior to the consolidation, bank customers could conduct their banking transactions only at the location of their bank. Once subsidiary banks are converted into branches, however, bank customers will be able to obtain bank services from their original bank or any of its branch offices. Branching thus permits banks to operate offices near the homes and the workplaces of their customers, thereby increasing convenience and reducing travel time for customers.

The reduction in the number of subsidiary banks brought on by consolidation could be substantial. If the bank holding companies in Texas consolidate as many of their subsidiary banks into branches as possible, the number of subsidiary banks would decline 63.7 percent. The effects of the consolidation, however, will not be uniform across the state. One reason for these differences is that bank holding companies have most of their subsidiary banks in the urban markets. In addition, multibank holding companies may decide to consolidate fewer banks in counties that are expected to grow rapidly. For each subsidiary bank that is converted into a branch, the multibank holding company foregoes the three potential branches that could have been opened. Multibank holding companies thus may find it advantageous to maximize the number of banking offices in rapidly growing counties by creating three branches for each subsidiary bank instead of consolidating all of its subsidiary banks within the county.[3]

Because subsidiary banks of the multibank holding companies are concentrated more in the urban markets, the effect on bank structure of converting subsidiary banks into branches will be greater in the urban markets.[4] Urban markets are defined as metropolitan statistical areas (MSAs), and rural markets are defined as individual counties not in MSAs. As reported in Table 1, the 683 banks located in rural counties in 1986 were split between 529 independent banks and 154 subsidiary banks of multibank holding companies. If the multibank holding companies converted as many subsidiary banks into branches as possible in rural counties, the number of subsidiary banks in rural counties could drop to 59 banks—a decline of 61.7 percent.[5] The total number of banks in rural markets would fall to 588, a decline of 13.9 percent.

In contrast, the subsidiary banks of multibank holding companies account for 703 of the 1,308 banks in urban markets. If the multibank holding companies converted their subsidiary banks into branches wherever possible in the urban markets, the maximum number of subsidiary banks could be reduced to 248—a decline of 64.7 percent. The total number of banks in urban markets could be reduced to 853—a decline of 34.8 percent, 2.5 times that in the rural market.[6]

The potential for a reduction in the number of banks based upon conversion of member banks into branches varies greatly across the urban markets. This variation results from the differences in the ratio of the number of subsidiary banks that can be converted into branches to the total number of banks in the market. In the larger urban markets, where each multibank holding company may operate multiple subsidiary banks, the consolidation of subsidiary banks into branches has an above-average potential to reduce the total number of banks. In the Houston and Dallas MSAs—the two largest markets in the state—the number of banks could be reduced by 45.6 percent and 40.1 percent, respectively. In contrast, some smaller urban markets have no potential for subsidiary banks to be converted into branches, because no multibank holding company has more than one bank in any given county in these markets. Thus, Bryan/College Station, Midland, Odessa, and Victoria are four urban markets where such consolidation cannot occur.

The conversion of subsidiary banks into branches will have no immediate effect on market concentration—one of the factors considered in an application for a merger or acquisition by a bank holding company. For regulatory purposes, concentration is calculated for banking organi-

Table 1
POTENTIAL CHANGES IN THE STRUCTURE OF TEXAS BANKING[1]

Banks	Total banks	Ind.[2] banks	MBHC[3] banks	Minimum MBHC[3] banks	Percentage change in total
Texas	1,991	1,134	857	307	-27.6
Urban	1,308	605	703	248	-34.8
Rural	683	529	154	59	-13.9
Metropolitan Statistical Areas					
Abilene	13	6	7	4	-23.1
Amarillo	12	6	6	4	-16.7
Austin	82	45	37	17	-24.4
Beaumont-Port Arthur	31	12	19	8	-35.5
Brazoria	23	12	11	8	-13.0
Brownsville-Harlingen	23	13	10	6	-17.4
Bryan-College Station	9	6	3	3	0.0
Corpus Christi	35	13	22	12	-28.6
Dallas	282	137	145	32	-40.1
El Paso	29	8	21	6	-51.7
Fort Worth-Arlington	115	46	69	23	-40.0
Galveston-Texas City	24	10	14	8	-25.0
Houston	329	145	184	34	-45.6
Killeen-Temple	24	13	11	6	-20.8
Laredo	7	4	3	2	-14.3
Longview-Marshall	26	15	9	6	-12.5
Lubbock	16	11	5	4	-6.2
McAllen-Edinburg-Mission	25	13	12	6	-24.0
Midland	9	4	5	5	0
Odessa	9	5	4	4	0
San Angelo	9	4	5	3	-22.2
San Antonio	94	34	60	19	-43.6
Sherman-Denison	17	9	8	6	-11.8
Texarkana	11	3	8	2	-54.5
Tyler	18	11	7	6	-5.6
Victoria	6	4	2	2	0
Waco	21	12	9	7	-9.5
Wichita Falls	11	4	7	5	-18.2

1. These changes result from the conversion of the subsidiary banks of multibank holding companies into branches.
2. Ind. = Independent.
3. MBHC = Multibank holding company.
SOURCE: Federal Reserve Bank of Dallas.

zations, not individual banks. For this reason, the market shares of all of the subsidiary banks of a bank holding company within a market are summed and treated as one market participant. Consequently, even if the subsidiary banks are converted to branches, the calculation of concentration would be unchanged.

Rate of consolidation: evidence from Florida

One of the most important questions facing bankers is how rapidly the conversion of banks into branches will occur. A good first estimate of such a conversion process can be obtained by examining the conversion process that occurred in Florida—another state that had a similar change in its branch banking laws.

In the recent past, Florida stands out as an excellent comparison because of its numerous similarities to Texas. The 1986 changes in branch banking laws in Texas were very similar to the 1977 branch banking law changes in Florida, and both states have no limitations affecting multibank holding company formation and expansion. In Texas, each bank is permitted to operate three *de novo* branches in the county in which it is located. In Florida, banks were limited to opening only two *de novo* branches per year in the county of their operations. In both Texas and Florida, it is also possible for branches to be established by merger with other banks within a county. Florida operated with these limited branch banking laws until mid-1980, when its branching laws were further liberalized. Finally, bank earnings were depressed in both states at the time of the branching law change.

The consolidation process in Florida was estimated using the state's banking data, following the shift from unit to limited branch banking in 1977. A model of the dynamic process of adjustment from the current number of banks to the new equilibrium number of banks was estimated. The results from this estimation then were applied to the Texas data to produce forecasts of the state's pattern of adjustment.

The adjustment of the multibank holding companies to the new banking law was modeled as a partial-adjustment process. The partial-adjustment model assumes that in each period bankers will reduce by some percentage the gap between the optimal and the current number of banks.[7] Prior to the change in branching laws, some optimal number of affiliated banks existed. Following the change, however, the optimal number of banks declined sharply, and a gradual transition to the new equilibrium can be expected.

The use of the partial-adjustment model is based upon the existence of potential bottlenecks in the conversion process and/or a high degree of uncertainty regarding the effects of the conversions. If the conversion process were costless and advantages accrued from converting banks into branches, such as cost savings, then theory would indicate an immediate conversion of all possible banks into branches. Because adjustment costs and constraints do exist, however, they may slow the conversion. In fact, the regulatory approval process and the effects of uncertainty are two factors that are extending the period of adjustment in Texas.

The regulatory process requires that a merger application be submitted to the primary regulator in order for two or more banks to be converted into one bank with a branch network. In the case of a state-chartered bank that is a member of the Federal Reserve System, the application is filed with its Federal Reserve Bank. The approval process requires approximately 60 to 90 days from the filing of the application before the merger can take place. This approval process not only introduces a lag but also is a potential bottleneck that might slow the overall adjustment process.

The uncertainty of future economic conditions and of the effects of branching are two additional reasons for a slow conversion process. If the expected cost savings from converting a subsidiary bank into a branch is unknown or imperfectly estimated, then a bank holding company may want to proceed slowly in its conversion plans in order to learn more about the potential cost savings before committing itself to a plan of conversion. In addition, given the Texas limitations regarding the number of *de novo* branches permitted per bank, a bank holding company may view the advantage in cost savings from converting a bank into a branch as less than the advantage of maintaining the office as a bank and retaining its potential to establish three *de novo* branches. This second source of uncertainty would be especially important in markets with a rapid-growth potential.

A third source of uncertainty may be management's concern about the best method to consolidate a number of subsidiary banks into a single bank with a branch network. This consolidation would eliminate redundant management positions and create new positions in branch administration. Texas multibank holding companies thus will be operating in a whole new environment. If the holding companies proceed slowly enough with the process of consolidation, they may be able to learn from their successes and failures and adjust their consolidation methodology appropriately.

The model. The partial-adjustment model is based upon three equations. First, the actual adjustment procedure is as follows:

(1) $$B_t - B_{t-1} = \delta_t(B^* - B_{t-1}),$$

where
B_t = number of affiliated banks in period t,
B^* = optimal number of banks, and
δ_t = rate of change parameter in period t.

The above equation models the change in the number of banks in period t, $B_t - B_{t-1}$, as a percent, δ_t, of the difference between the optimal number of banks, B^*, and the number of banks existing in period $t-1$. If the number of banks in the last period, $t-1$, equals the optimal number of banks, then the term in the parentheses is zero, and no change will occur in the number of banks. If the number of banks at time $t-1$ is greater than the optimal, then a proportion, δ_t, of the difference will be eliminated in the current period.

The second equation specifies the functional form of δ_t, which is the percentage of the gap between the optimal and existing number of subsidiary banks that will be closed in period t. In a simple partial-adjustment model, the parameter δ_t is assumed to be a constant. In reality, δ_t will be a function of the factors that suggest the use of a partial-adjustment model: regulatory lags, uncertainty, and costs of conversions. To allow for these factors, it is assumed in equation 2 that δ_t is a quadratic function of time.

(2) $$\delta_t = \gamma_0 + \gamma_1 t + \gamma_2 t^2.$$

The third equation in the partial-adjustment model specifies the optimal number of banks. It is assumed for the purposes of this research that the optimal number of subsidiary banks is equal to the minimum number of subsidiary banks the multibank holding company can operate and still be within the restrictions of the branching laws. The minimum number of banks clearly represents a lower bound on the optimal number of banks. This simple form permits a forecast of the pattern of adjustment without requiring a forecast of the Texas economy over the next several years.[8]

(3) $$B^* = B',$$

where
B' = minimum number of affiliated banks that can operate under the new branching law.

The model is estimated by substituting equations 2 and 3 into equation 1, as follows:

(4) $$B_t - B_{t-1} = (\gamma_0 + \gamma_1 t + \gamma_2 t^2)(B' - B_{t-1}).$$

The model in equation 4 is restated in equation 5 in a form that can be estimated using ordinary least squares. The equation includes an error term which is assumed to be independently identically normally distributed, with the mean equal to zero.

(5) $$B_t - B_{t-1} = \gamma_0(B' - B_{t-1}) + \gamma_1 t(B' - B_{t-1}) + \gamma_2 t^2(B' - B_{t-1}) + \varepsilon_t.$$

The consolidation process at the Florida multibank holding companies was estimated in equation 5, using quarterly data beginning in 1977 and extending through midyear 1980. The data consist of the number of subsidiary banks of the 47 multibank holding companies operating in 1976. Equation 5 was estimated for urban and rural markets separately. At year-end 1976, 404 subsidiary banks were operating in urban markets, and 55 subsidiary banks were in the rural markets. The results of the estimations are reported in the next section.

The results. The empirical results, as reported in Table 2, show that the partial-adjustment model fit the data for the rural Florida markets very well. The model explained over 90 percent of the variation in the number of subsidiary banks in the rural markets. The F statistic indicated that the overall regression was statistically significant, and the Durbin-Watson statistic indicated no problem with autocorrelation.

The regression results from the rural Florida markets indicated that the value of δ_t in the rural market can best be characterized as constant. Statistical tests showed that no significant losses in explanatory power occurred when the functional form of δ_t was reduced to a constant. The estimated value of δ was .584, which was statistically significant and in the expected range of values.

The estimated value of δ indicates a relatively rapid adjustment process in the rural Florida markets. The higher the value of δ, the more rapid the gap is closed between the current and the optimal number of subsidiary banks. Based upon the regression results, over 58 percent of the remaining gap in rural Florida subsidiary banks would be closed in each quarter. At this rate, the gap in these markets would be almost completely eliminated in roughly six quarters.

In the urban Florida markets, the partial-adjustment model fit the data fairly well, but not as closely as in the rural markets. The model explained roughly 67 percent of the variation in the number of subsidiary banks in the urban markets, and the regression overall was statistically significant, as indicated by the F statistic. The Durbin-Watson statistic indicated a virtual absence of autocorrelation.[9]

In contrast to the rural markets, the value of δ_t does not appear to be constant in the urban Florida markets. The parameter δ_t was estimated as a quadratic function of time, and statistical tests indicated it as superior to either a linear

Table 2
REGRESSION RESULTS OF THE PARTIAL-ADJUSTMENT MODEL[1]

RURAL

$$B_t - B_{t-1} = -0.4568\,(B' - B_{t-1})$$
$$(12.14)$$

$R^2 = .9185$
$F = 147.494$
Durbin-Watson $d = 2.308$

URBAN

$$B_t - B_{t-1} = -0.4568\,(B' - B_{t-1}) + 0.1051\,t(B' - B_{t-1}) - 0.0045\,t^2(B' - B_{t-1})$$
$$(2.18) \qquad (2.51) \qquad (2.32)$$

$R^2 = .6777$
$F = 10.112$
Durbin-Watson $d = 2.01$

NOTE: The t statistics are reported in the parentheses below the estimated parameters.
1. The model is estimated from data on Florida banks for the 1977-80 period.

or a constant function. (See Table 3 for the estimated values of δ_t in the urban model.) The estimated value of δ_t is low initially, rising to a peak value of .1599 in the eighth quarter of adjustment before finally declining to low values again. In fact, in the first and the last quarters of the estimation period, δ_t takes on negative values, outside of the expected range of values.

These estimated values of δ_t indicate a specific speed and pattern of adjustment in the number of subsidiary banks in the urban markets. The adjustment process in the urban markets takes roughly twice the amount of time it did in the rural markets. Initially, very little adjustment takes place, and, in fact, in the first quarter the gap between the optimal and current number of banks may actually increase. The process of adjustment then accelerates until the eighth quarter. Following the eighth quarter, the adjustment process slows. By the thirteenth quarter, the adjustment is essentially finished.

The regression results from the urban Florida markets also indicate that the optimal number of subsidiary banks may be well above the minimum number of subsidiary banks that could exist under the new branching laws. In its adjustment, the number of subsidiary banks in urban Florida markets did not approach 167 banks, the minimum number of subsidiary banks. Instead, it is asymptotically approaching a much higher number of subsidiary banks, approximately 220 banks.

The slow consolidation process in the urban Florida markets likely resulted from several factors. First, this change in the branching law came just after a severe national recession. Florida banks were especially hard hit by bad loans made in construction and to real estate investment trusts. The difficult economic environment had hurt earnings and had made these banks hesitant about expansion. Earnings did not show a strong recovery until the first half of 1978. Second, given the difficult economic times, the Federal Reserve Board implemented a policy of requiring banks to put their loan portfolios in good order prior to implementing any expansion plans. Third, Florida represented the first case in which a state changed its banking laws following the introduction of automated teller machines (ATMs). ATMs were a low-cost option that many banks attempted to use in place of branches.[10] These three factors are signs of the high degree of uncertainty that may have slowed the adjustment process.

The rural market, in contrast, consolidated very quickly. These markets may have consolidated more rapidly than the urban markets for several reasons. First, rural markets may be characterized by fairly simple consolidations of just two or three subsidiary banks, whereas urban markets are more complex and may require the consolidation of several

Table 3
VALUE OF δ_t, THE RATE OF ADJUSTMENT IN THE MODEL[1]

Date	Urban
1977	
Q1 . . .	-.0432
Q2 . . .	.0127
Q3 . . .	.0596
Q4 . . .	.0975
1978	
Q1 . . .	.1265
Q2 . . .	.1466
Q3 . . .	.1577
Q4 . . .	.1599
1979	
Q1 . . .	.1531
Q2 . . .	.1373
Q3 . . .	.1126
Q4 . . .	.0789
1980	
Q1 . . .	.0363
Q2 . . .	-.0152

1. The model is estimated from data on Florida banks for the 1977-80 period.

Table 4
NUMBER OF TEXAS BANKS FORECASTED WITHIN MULTIBANK HOLDING COMPANIES[1]

Date	Urban	Rural
1987		
Q1 . . .	723	98
Q2 . . .	717	75
Q3 . . .	689	66
Q4 . . .	646	62
1988		
Q1 . . .	595	60
Q2 . . .	544	60
Q3 . . .	498	59
Q4 . . .	458	59
1989		
Q1 . . .	425	59
Q2 . . .	398	59
Q3 . . .	377	59
Q4 . . .	363	59
1990		
Q1 . . .	354	59
Q2 . . .	350	59

1. The forecast is based on a model estimated from data on Florida banks for the 1977-80 period.

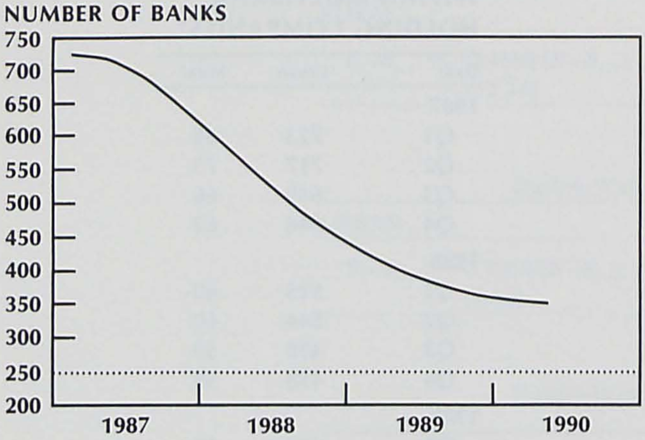
times that number. Second, the cost of consolidation possibly could be lower in the rural markets than in the urban markets, or other factors could have lowered the uncertainty in these rural markets relative to the urban markets.

Implication for multibank holding companies in Texas. Given the similarities between the Texas banking industry in 1986 and the Florida banking industry in 1977, it is possible to predict the short-run effects of the branching law change in Texas by substituting Texas data into the partial-adjustment model estimated from the Florida data. The forecast for the number of subsidiary banks in both urban and rural markets is reported in Table 4 and plotted in Charts 1 and 2. These forecasts assume that the same rate of adjustment that occurred in the Florida markets will apply to the Texas markets and that the optimal number of banks can be assumed to be the minimum number of banks permissible under law.

Urban markets in Texas will be in a state of transition for several years as the multibank holding companies consolidate their subsidiary banks into branches. Even after three years, a substantial amount of consolidation could still take place. As shown in Chart 1, the rate of adjustment slows substantially in the third year of adjustment. This pattern may indicate that the optimal number of subsidiary banks is higher than the minimum number of subsidiary banks, as appeared to be true in Florida. The minimum number of subsidiary banks that could legally exist—denoted by the dashed line—would be 248.

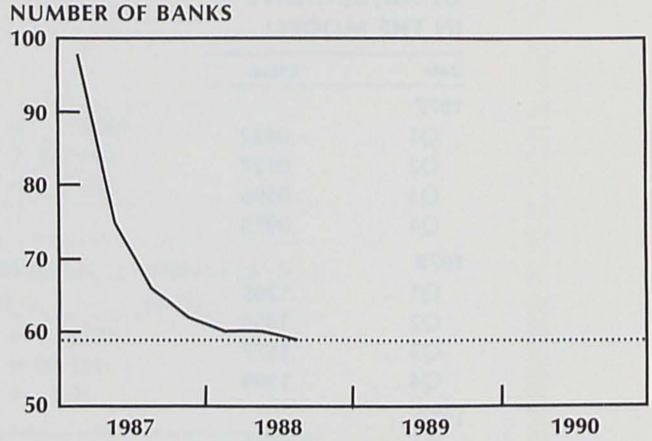
As was true in Florida, rural Texas markets are expected to consolidate very quickly. As can be seen in Chart 2, the adjustment process is essentially completed in the sixth quarter following the legal change. The actual number of subsidiary banks is forecasted to decline to the minimum number of banks. Consequently, in the rural markets, the

Chart 1
Number of Member Banks in Texas Urban Markets (Forecast)



SOURCE OF PRIMARY DATA: Consolidated Reports of Condition and Income.

Chart 2
Number of Member Banks in Texas Rural Markets (Forecast)



SOURCE OF PRIMARY DATA: Consolidated Reports of Condition and Income.

assumption that the optimal number of banks equals the minimum number of banks is probably close to reality.

Long-run effects of branch banking in Texas

The preceding analysis examines only the short-run effects of the branching law changes on multibank holding companies. In the long run, the branching law in Texas will have profound effects on the state's entire banking industry. The most direct method of estimating the long-run effects is by comparing the present structure of banking in Texas with that existing in states that have permitted limited branch banking for an extended period of time. Comparisons should *not* be made, however, with states that have sustained recent changes in branching laws, because the banking structure in these states is unlikely to have adjusted fully to the change.

The long-run effects of branching, when isolated from other factors affecting the structure of banking, will be a substantial decline in the number of banks. In contrast, a large increase in the number of banking offices is expected. Furthermore, the efficiency gains from branching are likely to reduce bank employment in the long run.

Projections of the long-term effects of branching on Texas banking are based upon comparisons of the current structure of banking in Texas with that existing in six other states that have permitted limited branching for some time. The banking structures in the following six states were used for comparison purposes: Louisiana, Michigan, New Mexico, Ohio, Pennsylvania, and Tennessee.[11] In most of these states, branching is limited to a county or adjacent counties. Because the recent changes in branching laws have been relatively minor in these states, they represent a sample of states whose banking industries are likely already in long-term equilibrium with regard to branching.[12]

Three characteristics of the long-run effects are determined for the Texas banking industry. These are the number of banks, the number of banking offices, and the employment at banks. The long-run effects for these three characteristics are determined separately for the urban and the rural areas. The separate effects are then summed to produce estimates for the state as a whole.

A common denominator for measuring the structure of banking must be used in cross-state comparisons. A nominal measure of the structure of banking, such as the number of banks or banking offices, would fail to take into account some important differences between states—such as geographical size, state income, or population. The data on banks, bank offices, and employment for this analysis were adjusted for population differences and reported as per capita ratios. Population and banking data from 1985 were used for these comparisons since that was the most recent population data. Employment is measured on a full-time equivalent basis as reported in the Consolidated Reports of Condition and Income.

Table 5
LONG-RUN EFFECTS OF BRANCH BANKING IN TEXAS ON BANK EMPLOYMENT AND NUMBER OF BANKS

URBAN	Banks (Per million persons)	Banking offices (Per million persons)	Bank employment (Per thousand persons)
Average	26.77	241.8	5.73
Texas	96.30	120.4	6.16
	(Total units)		(Persons)
Texas			
Currently	1,308	1,659	74,927
Long-run equilibrium	364	3,331	69,697
	(Percentage change)		
Change	-72.20	100.8	-6.98

RURAL	Banks (Per million persons)	Banking offices (Per million persons)	Bank employment (Per thousand persons)
Average	115.88	359.10	4.63
Texas	215.08	235.90	5.17
	(Total units)		(Persons)
Texas			
Currently	683	755	15,848
Long-run equilibrium	368	1,149	14,193
	(Percentage change)		
Change	-46.12	52.2	-10.44

TEXAS	(Units)		(Persons)
Texas			
Currently	1,991	2,414	90,775
Long-run equilibrium	732	4,480	83,890
	(Percentage change)		
Change	-63.3	+85.6	-7.6

The banking industry in the sample of limited branching states typically has relatively fewer banks and more banking offices than exist in Texas. In Table 5 are reported the ratios for banks per million persons, banking offices per million persons, and banking employment per thousand persons. Urban Texas markets had approximately 96 banks for every million persons, while those in states that permit limited branching had roughly 27 banks per million persons. Thus, to lower the urban Texas market ratio to the long-run equilibrium level, the number of banks in urban Texas markets would have to drop from its current level of 1,308 to 364, a decline of 72.2 percent.

By contrast, the number of banking offices per million persons is much higher in most limited branching states. Consequently, the urban Texas markets would need to increase the number of banking offices 100.8 percent to bring them into an equilibrium structure. In rural Texas markets, the change in total number of banks is expected to be a decline of 46.1 percent, while the number of banking offices is expected to rise by 52.2 percent.

Thus, as a result of branch banking, Texas as a whole is projected to have fewer banks and more banking offices. Combining the urban and rural results indicates that the total number of banks will decline from the current 1,991 to 732 after the adjustments to branching are completed. During the same period, the number of banking offices will rise from 2,414 to 4,480. These rather dramatic changes constitute the effects of the branching law change isolated from all the other effects that might influence the number of banks and banking offices. Growth in population or economic activity would at least partially offset the reduction in the number of banks but would further increase the number of banking offices.

Several factors would support a smaller increase in the number of banking offices. One is that the branch bank networks in the six states used for comparison were developed during a time characterized by different banking regulation and technology. During the period of interest-rate regulation, banks competed for customers using nonprice terms. One method of competing was through extensive branching to increase the convenience to the customer. Following deregulation, deposit interest rates provided a much more direct method of competition. To the extent that the number of banking offices in these states represented excessive branching in response to Regulation Q, the prediction for the increase in the number of banking offices in Texas would be overstated.

The change in banking technology is another factor that has not been taken into account in formulating the estimate on the number of banking offices. Texas has a well-developed network of automated teller machines (ATMs). These ATMs act as substitutes for branch offices. If the Texas ATM network is more extensive than the ATM networks in the comparison states, the estimated increase in the number of banking offices is overstated.

Finally, the limitation in Texas law permitting only three *de novo* branches per bank may act as a constraint to the Texas banking industry in reaching its theoretical long-run equilibrium. In the states used for comparison, there were no similar restrictions. The estimates provided in this research suggest that this limitation on number of branches may be a binding constraint in the urban Texas markets but not in the rural markets. Following the initial contraction of the multibank holding companies that is expected in the next several years, urban Texas markets likely will have approximately 968 banks, with the rural markets having 588. After adjustment for the number of branch offices that would result from converting existing banks into branches, the long-run equilibrium suggests that 2,991 *de novo* urban branch offices and 1,056 rural branch offices will be opened in Texas. To open 2,991 *de novo* branch offices in the urban markets, the average urban bank would be required to open 3.1 *de novo* branch offices per bank, which would exceed the number permitted by the branching law. To reach long-run equilibrium in the rural market, however, the average bank would need to open only 1.8 *de novo* branch offices—a number well within legal limits.

Branch banking is expected to have a larger effect on bank employment in the rural areas than in the urban areas. Bank employment in the rural areas is forecasted to decline 10.44 percent. In the urban areas of Texas, bank employment is expected to decline only 6.98 percent. Branching is thus expected to reduce the total employment in Texas banking from 90,775 in 1986 to 83,890 in the long run. As before, actual employment will likely be higher, because other factors such as population growth or increased economic activity could offset some of the effects of branching.

While the number of banks is expected to decline more in the urban markets than the rural markets, banking employment in the urban markets is expected to decline less than in rural markets. The reason for this difference probably lies in the expectation concerning the number of banking offices. Banking offices are expected to increase by 100.8 percent in the urban markets and only 52.2 percent in the rural markets. The workforce requirements to staff these new offices will offset some decline in employment that will result from the decline in the number of banks. But because urban markets are expecting a larger increase in the number of banking offices, banking employment in these markets will decline less than in the rural markets.

This decline in employment, however, could understate the effect of branch banking on employment. The sharp decline in the number of banks and the increase in the number of banking offices suggest that the composition of the workforce of Texas banks will change in response to the structural changes. Most likely, as many operations are consolidated through bank mergers, the shift will be an increase in customer service personnel, such as tellers, and a decrease in middle managers.

Implications for independent banks in Texas

The Florida experience suggests that the imminent decline of the Texas independent banker is unlikely. In addition, even the long-run analysis suggests a substantial, though reduced, presence of independent banks. The experience of independent banks in Florida during its transition period from unit to limited branch banking offers a positive outlook for independent bankers in Texas. In Florida, the effect of branching on the number of independent banks during the initial three and a half years was minor. As can be seen in

Table 6
BANKING STRUCTURE IN FLORIDA

Banks	Date 1976:Q4	1980:Q2	Percentage change
Urban			
Ind. Banks[1]	192	207	+7.8
MBHC Banks[2]	404	232	-42.6
Total	596	439	-26.3
Rural			
Ind. Banks[1]	106	96	-9.4
MBHC Banks[2]	55	43	-21.8
Total	161	139	-13.7
Florida			
Ind. Banks[1]	293	299	+2.0
MBHC Banks[2]	464	279	-39.9
Total	757	578	-23.6

1. Ind. = Independent.
2. MBHC = Multibank holding company.
SOURCE OF PRIMARY DATA: Consolidated Reports of Condition and Income.

Table 6, the number of independent banks in the urban market actually increased 7.8 percent. While the number of independent banks in Florida decreased in the rural markets, the total number of independent banks in the state increased 2 percent.

The long-run analysis suggests a more pessimistic outlook, however. As stated previously, the long-run effects of branching will be a decline of over 60 percent in the number of banks, or a decrease of 1,261 banks. The consolidation by multibank holding companies of their subsidiary banks can account at most for 550 banks. These figures suggest that an additional 711 banks will eventually cease to operate as independent banks. At year-end 1986, Texas had 1,134 independent banks. If the independent banks were to absorb the 711 closures, primarily through mergers into multibank holding companies and conversions into branches, then the number of independent banks would decline 62.4 percent.

The Florida experience is not inconsistent with the predictions of the long-run effects. As derived in the partial-adjustment model, a substantial period of transition is necessary for the multibank holding companies to respond in the urban markets to the changes in the branching laws. If the banking industry adjusts slowly, then the short- and long-run figures can be consistent. The adjustment process may be sufficiently slow that the demand for additional banks resulting from such factors as population growth or increased economic activity may offset some of the expected decline in the number of banks resulting from the branching law change.

Conclusion

The most immediate effect of the new branching legislation in Texas will be a conversion of the subsidiary banks of multibank holding companies into countywide branch networks. This consolidation could reduce the number of banks in the state by 27.6 percent. The reduction in the number of banks would be greater in the urban areas because of the concentration of subsidiary banks in these markets.

Evidence from a similar change in branching law that occurred in Florida in 1977 suggests that the process of converting affiliated banks into branches will likely occur very quickly in the rural markets over approximately six quarters. In contrast, the process will be much slower in the urban markets, possibly taking several years.

The long-term impact of permitting limited branching in Texas is estimated to be a 63-percent reduction in the number of banks and an 86-percent increase in the number of banking offices, sharply reducing the customer inconvenience associated with unit banking restrictions. Employment in banking is expected to be reduced as a result of branching. These effects, however, have been calculated while holding all other factors constant. The normal growth of population and economic activity that will increase the demand for banks, banking offices, and bank employment could offset part of these long-term effects of branching.

If the long-run effect of a 63-percent reduction in the number of banks were to result, it would have a severe effect on the number of independent banks. Evidence from the Florida experience, however, indicates that the transition process to reduce the number of banks is relatively slow and that independent banks can compete effectively in the changing market. Further, the number of independent banks in Florida, actually rose during the period following the liberalization of branching laws. Thus, the change in the Texas branch banking law may not eliminate the competitiveness of independent banks in Texas.

1. An amendment to Article 16, Section 16, of the Texas Constitution, to permit branch banking under various circumstances, was proposed in Senate Joint Resolution No. 4. Senate Bill No. 10, which proposed to amend Article 3, Chapter IX, of the Texas Banking Code of 1943, as amended (Article 342-903, Vernon's Texas Civil Statutes), was passed by the Senate on 20 August 1986, and by the House, with amendment, on 27 August 1986, with the Senate concurring on the House amendment

on 28 August 1986. (See the constitutional amendment, Acts 1986, 69th Leg., 2d C.S., ch. 13, sec. 1.) The amendment proposed by S.J.R. No. 4, secs. l and 2, was adopted at an election held 4 November 1986.

2. At least one such acquisition has already taken place in 1987. The Board of Directors of the Federal Deposit Insurance Corporation approved the acquisition of Montgomery County Bank, N.A., The Woodlands, Texas, by Texas Commerce Bank, N.A., located in adjacent Harris County. Texas Commerce Bank assumed the deposit liabilities and operates the only office of the failed bank as a branch of Texas Commerce Bank, N.A., located in Houston.

3. The limitation of operating only three *de novo* branches may not be a constraint on the multibank holding companies in fast-growing markets. Depending upon the interpretation of the law, a multibank holding company may be able to open as many branches as desired by opening a *de novo* subsidiary bank with three branches. The *de novo* subsidiary bank could then be merged with the existing subsidiary bank and converted into a branch. Thus, though the constraint would be removed, this method would introduce a substantial lag in establishing branches.

4. The term "concentration" is used here in its general interpretation as implying greater density, but not in its economic interpretation as a measure of market power. As explained in detail elsewhere in this paper, the conversion of subsidiary banks of multibank holding companies into branches will not alter the measures of market concentration.

5. This calculation of maximum consolidation is based upon the assumption that the multibank holding company will continue to operate a single bank in each of the counties where it is currently operating and will convert all other subsidiary banks in these counties into branches.

6. The decline in the number of banks will have a positive effect on bank customers, who will enjoy the convenience of branch banking. It will have an important effect on bank suppliers as well. For example, consolidation may change the demand for certain inputs and will certainly change the size of contracts. For instance, the demand for data-quality telecommunication may rise substantially as branch networks are established.

7. For a detailed description of the partial-adjustment model, see G. S. Maddala, *Econometrics* (New York: McGraw-Hill Book Company, 1977), 142-43.

8. From a purely economic view, the optimal number of banks is closely related to the demand for banking services and the legal structure governing banking. The optimal number of subsidiary banks would be a function of state banking laws, population growth, business formations, and employment growth. Utilizing such a structure for B^* would require a forecast of these variables for the next several years.

9. The independent variables do exhibit some multicollinearity, which may reduce the efficiency of the estimation. The t statistics for the individual parameters, however, are all significant.

10. See "Florida banks branch warily," *Business Week*, no. 2450 (September 20, 1976): 54-55; and "Florida banks come bouncing back," *Banking* 70 (September 1978): 88-89, 92, 94.

11. Florida was not included in the sample of limited branch banking states because it had liberalized its branching laws in 1980 to permit statewide branching.

12. Ohio and Pennsylvania liberalized their branching laws in 1979 and 1982, respectively, to permit branching outside the home county but limit it to a contiguous county in the case of Ohio and to contiguous counties and counties adjacent to contiguous counties in Pennsylvania. In addition, some differences exist among the states with regard to interstate banking laws. At year-end 1985, Ohio and Tennessee had permitted interstate banking on a regional basis for two and five months, respectively. See Dean F. Amel and Daniel G. Keane, "State Laws Affecting Commercial Bank Branching, Multibank Holding Company Expansion, and Interstate Banking," Board of Governors, Federal Reserve System, Unpublished Paper (Mimeographed), August 1986.

Deregulating Electric Utilities: Issues and Implications

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We assume the soundness of the economic proposition that the lighting business is essentially noncompetitive in its nature. . . . Competitive public utilities of the same nature inevitably result in burdening the service and its customers with duplicate plants, the fixed charges of which more than offset such reductions in the rates as may result from competition.

—Franklin D. Roosevelt, Portland, Oregon, 1932[1]

I. Introduction

Over the past decade, energy markets have been deregulated substantially. Oil and natural gas prices and supplies are for the most part determined in markets, rather than by regulation. Now, looming on the horizon as perhaps the subject of the next major energy policy debate is the possibility of deregulating part or all of the electric utility industry. This article reviews issues and research related to what is likely to become a very topical policy issue in the future.

Regulation of electric utilities has been pervasive since the early 1900s. The movement toward regulated electric power resulted from two basic causes. First, consolidation of competing utilities often resulted in price-fixing in the early 1900s, leading to demand for regulation. Second, as indicated in the above statement by Roosevelt, it has traditionally been *assumed* that utilities are natural monopolies and that attempts to introduce competition would increase unit costs by forcing duplication of costly transmission and distribution networks.

Regulation, however, necessarily alters incentives of the regulated entities, often reducing efficiency. In judging the benefit to society of regulations, it is necessary to compare the cost of the regulations—in terms of efficiency losses stemming from changing profit incentives—with the gains from eliminating monopoly pricing.

This article presents an overview of the merits of continued utility regulation. To reach a better understanding of the issues involved, five related topics are discussed:[2]

- The economic rationale for regulating utilities
- Traditional problems that have emerged with regulation in practice
- Recent theoretical and empirical evidence relating to the need for regulation
- Options for deregulation
- Trends in construction of future power facilities in the present regulated environment.

In general, the evidence suggests that the gains from regulation increasingly are negated by the disadvantages. Inefficiencies resulting from regulatory pricing have been accentuated by rapidly changing energy prices and inflation. Although some inefficiencies have been reduced by changes in rate proceedings, recent volatility in energy markets has increased the value of shifting to the more flexible pricing typically associated with deregulated markets.

Furthermore, expected costs of deregulation may be less than initially envisioned. Deregulation of other presumed natural monopolies, such as the telecommunications and airline industries, has thus far led to lower prices with little appreciable decline in service. Few of the negative consequences forecasted by opponents of deregulation have been as significant as originally feared.

Gains from regulating the production of electricity have also been reduced by the apparent exhaustion of scale economies. As discussed later, there is increasing evidence that competitive forces can be used instead of regulation to produce low-cost electricity. Improvements in the technology of transmission have made spatial location of power generation less important, allowing producers at widely disparate locations to compete effectively in the same markets.

The urgency of deregulation, however, is derived from concern about long-run supplies under regulation. Uncertainty about demand and operating costs arising from fuel price gyrations, major cost overruns associated with nuclear power plant construction, and the possibility that the cost of newly completed facilities will be excluded from rate bases have raised the risk of new construction, causing utilities to shelve plans for adding to capacity.

Although present generating facilities are sufficient to meet demand over the next several years, additional capacity is likely to be necessary by the end of the century. Because power plants can take more than 10 years to build, disincentive effects of utility regulation require careful study.

Suboptimal construction of new capacity makes deregulation particularly important. Generally, markets are able to assess investment risks more accurately than regulatory bodies can. Streamlining the regulatory process to allow greater use of market forces is likely to result in long-run efficiency gains in the provision of electric power.

Evidence presented in this article, therefore, suggests that deregulation is possible and is likely to yield efficiency gains. Changes in the technology of electricity production and transmission have raised the potential for competitive pricing of electricity. Furthermore, changes in the market environment have put a premium on flexibility in evaluating and responding to risk.

II. The rationale for existing regulations

Before turning to a discussion of the potential benefits of deregulating a portion of the electric power industry, it is important to understand the economic rationale for regulating the industry. Utilities are generally regulated because of a widely held perception regarding costs of providing service. Production, transmission, and distribution of electric power require large fixed investments in capital equipment. The cost of providing additional units of electricity tends to be relatively insignificant compared with the fixed costs of developing the system. Consequently, average costs per unit of power fall as usage increases because the fixed costs are spread over a larger number of customers.

This feature of declining average costs has been recognized by economists as a condition in which markets may fail to yield efficient outcomes. Economic models predict that in the absence of regulation, the emerging monopolies would provide less than socially optimal output at a higher price. Because the costs of providing service fall with the scale of operations, large firms are able to undercut smaller firms as a result of lower costs. Ultimately, a single firm would be expected to emerge to provide all of the service. Hence, industries with declining average costs are often termed "natural monopolies."

Obtaining lowest-cost service requires, therefore, the emergence of a single firm. Because the cost of entry is extensive, however, competitive forces are not available to keep pricing near average costs. In theory, regulation is designed to improve economic efficiency, by attaining the production efficiencies available through granting monopoly power while pricing services close to average cost.

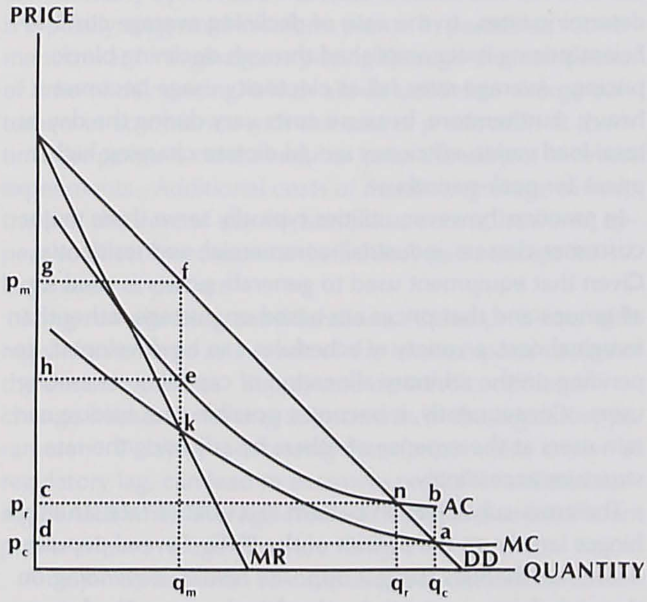
The simple natural monopoly problem can be seen more clearly in Figure 1. Demand is represented by the curve *DD*, with the marginal revenue schedule shown by curve *MR*. Marginal costs and average costs of producing electricity are shown by the curves *MC* and *AC*, respectively. Both marginal and average costs are assumed to be falling over the relevant range because of large fixed costs and the relatively low cost of providing an additional unit of power.

The competitive solution occurs where the demand curve intersects the marginal cost curve, designated by point a on the diagram, producing q_c units at price p_c. Because marginal costs are below average costs, however, losses would be registered by the competitive firm equal to the difference between average cost and the price multiplied by the amount produced, *abcd*. Consequently, a competitive structure would be unsustainable.

A monopoly could emerge to produce electricity profitably but at a higher price. The monopolist maximizes profits by equating marginal cost with marginal revenue (point *k* in the diagram). Output is less than in the competitive case, q_m, with a higher price, p_m. Profits are shown by the area *efgh*.

Because a monopoly is expected to result, regulation is interjected to improve on the situation by granting a

Figure 1
The Natural Monopoly Case



monopoly and setting a regulated price that allows the monopolist to recover costs but not to capture monopoly profits. A regulated price is set where the demand curve and the average cost curve intersect (point *n*). Prices are set at p_r with production at q_r.

The regulatory price is higher than the competitive price, but because the competitive solution yields negative profits, competition in this model is unlikely to persist. Consequently, the regulated solution is more efficient, in that it induces greater output at lower cost than would be possible if the market were not regulated.

III. Traditional problems with regulation

In a world such as that shown in Figure 1, regulation appears to offer significant advantages. Consumers receive more electricity at a lower cost because of the declining-cost nature of the industry.

Inefficiencies caused by incomplete information, however, emerge in the regulatory process and reduce or possibly eliminate the gains from regulation. In the short term, demand fluctuates with weather patterns and time of day. Over a longer period, demand grows at a rate determined by costs of other forms of power, technological change, and increases in electricity-using goods. As a result, the demand curve shifts in ways not easily predicted. Furthermore, information about the structure of production costs that is available to regulators is insufficient to allow the optimal pricing strategy shown in the figure to emerge.

In practice, the efficiency of utility regulation depends on the utility commission's judgments regarding the rate base, the appropriate rate of return to grant the utility, and the rate structure; the utility's ability to adjust to changing conditions rapidly; and overcoming the problems of overlapping regulatory jurisdictions.[3]

Problems defining the rate base. In return for granting a monopoly franchise to a utility, a state's public utility commission (PUC) sets the prices the utility can charge for service. To establish the rate, the PUC takes into account fuel and labor costs and then attempts to provide a fair return on invested capital. Once the total amount is calculated, the PUC sets a rate that can be charged, which, when multiplied by the rate base, yields that desired revenue stream.

The rate base is composed of the plant and equipment required to generate, transmit, and distribute the power. Because the capital lasts for decades, however, valuing the capital base becomes difficult. Until the early 1970s, technological progress and low inflation allowed average costs of new generating facilities to fall over time. As a result, the value of existing capital, calculated on the basis of historical costs, overestimated the cost of replacing the capital. Because replacement costs are a more accurate measure of the economic value of capital than historical costs are, rate bases were too large.

In contrast, during the inflationary 1970s, the replacement cost of capital rose sharply. Rate bases, still valued by using historical costs, provided insufficient revenues to compensate for the rising replacement cost of the capital, which undervalued the capital base.

Changes in relative fuel costs, such as increasing costs of fuel oil relative to coal, can also affect the current value of capital facilities. The value of the existing capital stock depends to a large extent on the expected operating costs of different types of capital.

An additional problem with determining the rate base is the treatment of construction work in progress (CWIP). In the past, capital investments were added to the rate base when they were completed. At that time, the rate was set to provide a fair rate of return on the capital, including an allowance for a return on the funds used during the construction period. Alternatively, the PUC can choose to include CWIP in the rate base before the project is completed. Although the two methods are presumably identical from a present-value calculation, the inclusion of CWIP has recently become a major point of debate.

The cost of nuclear power plants has forced the treatment of CWIP into prominence. Demand miscalculations, oil shortages, and rapidly changing fuel costs prompted utilities to begin construction of a large number of nuclear power facilities in the 1970s. Large cost overruns, construction and regulatory delays, and rapid inflation raised costs well above envisioned levels. Similarly, compliance with environmental regulations caused the cost of coal-fired generators to rise dramatically.

Because of the major construction expense, utilities have sought to include CWIP in the rate base to allow the utilities to attract funds during construction. On the other side, consumption growth slowed dramatically, leading utility customers to attempt to prevent the utilities from adding the new facilities to the rate base upon completion so as to avoid a major increase in electricity rates. Both utilities and utility customers contracting to purchase power from such facilities contend that they should not have to bear the cost of restructuring plants to meet compliance with changing federal regulations. Consequently, they argue that CWIP should be excluded and only part of the final costs should be eligible.[4]

Problems determining the rate of return. Determining the appropriate rate of return is also difficult. The rate reflects a combination of required interest payments on debt and a rate of return granted to equity owners. Ideally, the rate for the equity holdings would be set to match the return available from an alternative investment with the same degree of riskiness. As a result, the rate would be expected to attract the amount of new investment needed to provide future power needs. Setting rates to attract the optimal amount of new investment, however, requires forecasts of demand growth over long periods of time. As shown later in this article, such forecasts have been subject to large errors, leading to incorrect plans for new investment.

In practice, the rate—particularly the rate granted to equity owners—is determined by political forces because information on the "appropriate" rate of return is not available. Comparably risky alternative investments are seldom available. Rates are changed during rate hearings, at which time advocates of utilities and consumers attempt to convince commissioners that the rate should be changed in their favor. Before the rapid increase in inflation, rates of return were often considered excessive. Recently, evidence suggests that utility commissions have tended to suppress rate increases.[5] In general, however, the bias of individual utility commissions depends on the political power of the involved local interest groups.[6]

The rate structure and equity goals. Regulatory efficiency is also affected by the practice of interjecting income distribution concerns into the process. If utilities served only one class of customer, it would be considerably easier to determine rates. In the case of declining average costs, efficient pricing is accomplished through declining block pricing. Average rates fall as electricity usage becomes heavy. Furthermore, because costs vary during the day as total load varies, efficiency would dictate charging higher prices for peak-period use.

In practice, however, utilities typically serve three major customer classes: industrial, commercial, and residential. Given that equipment used to generate power is used for all groups and that prices are based on average rather than marginal cost, a variety of schedules can be developed, depending on the arbitrary allocation of capital costs among users. Consequently, it becomes possible to subsidize certain users at the expense of others by adjusting the rate structure accordingly.

The cross-subsidization pattern in a utility's rate structure hinges largely on the politics of the PUC. Several popular economic theories suggest opposite results, depending on the underlying assumptions of political power. The "capture theory" argues that regulatory bodies will act in the interest of the regulated industry.[7] Because technical expertise is required to regulate the industry, the regulators must lean heavily on the industry to provide information.

Alternative theories suggest that regulators use the rate structure as an implicit tax-transfer device.[8] Instead of direct taxes to change the distribution of income, utilities are used as an instrument of public policy and are encouraged to grant subsidies to certain consumers at the expense of others. In the case of electric power, these subsidies appear in the form of reduced residential rates, "lifeline" service to help low-income and handicapped residential consumers, and preventing utilities from halting service to delinquent users during winter heating months.[9]

If the capture theory is more descriptive, residential consumers would be expected to subsidize industrial customers. Industrial consumers often have greater potential to switch among fuels. To assure growth in demand—and, hence, in revenues—utilities would gain by keeping prices low to those with the most elastic demand (industrial consumers) and putting a disproportionate share of the costs on those least able to switch from electricity (residential users). The opposite conclusion would be expected if the tax-transfer theory were more correct.

In general, both types of behavior are likely to be observed, depending on the prevailing political environment in the particular jurisdiction.[10] Recent evidence, however, suggests that in most cases the direction of subsidization is toward consumers and away from industrial users.[11]

Reforming rate structure designs has been a central concern of many economists. Greater reliance on market forces is typically suggested in reform plans. In particular, movement toward marginal cost pricing through the introduction of time-of-day pricing, which allows utilities to charge customers in accordance with the cost of production at the time the power is consumed, has been the subject of several experiments. Additional costs of monitoring usage to keep track of the time of day consumption occurs, however, appear to offset most expected efficiency gains except for large users of power.[12]

Long-run planning considerations. Other problems with regulation emerge as a result of the intertemporal nature of the decision process. Supply and demand conditions change over time, forcing adjustments in the regulatory parameters. Delays in addressing these parameters, known as regulatory lag, can lead to excessive profits for utilities during periods when average costs are falling and to insufficient profits when average costs are rising.

A major contribution to intertemporal inefficiency in electric power generation results from distortions in incentives. Utilities do not have cost-minimizing incentives when it comes to selecting factor inputs. The fact that profits to the industry are derived from the rate of return on capital creates possible incentives for the industry to overinvest in capital.[13] By expanding generation capacity, the firm increases the share of expenses subject to a profitable rate of return. Alternatively, if rates of return are set below a profitable level, utilities will undercapitalize by using other factors (such as more expensive, less efficient older units) more extensively.

Furthermore, in the case of rapidly changing input costs, utility commissions have often allowed utilities to adjust rates automatically to pass through the higher costs. When oil and natural gas prices rose in the 1970s, fuel adjustment clauses were included to minimize regulatory lag. Although the process reduced some inefficiencies resulting from regulatory lag, incentives to decrease use of high-cost fuels through adjustments in the fuel mix were diminished because the utilities could simply pass the cost along to consumers.

Reliance on rule making also may inhibit the rapid dissemination of new information and new technologies. Utilities tend to use technologies that are most profitable under existing rules, rather than those that yield lowest economic costs. Entry by new firms, which could put downward pressure on prices, is often prohibited by existing monopoly franchising agreements. Furthermore, experimentation may be reduced by the need to comply with regulatory standards.[14]

Perhaps equally important, utilities have incentives to please utility commissions. In many cases, this desire to please commissions can lead to poor business decisions. For example, in the early 1970s, oil shortages led many utility commissions to promote expansion of nuclear power facilities. Utilities, given assurances that capital expenditures would be allowed a fair rate of return, began constructing the facilities. With partial elimination of the risk associated with investing in new capital projects, the investment undertaken was excessive. In the absence of such assurances, investors may require significantly higher projected rates of return to compensate for the risk.

Institutional complexities of regulation. An additional problem facing utility regulation is the structure of the industry and regulatory bodies. Most utilities (78 percent in 1980) are investor-owned. Such utilities are typically regulated by a state PUC, although some municipalities also exercise control. Bulk power and wholesale power transactions between private utilities are regulated by the Federal Energy Regulatory Commission (FERC). Merger requests are subject to scrutiny by FERC, the Securities and Exchange Commission, and the U.S. Department of Justice.

The remaining power is produced by publicly owned utilities, which are not operated for profit. Public electric power generation primarily results from federal water projects that are operated by federal agencies. Most prominent among these is the Tennessee Valley Authority, which is the largest utility system in the country. Other public forms of utilities include municipal utilities and rural electric cooperatives.

Public power projects often have a competitive advantage over private utilities. Power is typically subsidized: dams are built with national funding, nuclear power projects can be attached to projects receiving funding from defense appropriations, projects are free from state and federal taxes, and interest paid on municipal bonds for power is tax-exempt.

Most plans for deregulation, however, are directed toward the investor-owned utilities. The significance of the complexities of regulation is that each state tends to operate using different procedures, although most follow the general principles outlined earlier. Transactions between utilities in different states, therefore, require Federal Government approval as well as the consent of PUCs in the states involved. Utilities typically cannot enter freely into contracts with other generators without receiving permission from a host of regulatory institutions. Consequently, deregulation of electric utilities cannot be accomplished by federal legislation alone but must rely on cooperation at the state level also.

IV. Evidence of monopoly power

The preceding discussion concerns reductions in potential regulatory benefits caused by institutional inefficiencies. If choices about rate bases, rates, and rate structures yield incentives that decrease efficiency, the benefits of regulation are diminished.

As described in this section, both theoretical research and empirical research during the past decade have defined more precisely the nature of the potential costs of not regulating the electric power industry. On the theoretical side, conditions under which a monopolist can capture monopoly rents have been explored more carefully. Generally, the theoretical work indicates that capturing monopoly rents is more difficult than was assumed in the simple model described in section II.

Empirical work has raised further doubts about the extent of monopoly power that a utility possesses. Exhaustion of economies of scale and advances in the technology of transmission have increased the potential for a more competitive environment.

IV.A. Theoretical developments

Although the natural monopoly model of electric utilities was widely accepted in the 1960s, the implied ability of the natural monopolist to charge monopoly prices began to be questioned. Some economists argued that a natural monopolist could set a monopoly price only if there were legal barriers to entry and substantial costs associated with establishing new contracts with customers. If those barriers were minimal, potential entry by a neighboring rival utility would be sufficient to restrain monopoly rents.[15]

This view emphasizes the role of transaction costs in determining the sustainability of monopoly pricing. Theories of industrial organization have recently clarified the conditions under which monopolistic pricing can be sustained. First, the natural monopoly model requires permanently high entry costs for potential competitors. If regulations are relaxed to allow other firms to compete, the threat of competition is sometimes sufficient to yield pricing closer to competitive levels. As long as the threat is viable—in cases where an alternative utility could potentially move into the market at little cost—the market is said to be "contestable," and regulation may not be required to prevent monopoly pricing.[16]

Second, contestability is not limited to potential competition from other electric utilities. Monopoly pricing is also constrained by intermodal competition—competition from other sources of power or heat. Technological innovations have created the potential for consumers to switch from electricity to other forms of energy at relatively low cost. Monopoly pricing, therefore, is limited by the more elastic nature of electricity demand. If prices rise too high, consumers, particularly industrial consumers, have incentives to restrict usage and switch to fuel oil or natural gas for space heating, air-conditioning, and power.[17]

Third, electric utilities should really be considered multiproduct producers. Although the output is always electrical current, seasonal and daily variations in demand require different production technologies at each point in time. During peak periods, for example, utilities must use higher-cost facilities. Under this logic, conditions for a firm to be a natural monopolist are much more stringent. If the firm can produce at lower cost with its facilities than other firms at each level of production, then that firm may be a monopolist.[18] The multiproduct model argues that competition could emerge in power production, perhaps not at off-peak periods but at peak periods when more costly generating units must be brought on line.[19]

This competitiveness in the bulk power market has become especially significant in the wake of developing cogeneration capacity. Large industrial firms are discovering that it is cost-effective to build cogeneration units to produce power and use the heat by-product for space heating or industrial processes. When excess capacity exists at various periods during the day, the firms can sell the excess power to the local utility. Although these industrial firms could not compete with a utility in providing low-cost power during slack demand periods, they could profitably compete with regard to the high-cost older or oil-burning generators used in peak demand periods—especially the firm that is also using heat from the production process as an input for another product. Cogeneration, then, can flatten peaks in consumption, thus reducing capacity requirements.

IV.B. Empirical evidence of monopoly power

In addition to theoretical evidence suggesting that competitive forces may be more successful than previously believed in preventing monopoly pricing, empirical research has provided evidence supporting increased competition. Exhaustion of scale economies, advances in transmission technology, and expanding interlinkages in the power grid have all contributed to making the electricity market more conducive to competition.

A major change favoring competition is the apparent exhaustion of economies of scale, particularly in the area of power production. Empirical research in the 1960s found evidence of increasing returns to scale in production facilities, providing support for the natural monopoly model. More recent research, however, has estimated the minimum average cost of production to occur at firm sizes well below the capacity of many existing plants.[20] Estimates of scale economies remain a source of debate because of problems with data, but there is strong evidence that scale economies are not as significant today as they were in the pre-1970 period.[21] Consequently, it appears that multiple firms could emerge in large markets and successfully compete. The exhaustion of economies of scale would no longer allow one firm to underbid its competitors by expanding to reduce average costs.

Expansion of cogeneration capacity suggests that firms operating below the scale associated with minimum average costs can profitably produce electricity as a by-product. Although statistics on cogeneration are not readily available, evidence of decreased load growth indicates cogeneration's expanding role. For example, between December 1984 and March 1985, sales by Houston Lighting and Power to chemical and allied industries fell over 21 percent. In contrast, sales by other Texas utilities to the same industry group rose 1 percent during that period. Most of the sales decline for Houston Lighting and Power is attributed to cogeneration units coming on line in the Houston area.

Scale economies continue to exist in transmission and distribution, but they have been reduced sharply in recent years. Economies of scale in transmission result from the physics of delivery systems. As in the case of pipelines, costs of constructing transmission lines increase linearly with the size or voltage of the line. The capacity of the line, however, increases geometrically (approximately by the square of voltage). Consequently, larger lines are more expensive, but the unit cost of transmission falls.

Although it is cheaper to transmit power between two points on one line rather than two, the degree of scale economies in transmission does not appear to prohibit new entry. Recent studies have demonstrated the existence of decreasing average costs, but the degree of scale economies is not statistically significant.[22]

At the distribution level, competition may be possible without yielding higher costs. Economies of scale in distribution exist but are exhausted relatively quickly. Consequently, it would be possible for more than one utility to serve a densely populated geographic area.[23] Not surprisingly, it would be inefficient to have more than one utility serve any one customer, but when expansion occurs, competitive bidding—rather than simple extension of monopoly privilege—would increase efficiency.[24]

A major development favoring some form of deregulation involves important advances in the technology of power transmission. Power lines in the early 1900s carried 10 kilovolts of power. In recent years, 765-kilovolt transmission lines have been constructed, and feasibility studies are progressing on direct-current lines with double that capacity.[25] Line losses, which increase with distance, have been sharply reduced by more efficient transformers, allowing existing lines to be upgraded to higher voltage ratings at relatively low cost. Furthermore, in view of recent breakthroughs in research on superconductivity, line losses in long-distance transmission could be drastically reduced when that technology is implemented.[26]

In fact, development of large-capacity transmission lines with small line-loss characteristics already has made possible major transfers of bulk power over long distances. Utilities in Southern California, for example, now obtain power from Oregon and Washington, where low-cost hydroelectric power is available. Interconnections of utilities are also raising the feasibility of "wheeling" power (transmitting power between utilities through the facilities of intermediate utilities).

Regional—and potentially national—power grids made possible by improved transmission capabilities have increased interconnections of utilities. Various utilities have formed regional power pools to take advantage of efficiencies made possible by coordination. These efficiency gains include coordination of maintenance schedules (timing of plant shutdowns), exchange of excess power, and other arrangements that allow utilities to reduce reserve excess capacity to meet peak demand.[27] By coordinating and exchanging power, all members are able to avoid constructing costly generating capacity for peak demand or emergency situations.

While power pools have increased coordination and cooperation among regional utilities, competitive forces are also aided by improved transmission grids. Wheeling of bulk power among regional blocks has been undertaken. Such actions are particularly useful when peak loads occur at different times (that is, in different time zones). Furthermore, spot sales have become possible for generating units with excess capacity.

It is important to recognize that all these technological improvements have boosted the potential for more competition in power *production*. Many of the efficiency gains in sharing power through pooling and wheeling are the result of cooperation rather than competition. Plans for deregulation must be carefully designed to avoid eliminating the *cooperative* efficiency gains.

Table 1
DEREGULATION SCENARIOS

Joskow and Schmalensee (1983)[1]

1. Complete Deregulation
   (1) Eliminate all price and entry regulations at all levels.
   (2) Mergers or membership in power pools or joint ventures would be scrutinized under antitrust legislation.
2. Deregulation of Wholesale Transactions
   (1) "[D]eregulate wholesale power sales between utilities in areas where the federal government certifies that access to transmission, coordination, and power pooling services is open to all (at appropriate rates and with appropriate technical restrictions) and that the wholesale market is workably competitive."[2]
   (2) Distribution and transmission facilities continue as franchised monopolies.
   (3) Retail rates would be regulated at the state level, and power pooling and wheeling agreements would be regulated at the federal level.
3. Separate Distribution and Deregulate Wholesale Power Transactions
   (1) Deregulate wholesale power transfers, as in plan 2.
   (2) Vertically integrated firms would be forced to divest distribution companies. All distribution companies would operate as independent regulated franchised monopolies subject to price regulation.
   (3) Generation and transmission companies could remain integrated, although mergers would be encouraged among small wholesale power producers to foster more coordination and pooling.
   (4) Interconnection and wheeling would be regulated by the Federal Energy Regulatory Commission and be subject to antitrust scrutiny.
4. Complete Vertical Disintegration and Deregulation of Wholesale Power Transactions
   (1) Create independent distribution companies, as in plan 3.
   (2) "[O]wnership and operation of all high-voltage transmission capacity is transferred to a regional power pooling and transmission entity, which could be a public corporation or a regulated private corporation."[3] This provision, in effect, splits ownership of transmission and generation.
   (3) "[O]wnership of generating capacity is reorganized to allow for independent generating entities that can achieve all significant scale economies and preserve enough independent generating entities so that a competitive market for bulk power supply emerges."[4]
   (4) Transactions between distribution companies and the transmission entity would be regulated, as would retail rates. Furthermore, "transmission charges and charges for pooling services provided by the monopoly transmission-pooling entity" would be regulated.[5]

Continued on next page

In general, therefore, technological progress has "reduced distances" between utilities. Scale economies at the plant level are no longer increasing continuously with size. Consequently, the prospects of competition increasing efficiency in some portions of the industry have improved as technological progress has made markets more competitive.

V. Options for deregulation

Several proposals for deregulating some segments of the electric power industry have emerged in recent years. Because of the highly complicated technological interlinkages of elements of the industry, only a highly generalized discussion is presented here, outlining the areas in which competition could most profitably be introduced. In all proposed cases, major problems remain in ironing out details and technical problems, such as the difficulties in coordinating large-scale power movements among many diverse and spatially distinct units. Nevertheless, options for deregulation have begun to emerge.

Two of the more influential sets of options are summarized in Table 1. As shown in the table, plans for deregulation range from simply eliminating regulation (usually over a period of time) to active attempts at restructuring the industry through legislation.

Each plan has important implications for the resulting industrial structure. Elimination of regulations, as in Joskow

Table 1—*Continued*
DEREGULATION SCENARIOS

Weiss (1975)[6]

1. Maximum Competition

"(1) the separation of generation-transmission companies from distribution companies;
(2) the dissolution of combination utilities;
(3) the elimination of public and private territorial restrictions on sales to distributors or large industrial customers;
(4) a general requirement of interconnection and wheeling at reasonable charges;
(5) the elimination of preferential access to federal power and preferential tax and capital-cost treatment for municipals and cooperatives;
(6) the elimination of legal restrictions on entry into bulk power; and
(7) the limitation of horizontal mergers among generation-transmission companies to cases where the partners are too small to negotiate effectively with other bulk-power producers of a region."[7]

2. Modified Competition

"(1) the elimination of private and public territorial restrictions on sales for resale, and possibly private restrictions on sales to large industrial customers, as well;
(2) a general requirement of interconnection and wheeling;
(3) control of horizontal and vertical mergers; and
(4) at least some divestiture of gas properties in connection with further mergers."[8]

1. Paul L. Joskow and Richard Schmalensee, *Markets for Power: An Analysis of Electric Utility Deregulation* (Cambridge: MIT Press, 1983).
2. Ibid., 98.
3. Ibid., 104.
4. Ibid.
5. Ibid.
6. Leonard W. Weiss, "Antitrust in the Electric Power Industry," in *Promoting Competition in Regulated Markets*, ed. Almarin Phillips (Washington, D.C.: Brookings Institution, 1975), 135–73.
7. Ibid., 169–70.
8. Ibid., 170.

and Schmalensee's plan 1, would not place restrictions on the eventual industry structure. Public emphasis would be directed toward preventing collusive or noncompetitive mergers and agreements. In contrast, Weiss' plan 1 and Joskow and Schmalensee's plan 4 would eliminate vertical integration to prevent such noncompetitive behavior from emerging.

Although differing markedly in their provisions, the plans all attempt to make use of the findings of recent research. With regard to generation, exhaustion of returns to scale in power production boosts the potential for emergence of a competitive market in electric power. In regions with large populations, the viability of multiple firms successfully competing has increased sharply:

> Most important regions could support enough generating plants to permit extensive competition if the plants were under separate ownership and had equal access to transmission and distribution. . . . In the more populous parts of the country, the possibility of high-voltage networks makes it technologically feasible for plants anywhere in a wide region to supply any consuming center connected with the network, though costs will still vary with the supplier's location.[28]

As can be seen in Table 1, this assumption about the potential competitiveness of power transactions, particularly bulk power, has made the increased use of market-determined prices an important cornerstone of nearly all the plans.

As far as distribution systems are concerned, only partial deregulation is usually favored, except in the case of total elimination of all forms of utility regulation. In large markets, one distribution company could probably coexist with another, allowing competition to emerge for new customers entering the service area and for large users.

Competition among distribution systems for existing residential or retail consumers is less likely because of the cost of duplicating capital equipment. At the retail level, the main force preventing monopoly pricing would remain regulations or the threat of intermodal competition—consumers switching from electricity to natural gas. To enhance the potential of intermodal competition, therefore, separate operation of gas and electric companies is typically recommended.

In all the deregulation scenarios, however, a critical determinant of the sustainability of competition relates to the treatment of transmission facilities. "For vertical disintegration to be unequivocally beneficial to consumers, it should be accompanied by free access to interconnection and wheeling and by the absence of mergers that greatly increase regional concentration."[29] The development of market-determined pricing at the generation level requires that all producers have nondiscriminatory access to markets.

Gains from deregulation, as revealed in the plans, are expected to be the largest at the production level. It appears possible to change to an industrial and regulatory environment that better allows producers of power to compete, with resulting prices providing more efficient signals to producers and potential new entrants.

Reduced regulation of electric power production could result in additional concentration of firms.[30] Older plants with higher average costs of production would be unable to compete with newer plants. Because higher-cost plants could be used for peak-load periods, rather than baseline service, such plants might be desirable acquisitions. Consequently, most of the deregulation plans also provide for mergers of some generating companies.

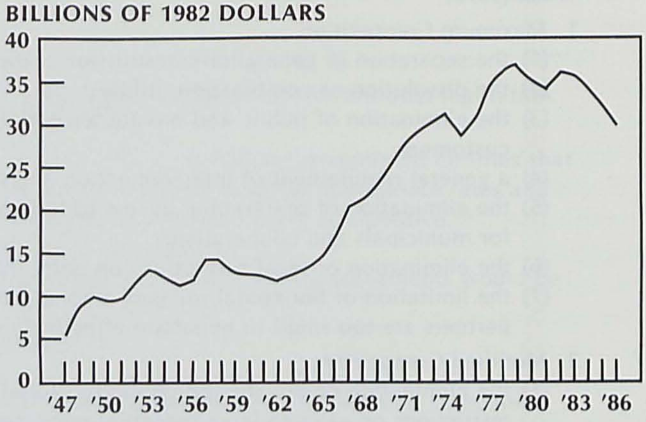
VI. Investment trends under regulation

Plans for deregulating portions of the industry have been proposed for many years. Recent actions in the construction of new facilities, however, have presented compelling reasons for giving greater attention to the viability of various plans. Utilities have increasingly shelved projects or halted construction largely because demand projections have been too high, costs of construction have been much higher than expected, and utilities are no longer confident that they will be able to add the finished facility to the rate base.

As a result of uncertainty about the costs and the eventual returns to investment, utilities have been exploring nontraditional solutions to load growth. The U.S. Office of Technology Assessment recently summarized its projection about the future of the industry as follows:

> During the 1970s, the environment within which utilities made investment decisions changed from a relatively predictable continuation of past trends to a highly uncertain and complicated maze of interrelated financial, regulatory, and technology considerations. As electric utilities face the 1990s, the experiences of the 1970s have made them much more wary of the financial risk of guessing wrong and overcommitting to large central station coal and nuclear plants. At the same time, the possibility of being unable to meet electricity demand exists, causing growing concern among utilities as the next decade approaches.
>
> As a result, utilities are now taking steps to enhance their flexibility in accommodating future uncertainties. In addition to continued and primary reliance on conventional technologies, supplemented by coal combustion technology enhancements to reduce pollution emissions and increase efficiency, utilities are considering a variety of less traditional options. These include life extension and rehabilitation of existing generating facilities, increased purchases from and shared construction programs with other utilities, diversification to nontraditional lines of business, increased reliance on less capital-expensive options such as load management and conservation, and smaller scale power production from a variety of conventional and alternative energy sources. Such options offer utilities the prospects of more rapid response to demand fluctuations than traditional, central station powerplants.[31]

Chart 1
Expenditures for New Plant and Equipment by Public Electric Utilities



SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis.

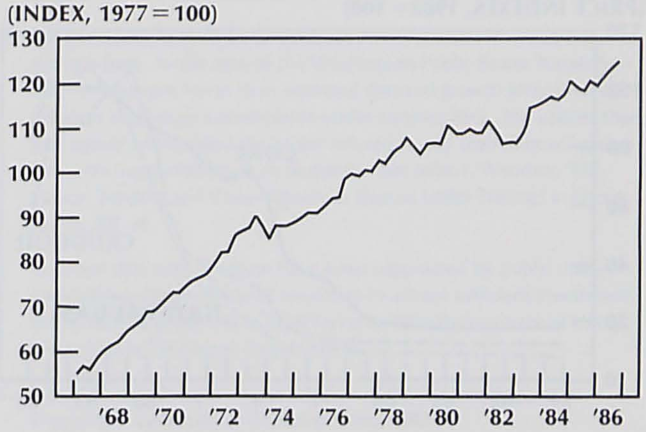
Table 2
EXPECTED ANNUAL GROWTH IN ELECTRICITY CONSUMPTION

Year	Annual expected growth rates (Percent)[1] Utilities	CEC	Trend growth estimates (Percent)[2]	In subsequent five years: Actual growth rates (Percent)	Deviations from trend estimates
1971 . . .	7.38	—	7.45	3.29	-4.16
1972 . . .	6.52	—	7.04	3.30	-3.74
1973 . . .	6.97	—	6.73	4.01	-2.72
1974 . . .	5.27	—	5.58	3.88	-1.70
1975 . . .	5.63	—	4.37	3.01	-1.36
1976 . . .	4.12	—	3.29	2.15	-1.14
1977 . . .	—	3.76	3.30	1.46	-1.84
1978 . . .	—	—	4.01	.84	-3.26
1979 . . .	3.30	1.74	3.88	1.76	-2.12
1980 . . .	1.74	1.47	3.01	2.07	-.94
1981 . . .	—	—	2.15	—	—
1982 . . .	—	1.97	1.46	—	—
1983 . . .	—	—	.84	—	—
1984 . . .	—	—	1.76	—	—
1985 . . .	—	—	2.07	—	—

1. Average forecasts made by a sample of California utilities and by the California Energy Commission (CEC).
2. Calculated from industrial production index for electric utility output, seasonally adjusted, from 1967:Q1 to 1985:Q1.

SOURCES OF PRIMARY DATA:
Board of Governors, Federal Reserve System.
California Energy Commission, *Securing California's Energy Future*, Biennial Report (Sacramento, Calif., 1983), 100.

Chart 2
Output by Electric Utilities



SOURCE: Board of Governors, Federal Reserve System.

Evidence of this reduced willingness to invest in new power-generating facilities is shown in Chart 1. Expenditures, measured in constant (1982) dollars, on new plant and equipment by public electric utilities rose steadily between 1947 and 1979. Since 1979, however, expenditures have been falling in both real and nominal terms.

This reduced interest in building large power-generating facilities for baseline power is a concern to many studying the industry. Although the potential for cogeneration has only begun to be tapped, additional new large-scale power plants will eventually be needed. In the current environment, there is little incentive for the risk taking required to undertake such ventures.

Hesitation in constructing new power plants stems partly from fears that public utility commissions will not allow the new plants into the rate base upon completion. Mainly, however, reluctance has arisen from uncertainty about demand growth.

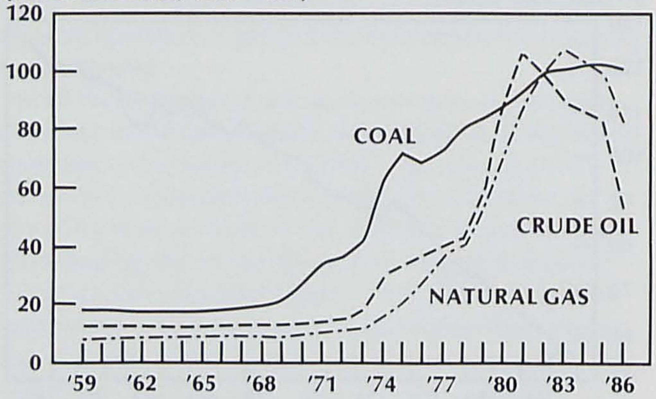
Doubts about demand projections can be understood by examining Table 2. The table shows expected electricity consumption growth rates reported to the California Energy Commission by California utilities, the commission's forecasts, and estimated trend growth rates from the previous five years. Expectations of utilities follow historical trend growth rates relatively closely but, as shown in the last column in the table, were consistently too high. These overly optimistic estimates of load growth were, in large part, responsible for a surge of new construction in the early 1970s. Failure of demand to grow at the predicted rates, on the other hand, was responsible for reluctance on the part of public utility commissions to allow the finished facilities into the rate base.

Examination of the data suggests one cause of the overestimated demand growth. As shown in Chart 2, output in recent years has fluctuated, but around a linear trend. Forecasters have typically assumed that growth is exponential, moving with increases in the population. Estimates assuming exponential growth when growth is actually linear will invariably project excessive growth.

On the other hand, changing projections to simple linear trends may lead to underestimates if growth is exponential, and the linearity observed in the 1970s merely reflected the effect of energy price shocks. The period of the 1970s, after all, included years of drastic swings in fuel prices that may have induced major changes in consumption behavior.

Chart 3
Comparison of Energy Fuel Prices

(PRICE INDEXES, 1982 = 100)



SOURCE: U.S. Department of Labor, Bureau of Labor Statistics.

It is these recent increases in energy price volatility, coupled with uncertainty about changes in environmental regulations, that have led to a marked expansion in investment risk. As shown in Chart 3, the volatility of oil, natural gas, and coal prices has risen sharply in the past decade. Furthermore, relative prices have shifted during the period. Oil became relatively more expensive than coal or natural gas in the 1970s, but the price of oil relative to coal is now falling. Consequently, the projected cost of operating a coal-fired plant versus an oil-fired plant has shifted with oil prices, making decisions about the most economical plant in which to invest more problematical.

It is important to recognize that the risks in building a new power plant are of two types. First, there is regulatory risk. In recent years, public utility commissions have been increasingly resistant to allowing newly completed power facilities into the rate base. Second, there is risk about future demands for the product. Because power plants can take in excess of 10 years to build, incorrect projections about load growth make the profitability of new construction highly uncertain.

A major argument in favor of deregulation is that a deregulated market is better suited to incorporating risk. Most obviously, risks from shifts in public policy, which create regulatory risk, would be reduced if the price of power were based on market pricing rather than on a regulated rate of return. Furthermore, market pricing tends to act more efficiently as a signal to potential producers that additional capacity should or should not be undertaken. Although deregulation would not eliminate risk, it would allow a more rational incorporation of risk into decision processes.

VII. Implications of deregulation

In light of recent investment trends, some form of deregulation of the utility industry warrants consideration. Heightened uncertainty about fuel prices and relative fuel prices and the uncertainty about demand growth make central planning of electric power production more difficult.

In a rapidly changing environment, increased use of market-determined pricing is likely to yield more rapid corrective responses to arising shortages or surpluses of power. Incentives to use a particular configuration of fuel inputs or capital inputs would be based more closely on cost minimization principles, rather than seeking to maximize artificial incentives built into regulatory structures.

Given the evidence that at least portions of the industry could engage in competitive behavior, deregulation becomes especially attractive. Regulation determining future power supplies, in particular, is the most difficult to justify. As long as free access can be maintained, an unregulated market is likely to be better than the regulatory body at making intertemporal investment decisions. Only if the PUC possesses better information than the utilities would the commission be expected to make more efficient choices about future power needs. Even in such cases, however, it would be possible to subsidize new construction by allowing the utilities access to below-market rates of interest, such as with industrial revenue bonds.

Institution of more market-determined pricing at the bulk power level would increase the value of time-of-day pricing. Because the distributing company's cost of acquiring power would rise during peak periods if power prices were market-based, efficiency gains would be possible by creating incentives for consumers to adjust power use to reduce peak loads.

Deregulation, however, is not without its drawbacks. Nearly every policy change has both efficiency and equity (fairness) effects. Deregulating electric utilities is no exception. Higher current prices may be needed to encourage construction of new power generation capacity, even though that capacity will not be available for 10 years. Deregulation could well mean an increase in present costs, although future costs would be expected to be lower.

In addition to possible increases in current average utility costs, the distribution of the added burden is likely to be uneven. Low-income consumers are generally assumed to have the most inelastic demand for electricity. Efficient pricing places the greatest burden on those least able to adjust, while those most able to switch to other power sources or reduce demand are given the lowest prices.[32] Consequently, any price increases would hit low-income consumers harder than higher-income consumers.

The regional incidence of price increases is also a potential issue of concern. To the extent that power production is deregulated, regional disparities in pricing will tend to be diminished. Although equalization of prices generally decreases average prices, regions with low-cost production will face price increases. Simulation experiments suggest, however, that most regions and customers would gain from such regional price equalization.[33]

In addition to concerns about fairness, reliability may suffer under some forms of deregulation. At present, utilities are obligated to have sufficient excess capacity to assure power supplies to their customers. If all regulations were eliminated, reliability requirements might be reduced. Certainly, the utilities would have little incentive to hold as much excess capacity as is required by current regulatory bodies.

Although these drawbacks are important to many policymakers, alternative ways exist to achieve the underlying social goals with fewer inefficiencies. Often, fairness or income distribution issues can be handled more efficiently through direct subsidies. Issues of reliability can be resolved by pricing structures—similar to those already in place—that grant lower prices to consumers who are willing to have service interrupted during periods of excessive demand.

To summarize, given the nature of the current industrial structure, deregulation is likely to yield efficiency gains in the provision of electric power. Furthermore, concern about future power supplies suggests that deregulation of power production may be of particular importance. Although deregulation may yield some unfavorable effects on the distribution of income among consumers and classes of users and across regions, the evidence suggests that movements in the direction of market pricing would foster efficiency gains in the supply of electricity.

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1. Quoted in Asghar Zardkoohi, "Competition in the Production of Electricity," in *Electric Power: Deregulation and the Public Interest*, ed. John C. Moorhouse (San Francisco, Calif.: Pacific Research Institute for Public Policy, 1986), 85.

2. The issues of environmental and safety regulation of electric utilities are not discussed in this article. Although they are important parts of the regulatory environment confronting utilities—particularly in the case of nuclear power plants and sulfur emissions by coal-fired plants—little is lost by treating the issues independently. Deregulation would not obviate the need for continued safety and environmental regulation. The interested reader is referred to *Electric Power*, Part II, for articles and references in this area.

3. For a more detailed discussion of the problems associated with regulating electric utilities, see Alfred E. Kahn, *The Economics of Regulation: Principles and Institutions*, 2 vols. (New York: John Wiley & Sons, 1970), 1:20-57; and Claire Holton Hammond, "An Overview of Electric Utility Regulation," in *Electric Power*, 31-61.

4. Recent decisions have often disallowed the inclusion of construction in the rate base. In the case of the Washington Public Power Supply System, for example, lower than expected demand growth forced the cancellation of several nuclear plants under construction. The utilities that had agreed to purchase the power refused to pay their debt obligation and were supported by court decisions. See John T. Wenders, "Efficiency, Subsidy, and Cross-Subsidy in Electric Utility Pricing," in *Electric Power*, 307-36.

5. Evidence that rates of return have been suppressed by public utility commissions below the level necessary to attract sufficient investment in the 1970s is presented in Peter Navarro, "The Performance of Utility Commissions," in *Electric Power*, 337-58.

6. See William T. Gormley, Jr., *The Politics of Public Utility Regulation* (Pittsburgh: University of Pittsburgh Press, 1983).

7. See George J. Stigler, "The Theory of Economic Regulation," *Bell Journal of Economics and Management Science* 2 (Spring 1971): 3-21.

8. See Richard A. Posner, "Theories of Economic Regulation," *Bell Journal of Economics and Management Science* 5 (Autumn 1974): 335-58.

9. Equity considerations enter the rate structure through lifeline rates, energy audits (to assist residential consumers in reducing power usage), and subsidized power from federal power projects. For a discussion, see Craig J. Bolton and Roger E. Meiners, "The Politicization of the Electric Utility Industry," in *Electric Power*, 249-77.

10. See Gormley, *The Politics of Public Utility Regulation.*

11. Wenders, "Efficiency, Subsidy, and Cross-Subsidy in Electric Utility Pricing."

12. Empirical studies of the welfare implications of time-of-day pricing suggest that such pricing is not generally cost-effective for small users. Application of peak-load pricing to large users can be cost-effective, although the gains are not major. Interestingly, peak-load pricing can yield some measurable gains for small users that have intensive air-conditioning needs. Apparently, because a house can actually "store" cold air, it is possible to change use patterns to avoid peak periods, with little behavioral change required. For a review of the econometric literature, see Dennis J. Aigner, "The Welfare Econometrics of Peak-Load Pricing for Electricity: Editor's Introduction," *Journal of Econometrics* 26 (September/October 1984, Annals Issue): 1-15.

13. The model of a regulated natural monopoly's tendency toward excess investment in capital is found in Harvey Averch and Leland L. Johnson, "Behavior of the Firm Under Regulatory Constraint," *American Economic Review* 52 (December 1962): 1052-69.

14. See E. C. Pasour, Jr., "Information, Incentives, and Regulation," in *Electric Power*, 359-79.

15. See Harold Demsetz, "Why Regulate Utilities?" *Journal of Law and Economics* 11 (April 1968): 55-65.

16. See Oliver E. Williamson, "Transaction-Cost Economics: The Governance of Contractual Relations," *Journal of Law and Economics* 22 (Oc-

tober 1979): 233-61; Elizabeth E. Bailey, "Contestability and the Design of Regulatory and Antitrust Policy," *American Economic Review* 71 (May 1981, Papers and Proceedings, 1980): 178-83; and William J. Baumol, John C. Panzar, and Robert D. Willig, *Contestable Markets and the Theory of Industry Structure* (New York: Harcourt Brace Jovanovich, 1982).

17. Empirical evidence suggests that electricity demand has become more elastic in recent years. Industrial demand has become especially sensitive to price movements, but some increases in residential price elasticities and the speed of adjusting to price movements have also been isolated. See Ronald J. Sutherland, "Instability of Electricity Demand Functions in the Post-Oil-Embargo Period," *Energy Economics* 5 (October 1983): 267-72; and Roger H. Dunstan and Ronald H. Schmidt, "Structural Changes in Residential Energy Demand," *Energy Economics*, forthcoming 1988.

18. See William J. Baumol, "On the Proper Cost Tests for Natural Monopoly in a Multiproduct Industry," *American Economic Review* 67 (December 1977): 809-22.

19. Utilities generating power typically minimize costs by using power plants sequentially. Large-scale hydroelectric, nuclear, or coal generating facilities provide the bulk of the "baseline" load and operate continuously. Older, less efficient plants and plants using oil or natural gas are then used during peak periods. The oil- and gas-fired generators also have the advantage of being able to bring electric power on line in considerably less time than the other facilities. For a discussion of the optimal structure of a multiproduct firm, see Baumol, Panzar, and Willig, *Contestable Markets and the Theory of Industry Structure*.

20. Summaries of empirical studies about production economies of scale can be found in Thomas G. Cowing and V. Kerry Smith, "The Estimation of a Production Technology: A Survey of Econometric Analyses of Steam-Electric Generation," *Land Economics* 54 (May 1978): 156-86, and in Asghar Zardkoohi, "Competition in the Production of Electricity," in *Electric Power*, 63-95. Two of the more influential studies are by Laurits R. Christensen and William H. Greene, "Economies of Scale in U.S. Electric Power Generation," *Journal of Political Economy* 84 (August 1976, pt. 1): 655-76, and by David A. Huettner and John H. Landon, "Electric Utilities: Scale Economies and Diseconomies," *Southern Economic Journal* 44 (April 1978): 883-912. Huettner and Landon report minimum average cost achieved at a scale of 1,600 megawatts, based on a sample of firms with capacity ranging from 100 megawatts to 9,000 megawatts.

21. For a critique of the empirical estimates and a discussion of data limitations, see Paul L. Joskow and Richard Schmalensee, *Markets for Power: An Analysis of Electric Utility Deregulation* (Cambridge: MIT Press, 1983), 45-58; and Zardkoohi, "Competition in the Production of Electricity," 71-77.

22. See Huettner and Landon, "Electric Utilities."

23. See Leonard W. Weiss, "Antitrust in the Electric Power Industry," in *Promoting Competition in Regulated Markets*, ed. Almarin Phillips (Washington, D.C.: Brookings Institution, 1975), 135-73; and Huettner and Landon, "Electric Utilities."

24. Increases in output to existing customers are found to yield economies of scale, while increases in output to new customers have virtually no decreases in average ray costs. See Mark J. Roberts, "Economies of Density and Size in the Production and Delivery of Electric Power," *Land Economics* 62 (November 1986): 378-87.

25. See Taylor Moore, "Network Access and the Future of Power Transmission," *EPRI Journal* 11 (April/May 1986): 4-13.

26. See John W. Wilson and Otis Port, "The New World of Superconductivity," *Business Week*, 6 April 1987, 98-100.

27. See Joskow and Schmalensee, *Markets for Power*, 62-77.

28. Weiss, "Antitrust in the Electric Power Industry," 136.

29. Ibid., 159.

30. Large cost savings from coordination are not readily evident from empirical research, although commonly owned facilities seem to have an advantage relative to independently owned facilities. This relationship would argue for allowing small firms to merge because they could realize some cost savings, but large firms have little to gain except possible monopoly power. See Laurits R. Christensen and William H. Greene, "An Econometric Assessment of Cost Savings from Coordination in U.S. Electric Power Generation," *Land Economics* 54 (May 1978): 139-55.

31. *New Electric Power Technologies: Problems and Prospects for the 1990s* (Washington, D.C.: U.S. Congress, Office of Technology Assessment, OTA-E-246, July 1985), 1.

32. Efficient pricing for multiple consumers is based on "Ramsey pricing," where relative prices for the customers are inversely related to the customers' elasticity of demand. Simply put, those most able to adjust by avoiding the commodity are given the least incentive to adjust (by keeping their prices low), and those least able to adjust are given the highest prices.

33. See Ronald H. Schmidt and Jeffery W. Gunther, "Distributional Implications of Reducing Interstate Energy Price Differences," Federal Reserve Bank of Dallas *Economic Review*, November 1986, 1-15.

Agricultural Lending: Bank Closures and Branch Banking

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Bank closures are no longer the infrequent occurrences they once were. Many of the banks that have failed in the 1980s have been agricultural banks. Overall, the closure rate of agricultural banks in recent years has been significantly higher than for nonagricultural banks. Although the downturn in agriculture during the 1980s is the likely culprit in most agricultural bank closures, restrictions on branch banking have also played a role.

This article first looks at some of the conceptual issues involved in singling out so-called agricultural banks from other banks. Then it examines the bank closure data to see whether, given the definition of agricultural banks, they have closed at a faster rate than other banks. The article analyzes whether agricultural lending under different state branch-banking regulations influenced bank closures. The conclusions reached are that branching does affect the probability of bank closure and that at the margin in states where branching is restricted, agricultural loans contribute no more to the probability of closure than do some other types of loans.

What are agricultural banks?

As a conceptual matter, agricultural banks should be banks for which loans to farmers and ranchers are an indispensable part of business. Most definitions of "agricultural bank" are based on the percentage of agricultural loans (by volume) in a bank's portfolio. While other definitions of agricultural bank could be devised, two definitions are currently recognized: a fixed-percentage standard, where an agricultural bank is a bank with 25 percent of its loans out to agriculture, or a variable-percentage standard, where an agricultural bank is a bank with an above-average ratio of agricultural loans to total loans. This ratio changes every quarter and was about 15.7 percent in December 1986.

The 25-percent figure is widely used in newspaper and magazine articles concerning commercial bank lending to agriculture. As shown in Chart 1, as late as 1970, the two definitions would have described the same banks because the average of the ratios of agricultural loans to total loans at commercial banks was about 25 percent.[1] The chart also shows that the ratio has declined steadily since 1966 and displays no sign of leveling off. Despite almost a tripling of farm debt at banks in the 1970s, more than 1,000 banks dropped out of the 25-percent definition of agricultural bank during that time.

In 1984 the Board of Governors of the Federal Reserve System, in revising Regulation A, used a variable-percentage definition of agricultural bank: a bank whose ratio of agricultural loans to total loans exceeds the average of such ratios for all banks. This new definition strengthens the link

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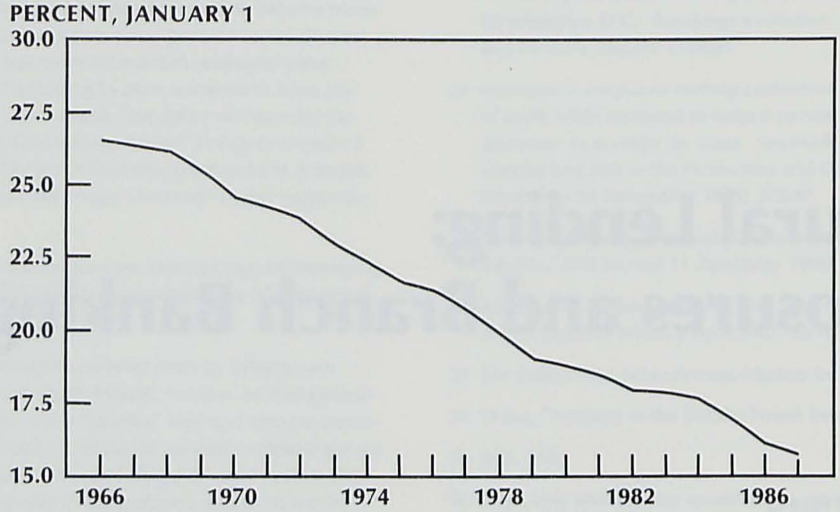
Chart 1
Average of the Ratios of Agricultural Loans to Total Loans at U.S. Commercial Banks



SOURCE OF PRIMARY DATA: Board of Governors, Federal Reserve System.

between small banks and agricultural lending by restoring about 1,000 banks to the ranks of "agricultural banks."

Thus, the choice between these two definitions turns on whether it is more important for the purpose at hand to follow a group of banks over time that is declining in numbers and lending importance (the fixed-percentage, 25-percent rule) or to try to maintain agricultural bank numbers with a variable-percentage standard (the above-average rule). The standard selected here uses elements of both: an agricultural bank is a bank with greater than 16.1 percent of its loan portfolio in agriculture, which was determined by using the above-average rule as of December 31, 1985.

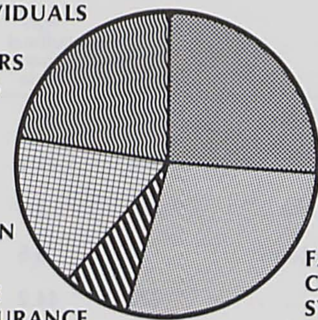
Since one of the quantitative parts of this article examines the probability of bank closures in the nine quarters beginning January 1, 1985, a rule was needed to determine which banks were agricultural banks as of the date of the balance sheet determinants of closure, which came from the December 31, 1984, Reports of Condition and Income. Except for historical interest, there seems to be little point in sticking with the 25-percent rule. The 16.1-percent standard is roughly at the midpoint for the time period covered by the probability-of-closure analysis here. In the interest of consistency, this standard was also used in the sections that examine bank closure rates from 1981 through the first quarter of 1987.

Agricultural banks just one source of farm credit

Conditions at agricultural banks do not necessarily reflect conditions for other lenders to agriculture. Commercial banks and the Farm Credit System are the preeminent institutional lenders to agriculture. Chart 2 shows the division among creditors of $169 billion in agricultural debt as of December 31, 1986, excluding Commodity Credit Corporation (CCC) loans.[2] Commercial banks had $44.1 billion in agricultural loans, just 26 percent of the total.

Agricultural banks are, for the most part, small banks. Larger banks ($100 million or more in assets) have almost 40 percent of the agricultural loans made by banks, but very few are classified as agricultural banks. The importance to commercial banks of lending to farmers varies with the size of the bank. Table 1 shows that the average ratio of agricultural loans to total loans declines sharply as banks become larger. As a group, the smallest banks hold the highest average proportion of farm loans—more than 25 percent. This ratio diminishes steadily out to the very largest banks. At these banks with $300 million or more in assets, farm loans average well below 2 percent of the loan portfolio.

Chart 2
Sources of Farm Credit, Excluding Commodity Credit Corporation



NOTE: Farm credit extended, excluding CCC loans, was $169 billion as of December 31, 1986.
SOURCE OF PRIMARY DATA: Board of Governors, Federal Reserve System.

By reason of the definition of an agricultural bank, most agricultural banks are found in states that place numerical or geographical restrictions on branch banking. Table 2 shows U.S. commercial banks sorted by restrictions on branching (as of September 1984). At the end of 1985, there were 4,576 agricultural banks in restricted-branching states (states with limited branching or unit banking) and only 272 in statewide-branching states.

Given the different regulatory environment in statewide-branching states, it seems plausible to expect a different historical development pattern than that in restricted-branching states. Small banks in a branching environment

Table 1
BANKS AND AGRICULTURAL LOANS, DECEMBER 31, 1985

		Bank asset size (Millions of dollars)					
		Less than $25	$25 to $50	$50 to $75	$75 to $100	$100 to $300	$300 and over
	Total[1]	Percent of total					
Banks	14,346	36.3	26.0	13.0	6.6	12.4	5.7
Assets	$2,716.9	2.8	4.9	4.2	3.0	10.5	74.6
Agricultural loans	$46.9	18.4	22.8	13.2	6.7	13.3	25.7
Average agricultural loan ratio[2]	16.1	25.3	16.9	11.1	7.7	4.4	1.4

1. Dollar amounts in billions.
2. Unweighted average for all banks.
SOURCE: Board of Governors, Federal Reserve System.

Table 2
BRANCHING AND AGRICULTURAL LENDING, DECEMBER 31, 1985

	Number	Agri-cultural loan ratio	Percent of total agri-cultural loans	Average bank asset size (Millions of dollars)
Restricted-branching states . . .	27	18.1	76.2	$107.4
Agricultural banks	4,576	41.1	53.1	30.9
Nonagricultural banks	7,274	3.6	23.1	156.0
Statewide-branching states[1] . . .	24	6.6	23.8	578.5
Agricultural banks	272	44.2	4.9	45.1
Nonagricultural banks	2,224	1.9	18.9	643.7

1. Includes the District of Columbia.
SOURCE OF PRIMARY DATA: Board of Governors, Federal Reserve System.

that are successful in agriculture will grow, branch, and diversify. For example, by the end of 1986, California had three banks that, together, had more than 2,300 branches and more than $2 billion in farm loans. But these farm loans were less than 3 percent of their loan portfolio. By definition, none of these banks are agricultural banks, but they are certainly representative of bank lending to agriculture in California. Nationally, agricultural banks in branching states averaged fewer than two branches per bank. Thus, agricultural banks in statewide-branching states are mostly a few small banks that are geographically isolated or service market niches.

To sum up, statements about agricultural banks will largely refer to small banks in restricted-branching states and only coincidentally to other lenders to agriculture. Agricultural banks, however, are very important lenders to farmers and ranchers, and some short-run disruptions in agricultural credit would likely occur if many of them closed in a short period of time.

Fewer banks close than fail

"Bank closure" is a more restrictive term than "bank failure."[3] The Federal Deposit Insurance Corporation (FDIC) has many methods of dealing with a bank once it ascertains that the bank is insolvent: it can close the bank and pay off the insured depositors and sometimes others; it can, in effect, nationalize the bank; it can let another bank buy the failing bank; or it can supply the failing bank with funds to continue to operate and, presumably, return to good health.

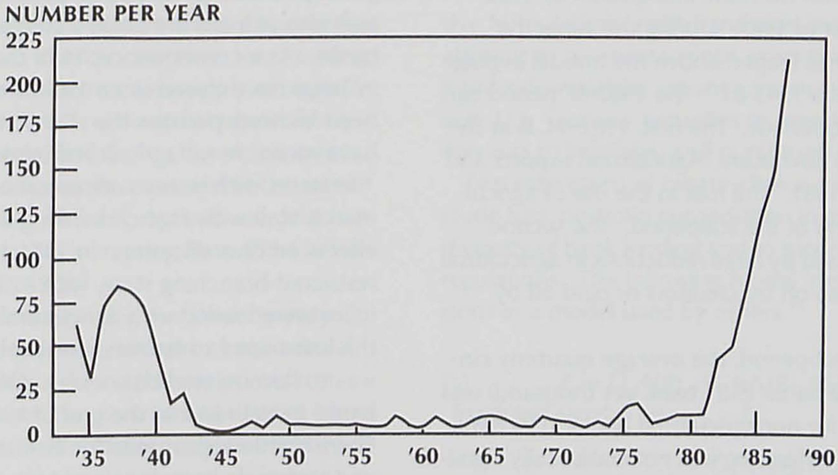
Because of the role of regulators in determining the continued operation of banks, "bank failure" is a much more nebulous term than, say, "business failure." For the purposes of this study, "bank closure," which is a subset of "bank failure," will be used. Bank closure is defined as describing banks that become insolvent and either are closed by the FDIC or are sold to other banks and reopened. The broader definition of failure would include banks that stay open. Some examples would be banks that are insolvent but not closed by regulators or banks that are supplied with funds by the FDIC to stave off economic collapse.

Closure seems the appropriate definition for this study. When a bank that lends to farmers and ranchers is closed, the lines of credit either are terminated when the bank is liquidated or face possible interruption when the bank is sold.

Are agricultural banks closing faster than other banks?

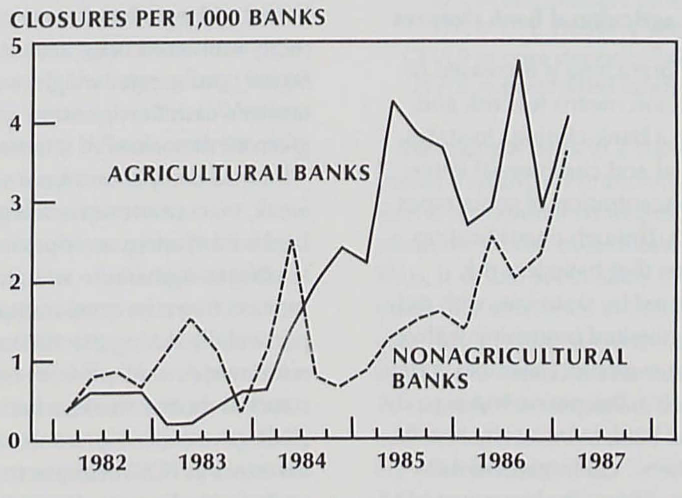
During the 1980s the annual number of bank closures rapidly increased over what it had been between World War II and 1980. Chart 3 shows the number of yearly bank closures from 1934—or after the worst of the Great Depression (4,000 banks closed in 1933)—to 1987 (projected). After the lingering effects of the Great Depression were reversed by the beginning of World War II, bank closures settled into the

Chart 3
Bank Closures Since 1934



NOTE: The total of 212 bank closures projected for 1987 is based on 53 closures in the first quarter.
SOURCE OF PRIMARY DATA: Federal Deposit Insurance Corporation.

Chart 4
Quarterly Bank Closure Rates



SOURCES OF PRIMARY DATA: Board of Governors, Federal Reserve System.
Federal Deposit Insurance Corporation.

single-digit range for most years until the 1980s. Then there was a dramatic escalation in closures.

Chart 4 shows the quarterly closure rates of agricultural and nonagricultural banks from the first quarter of 1982 through the first quarter of 1987. During this time, the numbers of bank closures leaped above the annual average of 5.7 banks for the years 1943-81.[4] The 1982-87 period can be divided into two subperiods. The first, 1982-84, is at the start of the agricultural downturn. Agricultural exports and land values peaked in 1981. The halt in the rise of agricultural debt marks the end of the subperiod. The second subperiod is characterized by large reductions in agricultural debt as loans are written off by creditors or paid off by farmers.

During the 1982-84 subperiod, the average quarterly closure rate of agricultural banks (0.81 bank per thousand) was actually less than that for nonagricultural banks (0.96 bank per thousand), but the difference was not statistically significant. For the 1985-87 subperiod, the difference in quarterly closure rates was strongly significant, with agricultural banks having a much higher rate (3.44 banks per thousand) than nonagricultural banks (1.89 banks per thousand). Tests covering the whole 1982-87 period show the closure rates to be statistically different: 1.95 banks per thousand for agricultural banks; 1.35 banks per thousand for nonagricultural banks. Still, for three of the last four quarters, including the first quarter of 1987, the agricultural bank closure rate was quite close to the nonagricultural bank rate. Unfortunately, the comparison reflects the higher number of nonagricultural bank closures rather than a lower number of agricultural bank closures.[5]

Branch banking may influence agricultural bank closures

One of the chief advantages of branching is increased diversification. Greater diversification means less risk and, hence, lowers the probability of a bank closing. In states with a broad mixture of industrial and commercial enterprises but with geographical concentration of some types of industry, statewide branching, through diversification, can result in bank loan portfolios that have less risk. Branching within states is governed by state law, with only about half the states allowing unlimited branching within their respective boundaries. For example, California is the most important agricultural state in the nation but is so diverse that only 2.6 percent of all bank loans at the end of 1984 were to farmers and ranchers. California had 447 banks and allows statewide branching. There were only 13 agricultural banks in the state, one of which has closed since 1984.

Texas, also an important agricultural state, is almost equally as diverse as California. In December 1984, only 3.3 percent of the loans at the 1,854 Texas banks were to farmers and ranchers. Texas is a restricted-branching state, and agricultural loans are heavily concentrated in some of the banks. As a consequence, 15 of the 335 agricultural banks in Texas have closed since 1984. If unlimited branching had been allowed, perhaps the state's natural diversity would have meant fewer agricultural bank closures.

In states with heavy concentration in a few lines of commerce, statewide branch banking would have only limited effects on diversification. In 1984, Nebraska was also a restricted-branching state, with 473 banks. Their loan portfolios were loaded with agricultural loans: 37.9 percent of the loans were to farmers, and probably half again as much was to farm-related businesses. Of the 413 agricultural banks in Nebraska at the end of 1984, 19 have since closed. There is little opportunity for diversification within Nebraska, and statewide branching would not have made for much more diversified banks.

Mispricing agricultural loans accentuates the lack of diversification

The closure of many agricultural banks in restricted-branching states during the 1980s might have been avoided if these banks had been able to price agricultural loans correctly for default risk and for the additional risks inherent in less diversification. If the risks involved were correctly estimated, then loans would have been priced to provide larger loan-loss reserves and still yield a profit. Pricing loans in a broad sense would cover the terms attached to the loans, so some loan applicants would be "priced" out of the market because they failed to meet all the conditions. With correctly estimated risks, loan standards would have been higher, and greater weight would have been attached to a farmer's cash flow position and less weight would have been given to the values of a farmer's assets.

Intense competition from subsidized nonbank lenders and weak, inaccurate, or nonexistent market signals prevented banks from adequately pricing their agricultural loans. Bank lending to agriculture was sorely pressed by intense competition from the cooperative Farm Credit System (FCS), particularly during the 1970s and early 1980s.[6] The FCS is a nationwide nondepository organization, raising money in national money markets with securities that carry an implicit government guarantee. The implicit guarantee allows investors in FCS securities to be unconcerned about the undiversified nature of FCS lending. Loan interest rates based on the cost of government-guaranteed securities are not likely to reflect fully the risks involved, regardless of the outlook for agriculture. Undiversified banks, when faced with FCS competition, would be less able to charge a risk premium on loans.

What market signals were all lenders to agriculture getting during the 1970s? Generally, the picture was a rosy one that was expected to continue. The concern then was meeting the growing export demand for, not oversupply of, agricultural commodities. In 1973, U.S. agricultural exports doubled in nominal-dollar terms, and during the export boom of 1973-81, U.S. agricultural exports increased at the rate of $2.1 billion per year (in 1985 dollars).[7] Agricultural debt (excluding CCC loans) kept pace, increasing from $58.4 billion in 1973 to $181.0 billion in 1981.[8]

The impairment of market signaling mechanisms may have helped to mask the eventual riskiness of agricultural lending by commercial banks during this period of farm prosperity. If there had been no government deposit insurance, depositors at banks lending to agriculture might have insisted on more conservative banking practices in loan terms, pricing, and diversity. But with the insurance, depositors could afford to be oblivious of the banks' lending activities. Because the stocks of many agricultural banks were not traded publicly, there was little possibility of public signals from stockholders to bank management about concerns that agricultural loans were correctly priced for risk.

The branching and loan pricing issues are intertwined. Branching should lower the probability of bank closure through diversification, which would be especially important given the effects on loan pricing of FCS competition and misleading expectations about agricultural prosperity.

Modeling bank closures

At least two empirical questions have been raised so far. First, in restricted-branching states, is agricultural lending a dominant factor in closure, meaning that agricultural banks are at particular risk of closure? Second, has the diversification afforded by branching made any difference in the risk of bank closure? Probability-of-closure models are one convenient method of studying these questions.

Probability-of-closure models can be roughly divided into two types: predictive and descriptive. Predictive models include such variables as delinquent loans as a percentage of capital, net charge-offs as a percentage of total loans, net income as a percentage of assets, and the like. A predictive model may tell little about how a bank came to close but, rather, that banks with similar performance figures are likely to close. A descriptive model attempts to look at the strategies behind the performance figures by focusing on balance sheet variables.[9] Since the interest of this study is more on strategy, the model chosen is a descriptive one.

Binary-choice models, such as logit or probit models, can be used to measure the effects of different factors on the probability of a bank closing. The binary dependent variable indicates whether or not the bank closed. In descriptive formulations, right-hand-side (explanatory) variables attempt to measure various aspects of risk. Typical right-hand-side variables are such financial ratios as loans to assets, U.S. Treasury securities to assets, capital to assets, core deposits to liabilities, and purchased funds to liabilities.

Two extensions of binary-choice models would be to include loan portfolio composition in an effort to measure the diversity of bank lending and to incorporate branch-banking regulations. The following model incorporates these extensions in a model used by others:[10]

(1)
$$P_i = f\,[\underset{-}{A(B)},\ \underset{?}{AG/LN(B)},\ \underset{?}{RE/LN(B)},\ \underset{?}{CI/LN(B)},\ \underset{?}{CO/LN(B)},\ \underset{-}{C/A(B)},\ \underset{+}{L/A(B)},\ \underset{-}{T/A(B)},\ \underset{-}{CD/LB(B)},\ \underset{+}{PF/LB(B)}],$$

Expected signs: shown beneath each variable.

where

P_i = the probability of closure of bank i
(B) = variable setting influenced by presence or absence of branching restrictions
A = assets
AG/LN = agricultural loans-total loans ratio
RE/LN = nonfarm real estate loans-total loans ratio
CI/LN = commercial and industrial loans-total loans ratio
CO/LN = consumer loans-total loans ratio
C/A = capital-assets ratio
L/A = loans-assets ratio
T/A = U.S. Treasury securities-assets ratio
CD/LB = core deposits-liabilities ratio
PF/LB = purchased funds-liabilities ratio.

Managing a bank in a statewide-branching environment versus a restricted-branching environment may call for different operational strategies. As mentioned before, diversification should be a notable advantage of branching. Thus, it would seem likely that if branching regulations made any difference in individual-bank behavior, the influence would show up in the coefficients on asset size, loan shares, the capital-assets ratio, and the remaining variables. To capture that response, the model has the coefficient of each independent variable being influenced by the branching environment.

The independent variables were chosen because they are, for the most part, under management control. Assets are included to control for size. The FDIC seems to be willing to close smaller banks while maintaining a policy that some very large banks will not be closed.

The loan share variables are included as a measure of diversity. Banks will diversify their loan portfolio to yield some acceptable combination of risk and return. Some of the risks that can be offset, at least partially, by diversification are changes in the economic environment induced by the business cycle. Unforeseen non-business-cycle shocks to a particular sector could also be offset, to some degree, by diversification. If banks' loan portfolio diversification was completely successful, then none of the loan category variables would likely be significant in determining the probability of closure.

If, however, the pronounced agricultural downturn of the 1980s overpowers banks' diversification, then the expected sign on the agricultural loan share coefficient would be positive and significant for banks in both restricted- and statewide-branching states. If the coefficient is significant for the restricted-branching group and not for the statewide-branching group, then a likely explanation is overconcentration in the restricted-branching group. For the remaining loan category variables, coefficient significance would also indicate problems of overconcentration. Further, it could be that overconcentration in some loan types has actually helped banks weather the economic turmoil of the 1980s. In that case, the coefficients would be negative and significant. To prevent perfect collinearity among the loan share variables, the category "all other loans" was dropped.

Turning to the expected influence of the other variables, the capital-assets ratio is one measure of bank conservatism: the higher the ratio, the lower is the probability of closure. This ratio is not an unconstrained management decision, as its lower limits are set by regulators.

The loans-assets ratio is a measure of a bank's riskiest asset: the greater the proportion of loans in a portfolio, the greater is the risk of bank closure. In contrast, the greater the proportion of Treasury securities in a portfolio, the lower is the probability of bank closure.

Two measures of bank dependence on volatile funding sources are included: the ratio of core deposits to liabilities and the ratio of purchased funds to liabilities. Core deposits are thought to be less prone to flight under adverse conditions, whereas the availability of purchased funds may be severely restricted if confidence in the bank wanes. Thus, the higher the proportion of core deposits to total liabilities, the lower is the probability of closure of the bank. The reverse is hypothesized to be true for purchased funds.

Bank closure models: estimation and data

The estimated model flows directly from the theoretical construct.

$$\begin{aligned}(2)\quad CLOSE = {} & \beta_0 + \beta_1\, BRANCH \\ & + \beta_2\, A + \beta_3\, BRANCH\ \ A \\ & + \beta_4\, AG/LN + \beta_5\, BRANCH\ \ AG/LN \\ & + \beta_6\, RE/LN + \beta_7\, BRANCH\ \ RE/LN \\ & + \beta_8\, CI/LN + \beta_9\, BRANCH\ \ CI/LN \\ & + \beta_{10}\, CO/LN + \beta_{11}\, BRANCH\ \ CO/LN \\ & + \beta_{12}\, C/A + \beta_{13}\, BRANCH\ \ C/A \\ & + \beta_{14}\, L/A + \beta_{15}\, BRANCH\ \ L/A \\ & + \beta_{16}\, T/A + \beta_{17}\, BRANCH\ \ T/A \\ & + \beta_{18}\, CD/LB + \beta_{19}\, BRANCH\ \ CD/LB \\ & + \beta_{20}\, PF/LB + \beta_{21}\, BRANCH\ \ PF/LB,\end{aligned}$$

where

$CLOSE = 1$ if the bank was liquidated or was purchased by another bank; 0 otherwise.
$BRANCH = 1$ if the bank is in a statewide-branching state.
$= 0$ if the bank is in a restricted-branching state.

This formulation allows for intercept and slope changes because of branching. If the coefficients on any of the branching interaction terms are statistically significant, then those model variable coefficients are statistically different for banks in statewide-branching states compared with banks in restricted-branching states. Equation 2 generates two sets of results:

For banks in statewide-branching states ($BRANCH = 1$),

$$\begin{aligned}(3)\quad CLOSE = {} & (\beta_0 + \beta_1) + (\beta_2 + \beta_3)A \\ & + (\beta_4 + \beta_5)AG/LN + (\beta_6 + \beta_7)RE/LN \\ & + (\beta_8 + \beta_9)CI/LN + (\beta_{10} + \beta_{11})CO/LN \\ & + (\beta_{12} + \beta_{13})C/A + (\beta_{14} + \beta_{15})L/A \\ & + (\beta_{16} + \beta_{17})T/A + (\beta_{18} + \beta_{19})CD/LB \\ & + (\beta_{20} + \beta_{21})PF/LB.\end{aligned}$$

For banks in restricted-branching states ($BRANCH = 0$),

$$\begin{aligned}(4)\quad CLOSE = {} & \beta_0 + \beta_2\, A + \beta_4\, AG/LN + \beta_6\, RE/LN \\ & + \beta_8\, CI/LN + \beta_{10}\, CO/LN + \beta_{12}\, C/A \\ & + \beta_{14}\, L/A + \beta_{16}\, T/A + \beta_{18}\, CD/LB \\ & + \beta_{20}\, PF/LB.\end{aligned}$$

A likelihood-ratio statistic can be used to test the validity of pooling banks in statewide-branching states with those from restricted-branching states. Such pooling restricts the coefficients on the independent variables to be the same for banks in statewide-branching and restricted-branching states. If the likelihood-ratio test rejects the restriction, then

Table 3

BANK NUMBERS AND MEANS OF VARIABLES, DECEMBER 31, 1984, BY BRANCHING STATUS AND BY BANK DEFINITION

		Branching status		Agri-cultural banks	Nonagri-cultural banks
	Total[1]	Restricted	Statewide		
Number of banks	14,470	11,938	2,532	5,132	9,338
Closed banks[2]	323	282	41	167	156
		Means of variables			
As percent of total loans					
Agricultural loans	.169	.190	.071	.418	.032
Real estate loans	.309	.303	.338	.199	.370
Commercial and industrial loans	.237	.231	.268	.175	.271
Consumer loans	.233	.227	.262	.173	.266
Assets[3]	$172.7	$99.4	$518.3	$31.8	$250.2
As percent of assets					
Capital	.098	.096	.110	.100	.097
Loans	.601	.596	.625	.566	.620
Treasuries	.173	.180	.137	.223	.145
As percent of liabilities					
Core deposits	.381	.364	.461	.310	.421
Purchased funds	.139	.134	.162	.087	.168

1. Some banks were not included because of incomplete data.
2. Banks closed from January 1, 1985, through April 23, 1987, that had complete data for all regression variables.
3. In millions of dollars.

SOURCES OF PRIMARY DATA: Board of Governors, Federal Reserve System. Federal Deposit Insurance Corporation.

it is evident that the coefficients, as a group, are significantly different for banks in statewide-branching states as opposed to restricted-branching states.

A probit model was used, and the balance sheet data came from Reports of Condition and Income for December 31, 1984. Of the banks covered in the reports, those closing in the next nine quarters were given a value of 1; all others were given a value of 0. This is a departure from the usual pooling practice of combining yearly observations for all banks. The advantage of choosing a time period greater than a year is that banks closing in the second year of the pooled sample are not included as unclosed banks in the first year. That is, under the procedure used here, banks are never duplicated. Table 3 gives the number of banks, by several categories, and the means of the regression variables. The means of the variables for agricultural and non-agricultural banks are included for reader interest, but these variables are not used in the regressions.

Results and conclusions

The probit estimates presented in Table 4 seem to show four main results. First, banks in restricted-branching states are generally at greater risk of closure because of less diversified loan portfolios than are banks in statewide-branching states. Second, in restricted-branching states, the probability of closure of banks seems equally influenced by the share of loans in the commercial and industrial category and the share in the agricultural category. Third, several of the financial ratio coefficients are statistically different between restricted-branching states and statewide-branching states. Fourth, conservative banking practices, such as maintaining a relatively high ratio of capital to assets and a low ratio of loans to assets, are good bulwarks against bank closure.

Agricultural lending in restricted-branching states does appear to increase the risk of bank closure. The coefficient on agricultural loan share was positive and significant in restricted-branching states but insignificant, with a value

Table 4
PROBIT ESTIMATES OF BANK CLOSURE PROBABILITIES

RESTRICTED BRANCHING			STATEWIDE BRANCHING			
Variable	Coefficient	Derivative	Interaction variable	Coefficient	Sum coefficient[1]	Derivative
Intercept	-3.68*	-.002	*BRANCH*[2]	3.50*	-.18	-.07
	(-6.69)			(3.12)	(-.18)	
As percent of total loans			*BRANCH* × explanatory variable			
Agricultural loans	1.66*	.63	Agricultural loans	-1.73**	-.07	-.03
	(3.47)			(-1.72)	(-.08)	
Real estate loans	-.32	-.13	Real estate loans	-.49	-.82	-.31
	(-.63)			(-.52)	(-1.02)	
Commercial and industrial loans	1.72*	.64	Commercial and industrial loans	-2.31*	-.58	-.23
	(3.54)			(-2.49)	(-.74)	
Consumer loans	.23	.09	Consumer loans	-1.59**	-1.35**	-.51
	(.46)			(-1.68)	(-1.69)	
Assets	-1.00*	-.39	Assets	-1.23	-2.23*	-.45
	(-3.49)			(-1.48)	(-2.78)	
Capital/assets	-5.43*	-1.89	Capital/assets	-13.02*	-18.44*	-1.27
	(-6.30)			(-3.96)	(-5.80)	
Loans/assets	2.81*	.27	Loans/assets	-1.73*	1.08**	.35
	(7.66)			(-2.33)	(1.66)	
Treasuries/assets	-1.10*	-.43	Treasuries/assets	-.56	-1.66	-.65
	(-2.60)			(-.50)	(-1.61)	
Core deposits/liabilities	-1.52*	-.51	Core deposits/liabilities	.95	-.58	-.22
	(-4.89)			(1.24)	(-.83)	
Purchased funds/liabilities	1.71*	.66	Purchased funds/liabilities	-.37	1.34*	.52
	(6.76)			(-.58)	(2.28)	
-2 × likelihood ratio	561.03		-2 × likelihood ratio		94.06	
Pseudo-R^2	.22		Pseudo-R^2		.22	

1. Sum of restricted-branching coefficient and interaction-variable coefficient. Components may not add to sum because of rounding.
2. *BRANCH* is a binary variable: 1 = statewide branching; 0 = otherwise.
* Significant at the 5-percent level.
** Significant at the 10-percent level.
NOTE: Pseudo-R^2 is discussed in George G. Judge, R. Carter Hill, William Griffiths, Helmut Lutkepohl, and Tsoung-Chao Lee, *Introduction to the Theory and Practice of Econometrics* (New York: John Wiley & Sons, 1982), 525.
Figures in parentheses are *t* statistics.

close to zero, in statewide-branching states. This result would accord with the interpretation of overconcentration in bank loan portfolios in restricted-branching states.

Agricultural banks are hardly the only banks exclusively at risk in restricted-branching states. The results show that banks in restricted-branching states were overly concentrated in both agricultural loans and commercial and industrial loans, leading to increased likelihood of closure.[11] Coefficients on both variables were positive and significant. For the statewide-branching states, neither coefficient was significant.

The effect of the agricultural loan share in restricted-branching states does not seem to be the dominant influence on closure. Notice that the effect of a unit change in the commercial and industrial loan ratio at the mean, as shown by the derivative (0.64), is about the same size as the derivative (0.63) for the agricultural loan ratio. The indication seems to be that for marginal changes for the average bank, agricultural loans do not contribute any more to the probability of closure than do commercial and industrial loans.

Branching seems to influence banks' strategy for avoiding closure.[12] For branching to make a difference, the coefficients on the model variables in the restricted case must be statistically different, as a group, from those in the statewide-branching case. A likelihood-ratio test confirms that the two coefficient groups are statistically different at the 5-percent level of significance.

Looking at the individual coefficients, the effect of branching on loan share coefficients has already been discussed. For the remaining variables, the results show that at the 5-percent level, only the capital-assets ratio is statistically significant in the statewide-branching case while at the same time having a coefficient value significantly different from the restricted-branching case. The derivatives indicate that for a unit change in the capital-assets ratio at the mean, the influence on the probability of closure is almost 50 percent greater in restricted-branching states than in statewide-branching states. Although part of the difference may be accounted for by the larger mean value for the capital-assets ratio in statewide-branching states, an interpretation for the remaining difference is that with less diversification in restricted-branching states, capital reserves become more important in warding off closure.

At the 10-percent level, the statewide-branching coefficient on the loans-assets ratio is statistically different from the restricted-branching coefficient, and it is also significant in influencing the probability of closure in the statewide-branching case. Given the higher mean level of loans to assets in statewide-branching states, it is perhaps not surprising that the derivative shows that for a unit change in the loans-assets ratio at the mean, the influence on closure is higher in statewide-branching states than in restricted-branching states.

For banks in general, the capital-assets ratio derivative was quite large and was negative and significant. Further, the loans-assets ratio derivative was positive and significant. Taken together, they seem to indicate that conservative operations of banks (high levels of capital and greater proportions of nonloan assets) are a good defense against closure regardless of branching structure.

Overall, agricultural banks are important lenders to agriculture and are still closing faster than other types of banks. Branching seems to have allowed banks to take advantage of diversification and lend to agriculture without increasing the likelihood of closure. For the average bank, increases in the proportion of the loan portfolio committed to agriculture put the bank at greater risk of closure in restricted-branching states. In the same states, however, increases in commercial and industrial loans would have about the same effect. And finally, regardless of branching regulations, conservatism in bank management would appear to be the best defense against closure.

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1. It should be kept in mind that calculation of the average of the ratios gives equal weight to each bank. In contrast, calculation of the ratio of total agricultural loans to total loans at banks weights each bank by its share of total loans at banks. The two numbers are very different. For example, at the end of 1986, the average of the ratios was 15.7 percent, while the ratio of total agricultural loans to total loans at banks was 2.5 percent.

2. CCC loans, while not without use in financing agricultural production, are part of the government farm income support mechanism. With these nonrecourse loans, crops are used as collateral and are forfeited or redeemed to the farmers' advantage. Thus, CCC loans help protect farmers' incomes from downward price movements, without preventing gains should prices rise, while at the same time moving income from a future year to the current year. The U.S. Department of Agriculture treats net CCC loans (loans booked less loans repaid) as additions to cash receipts or gross income. Consequently, when agricultural debt is examined, CCC loans should be omitted.

3. For an illuminating discussion of the nomenclature surrounding bank failure and options of the FDIC, see George J. Benston, Robert A. Eisenbeis, Paul M. Horvitz, Edward J. Kane, and George G. Kaufman, *Perspectives on Safe & Sound Banking: Past, Present, and Future*, A Study Commissioned by the American Bankers Association (Cambridge: MIT Press, 1986).

4. Bank closures dropped rapidly with the onset of World War II. In 1940, 48 banks closed; in 1941, 23 closed; in 1942, 16 closed; and in 1943, 5 closed. Starting in 1943, the annual number of bank closures stayed below 10 for more than 30 years.

5. It appears that closures of nonagricultural banks in energy-producing states have worked to narrow the gap between the closure rates of agricultural and nonagricultural banks. Oil prices declined sharply in early 1986. From June 1, 1986, to June 12, 1987, 179 banks were closed; 82 were agricultural banks. Of the remaining 97 banks closing during that period, 57 were nonagricultural banks in the energy-producing states of Louisiana, Oklahoma, and Texas. Emanuel Melichar, of the Federal Reserve Board staff, alerted the author to this point.

6. Banks' share of non-real-estate loans to farmers (excluding loans from the Farmers Home Administration, which lent to operators unable to qualify for private credit) dropped from 51.1 percent in 1970 to 44.1 percent in 1981. The production credit associations (PCAs) were the parts of the FCS that were most directly in competition with commercial banks. Over the same period, the PCAs' market share increased from 25.8 percent to 30.0 percent. The share of credit supplied by individuals and others increased from 23.1 percent in 1970 to 25.9 percent in 1981. See Emanuel Melichar, *Agricultural Finance Databook*, Statistical Release E.15 (125) (Washington, D.C.: Board of Governors of the Federal Reserve System, Division of Research and Statistics, June 1986).

7. G. E. Rossmiller, "Farm Exports: An Historical Perspective," *Choices*, Third Quarter 1986, 24-25.

8. Melichar, *Agricultural Finance Databook*.