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Guillén, Jorge

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A LESSON TO LEARN FROM DEVELOPED COUNTRIES: THE CASE OF STATE BRANCHING DEREGULATION IN THE US*

UNA LECCIÓN PARA APRENDER DE LOS PAÍSES DESARROLLADOS: EL CASO DE LA DESREGULACIÓN DE SUCURSALES EN EE.UU.

JORGE GUILLÉN**

Abstract

The era of US state branching deregulation started in 1970 and ended up with the enactment of the Riegle Neal Act of 1994. One of the purposes of the branching restriction was to avoid bank concentration. The following paper addresses the influence of the state deregulation on commercial banks' efficiency within the US. We calculate an indicator of bank efficiency using Data Envelopment Analysis (DEA). The efficiency indicator is used as the primary step to analyze the effect of state branching law deregulation on bank's efficiency. The analysis is complemented with a failure prediction model using these DEA scores.

Key words: *Data Envelopment Analysis, Input Oriented Models, Interstate Branch Regulation.*

Resumen

La era de la desregulación para abrir sucursales empezó en 1970 y culminó con el Acta Riegle Neal de 1994. Uno de los propósitos de la regulación para abrir sucursales era evitar la concentración bancaria. El presente trabajo analiza la influencia de la desregulación de sucursales sobre la eficiencia bancaria. Estimamos el indicador de eficiencia mediante la técnica del DEA y lo consideramos como un insumo para nuestro análisis. El estudio se complementa

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** CENTRUM, the Business School of the Pontificia Universidad Católica del Perú. Jr. Alomía Robles 125-129, Los Álamos de Monterrico, Santiago de Surco, Lima 33, Perú.

con una evaluación de la probabilidad de quiebra bancaria, utilizando como herramienta el mismo DEA.

Palabras clave: *Análisis envolvente de datos, modelos orientados a la entrada, regulación interestatal.*

JEL Classification: *G21, G28, E58, E61.*

I. Introduction

The McFadden Act (1927) established a restriction that prevented banks from opening a branch or subsidiary in another state. The referred law was in effect from 1927 to 1994, when a Federal Law called "Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994" (Act of 1994) was released.[1] One of the objectives of the Act of 1994 was to enhance efficiency in the banking sector. A 1981 report from the Carter Administration claimed that restrictions on interstate banking caused "inequities and inefficiencies", and removing such restrictions would, in their view, serve "the public interest". During the 1980's, more than 80 percent of failed-bank assets were in just four states: Texas, Illinois, New York and Oklahoma. The Report claims that "this failure problem could have been prevented by allowing more geographic diversification among banks".

The main objective of this paper is to evaluate changes in efficiency in the banking sector linked to banking deregulation. In addition, we evaluate whether bank deregulation affected the probability of bank failure.

There are many different explanations about how branching deregulation may have affected banks performance. DeYoung (1998) and Carrow and Heron (1998) asserted that deregulation might enhance industry productivity in general. However for DeYoung (1998) there is a possibility that the change in efficiency may not be significant. The possibility of a change in the efficiency will depend on how a state considers their restriction. For instance, the states can take the restricted regulation as a previous stage to improve their competitiveness by making competitive entry barriers for their local banks.

The most contestable argument in the branch banking debate was whether it would increase efficiency. The branch proponents believe that increasing the number of firms would allow individual branches to participate in multiple markets and offer services to specific market needs that small local banks could not offer due to risk.

On the other hand, Kroszner and Strahan (1999) present a different explanation of branching restriction. They cite the relative political power of different interest groups that would benefit from the status quo of restricted diversification versus those that would benefit from expanding geographic areas. The authors also claim the importance of communications and technology as factors that permitted the deregulation.

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[1] In principle some states were releasing the branching restriction before, but the Act of 1994 extended the deregulation to all states.

Along the line of the latter authors, Garret, Wagner and Wheelock (2003) found that the decision of a state to adopt a specific bank regime depends on the regime adopted by other states. They point out that banks located in the Midwest and the South were the last to deregulate because those particular banks were in favor of restricting the entrance to larger banks. The smaller banks in the US are located in the Midwest and South.

In contrast, Avery and Samolyk (2004) put accent on the role of small banks in the consolidation of the financial system besides the high information cost that these types of banks have to overcome.

Berger, Miller, Petersen, Rajan and Stein (2005) complemented Avery and Samolyk's study with an analysis of the relevant role of small banks. In particular, they explore the idea that small organizations may have a comparative advantage in activities that make heavy use of "soft information". In the context of bank lending, large banks are less willing to lend to small firms with no financial records. In contrast, small banks are able to do it because they can personally interact with borrowers. Petersen and Rajan (2002) analyze small business lending and show how the distance between small firms and their lenders have increased with a substantial development of the financial sector even in small business areas. The availability of credit for small businesses is based on the close relationship with their creditors.[2]

Following latter research, Berger and Udell (2002) study the dichotomy between hard and soft information with a different terminology. He introduces the concept of "relationship" lending versus "transaction based" lending. Large banks have the advantage when it comes to "transaction based" lending and the small institutions manage better the "relationship" lending.

There is some research about the impact of banking deregulation. Jayaratne and Strahan (1996) found that branching deregulation encouraged efficient allocation of capital and, hence, induced higher growth rates. However, Freeman (2002) thinks that Jayaratne and Strahan's study is overestimated because the branching deregulation did not produce large effects.

In the literature, there are some papers that analyze the determinants of efficiency, for instance, Berger and DeYoung (1997), Chen, Mason and Higgins (2001) and Guillén (2003) do some analysis of bank's efficiency. However, these papers do not study the influence of the regulation on banks' efficiency.[3]

Efficiency has been calculated using the Data Envelopment Analysis technique (DEA). DEA is a particular frontier analysis technique which measures the efficiency of a decision making unit (DMU). The DMU, in this case, are U.S banks, which will be analyzed across regions and different bank sizes.[4]

Efficiency varies across regions during 1984. Most of the efficient banks are located in the North while the least efficient are in the South. Some banks may overcome this situation when they started to deregulate the branching restriction.

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2 See more about this topic in Keeton (1995) and DeYoung, Goldberg and White (1997).

3 However, Humphrey (1993) studied the impact of bank deregulation on efficiency but this type of deregulation is different than our study. It is regulation of interest rate ceilings instead of branching regulation.

4 The DEA methodology was formally introduced in a seminal paper by Farrel (1957) and later estimated by Charnes, Cooper and Rhode (1978).

We will verify if this change in efficiency over the time and across regions has a positive effect for the banks regarding location and size.

In addition, we examine the effects that bank deregulation had on bank failure. In particular, we are interested if location and size can explain the failure of the bank.

The hypothesis within this paper is that the "State Branch Deregulation" increased efficiency and reduce failure. Riegle Neal Act of 1994 was enacted as a Federal Law to homogenize banking rules across states. Bank location and size effect are considered in this paper.

This episode in the US financial System can serve as an experience to developing countries, in particular the Latin-American region. The latter area has characterized by bank concentration in a few institutions and there is not any attempt to avoid the monopoly power of some Latin-American banks. The American experience attempted to avoid bank concentration[5] by enacting the McFadden Act, but it did not work. We will see in the next sections of the paper the reason why the US banking regulation was not successful.

The rest of the paper is organized as follows: Section II describe the situation before and after Riegle Neal Act of 1994. Section III describe the situation in the Latin-American financial system, section III present the Data Envelopment Analysis methodology. Section IV shows the econometric models, and Section V explains the results. Finally, the last section concludes.

II. Situation Before and After 1994 Act

The discussion on bank branching can be traced back to 1864, when the Congress passed the first major national banking legislation in the United States. The National Banking Act of 1864 (the "1864 Act" hence forth) established a uniform currency system for the U.S and created a market for government bonds to finance the Civil War. The passage of the 1864 Act provided banks the alternative to choose between a federal or state chartering legal scheme. In this way, banks are given the possibility to choose the laws and regulation under which they would be able to operate: federal or state. As a result, many national banks converted their federal charters into state charters to take advantage of the favorable state branching laws. This imbalance endangered the existence of the entire national banking system.

The McFadden Act was passed by Congress in 1927. The Act was originally intended to authorize national banks to establish branch offices within the limits of the banks' home city only when state law explicitly permitted state banks to branch in this way. In 1933, Congress amended the Act by removing the home city restriction. Then national banks were given the authority to branch up to the border limits of the state, where state banks were permitted to take this action.

Congress passed the branch restriction act of 1927 after long debates.[6] Opponents of branch banking argued that branches from large banks would not

[5] The fact that the McFadden avoid bank concentration will be discussed in detail later.

[6] See Carrow and Heron (1998) and Tart (1995) for a careful historic review.

be able to serve the needs of their host communities. They also believed that banking services must be provided at unit banks because branch banks would be run by people that are not familiar with the needs of a particular community. Branching opponents also argued that local communities could grow because the local bank reinvests the loanable fund in the surrounding area.

The opponents of branching believed that branch banking was based on the theory of market concentration. These people feared that concentration of resources would reduce competition and thereby reduce the services provided to a community.

The proponents of the branching, however, stressed the necessity of risk diversification in bank portfolio. They claim that efficient redistribution of resources is possible by transferring loanable funds from areas of low demand to areas with a higher level of need. These transfers were characterized by opponents as draining money away from rural communities to be used for speculative investments in home office cities far from local community.

There was a "special interest group" who were the proponents of the branching restrictions and obtained the enactment of the MacFadden act of 1927.

Therefore, there were many attempts to avoid bank branching restriction.[7] The most typical case involved the First National Bank. This bank was sued and the Supreme Court found illegal the attempt to collect cash and checks in a car service. The bank also attempted to establish "secured receptacles" where customers could leave deposits to be picked up by the armored car. Courts decided that an armored car service constitutes a branch whenever the bank or affiliate owns or operates the service. In contrast, Bay National Bank and Trust Co. was allowed to upheld the operation of an armored car service owned by a third party. The ambiguity of verdicts was the consequence of the vagueness of law definition of branch in the McFadden Act (1927) and its amendments.

Another early attempt for banks to expand their frontiers of business geographically while avoiding "branching" was the establishment of loan production offices (LPOs), Automatic Teller Machines (ATM) and Bank Holding Companies (BHC).[8] Courts found that each one of these alternatives was equivalent to bank branching.[9]

Given the necessity to expand geographically, regional agreements among banks emerged. The first reciprocal regional arrangement involved the New England states: Massachusetts, Connecticut, Vermont, New Hampshire, Maine, and Rhode Island.

During the 80's, many banks failed which lead to the US financial banking crisis. In response to the savings and loan crisis of the 1980s, Congress enacted the St. Germain Act (1982) and the Federal Institutions Reform, Recovery and Enforcement Act of 1989 (FIRREA)[10] to relief the crisis. During that period

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7 See a detailed explanation of the attempts in Tart (1995).

8 The government enacted the Douglas Amendment (1956) that avoided the creation of BHCs. The BHCs were branching across the nation and this situation was not clearly defined as bank branching in the McFadden Act (1927).

9 Section 36 (f) of the McFadden Act consider an entity as a branch if it receives deposits, pays checks, or lends money.

10 FIRREA restructured the savings and loan association regulatory system. It was enacted in response to the savings and loan crisis of the 1980s. This Act regulated the Capital by

of time, U.S. commercial banks were loosing competitiveness with respect to European.

Finally, The Riegle Neal Act was released in 1994. The act introduced many changes in the banking sector. It allowed interstate expansion by Bank Holding (Interstate Banking) companies, subject to concentration limits. Thus, the Federal Reserve Board is prohibited from approving an interstate acquisition that would result in the holding company controlling more than 30 percent of the deposits held by insured depository institutions in a particular state, unless the host state eliminates the limitations entirely or has a lower concentration restriction. The Federal Reserve is also prohibited from approving an acquisition if, as a result, the bank holding company would control more than 10 percent of the total amount of deposits of insured depository institutions in the United States. Interstate branching, or the ability of banks to operate branches in more than one state was also permitted. Concentration limits were imposed also. However, the concentration limits in this case do not apply to any mergers of banks that are already affiliated. This would allow a bank holding company to consolidate its existing network of subsidiary banks into one bank with branches even when some of the existing subsidiaries have a market share larger than the limits.

III. The Situation in the Latin-American Financial System

The financial system in Latin-American is concentrated in a few banks. In the case of Chile during 1990 there were 40 banks and the combined market share of the largest four was 50%. In 2002, the number of banks had dropped to 26 and the market share of the largest four was almost 60% (see Duarte and Repetto, 2004).

In Peru, the situation is not alienated from the latter example because the largest four banks control for 80% of market share (See Rivas-Llosa and Martin, 2007). The number of banks for this country was eleven in 2006, and there is not any attempt to avoid monopoly power in this financial system.

Basically in certain degree, the whole Latin-American region has banking concentration in common. This regional issue can be located back in the early 1900 when Kemmerer Mission[11] promoted the ongoing concentration in the Latin-American financial system (see Drake, 1989). Kemmerer regulation accelerated the concentration but also amplified the credit availability.

For example, Kemmerer plans made to drop the number of banks in Colombia from thirty five in 1924 to sixteen in 1930. The four foreign bank in this country loomed largely than before. The number of regional branches multiplies as long while the number of banks declined. The plans seemed to have achieved his goals

imposing that for every dollar purchase in asset, 10% goes to Capital. The St. Germain act allowed emergency interstate acquisition of thrift institutions regardless of any state anti-branching laws.

[11] Edwin W. Kemmerer was an American economist who advised some Latin-American countries, promoting plans to reform the financial system, fiscal and monetary policies. He advised in Filipinas (1904), Mexico (1917), Guatemala (1919), Colombia (1923), Chile (1925), Ecuador (1926) and Peru (1931).

because the number of credits and deposit soared in the countries Kemmerer visited. Similar policies of Kemmerer were implemented in the Latin-American countries he did not visit.

Although the American reality is different from the Latin-American[12], there is something that we may learn from the US experience. The key issue in common is to find out if the concentration brings efficiency and reduce banking failure. The scope of this study is not to find out if Kemmerer mission was useful for the region. Our paper focuses the attention in the consequences of the US banking deregulation, and then we review possible experiences from this episode.

In the preceding section, we have seen that there are some arguments against banking concentration but there is an explanation why we should keep the system concentrated in a few banks. This fact will be explained within the remaining parts of this study.

IV. Calculation of Efficiency Indicators

4.1. Methodology.

In this section we will explain how the efficiency scores are constructed. In addition, we describe the data sources and justify the use of certain variables to elaborate the efficiency scores.

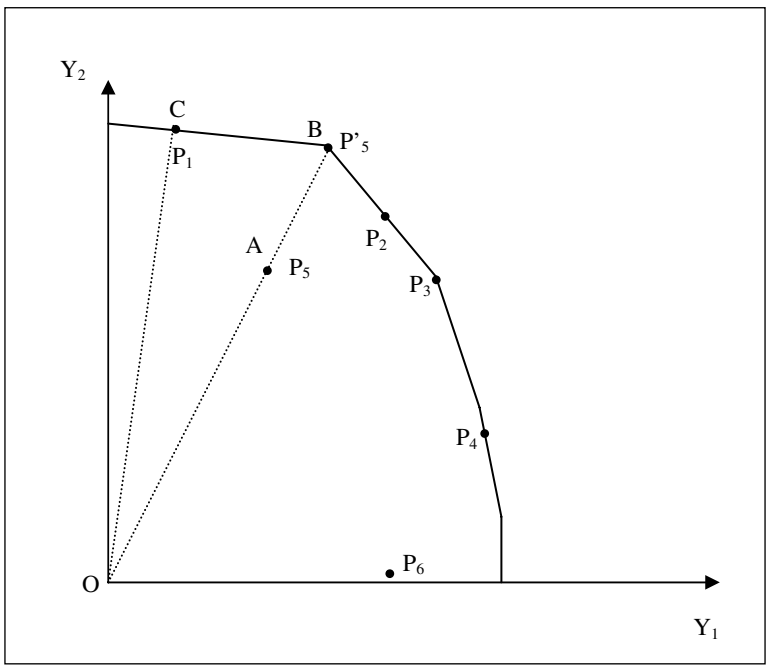
The efficiency indicator has been calculated using the Data Envelopment Analysis (DEA) technique. In the past, average productivity of labor was used to measure efficiency but this indicator failed to use all the information of inputs and outputs available (see Farrell, 1957). Cooper, Seiford and Zhu (2004) provide the following definition of 'relative efficiency' that solves the problem of the efficiency indicator used in the past:

> "A DMU is to be rate fully efficient on the basis of available evidence if and only if the performances of other DMUs do not show that some of its inputs or outputs can be improved without worsening some of its other inputs or outputs".

Farrel (1957) introduced the basic idea of measuring relative efficiency using Euclidean distances from a given observation to an optimal "relative frontier". The word 'relative' is used because it is constructed based on sample information. A bank allocated on the frontier receives a score of one while banks allocated below the frontier get scores bigger than one. The idea can be visualized by looking at the figure below.

[12] Latin-American countries do not have the federal and state banking regulation that we have mention in the section 2.

FIGURE 1
A GRAPHICAL EXPLANATION OF THE DEA



Note: The units P1, P2, P3 and P4 are efficient while, P5 and P6 are inefficient. Y_1 and Y_2 are outputs.

The Figure represents the case of two outputs and six decision making units: P_1, P_2, P_3, P_4, P_5 and P_6 (DMUs).[13] DMU "P1" is efficient and, according to the Farrel's distance method, it receives a score of one. This score is calculated by dividing two rays: the Euclidean distance from the origin to the optimal frontier (OC) divided by the Euclidean distance of the DMU "P1" to the origin (OC). DMU "P5" obtains an efficiency score lower than one because the Euclidean distance from the origin to the frontier (OB) is higher than the Euclidean distance of DMU "P5" to the origin (OA, i.e., OA/OB<1).

In the case of multiple inputs, outputs, and DMUs, efficiency scores are calculated using linear programming techniques. This methodology receives the name of DEA. Charnes, Cooper and Rhodes (1978) set up this linear programming that was not completely solved in paper of Farrel (1957).

The linear program employed by Charnes, Rhodes and Cooper (1978) calculates the efficiency scores given by:

[13] In our case the DMU are banks but there are several studies analyzing efficiency of hospitals, colleges, departments, etc.

Min φ

$$
(1) \qquad \begin{aligned}
&\sum \lambda_j x_{ij} + S_i^+ = \varphi x_{ij_0} \\
&\sum \lambda_j y_{rj} - S_r^- = y_{rj} \\
&S_i^+, S_i^- \geq 0 \\
&\lambda_j \geq 0 \\
&\forall i, j, r
\end{aligned}
$$

Where x_{ij} is the amount of ith input at DMU j, y_{rj} stands for the amount of rth output from DMU j, and finally j_0 is the DMU to assess. S_i^+, S_r^- are the slack variables.[14] The main idea of the program is to find the maximum possible reduction in the vector of inputs for the DMU in evaluation, keeping constant the amount of output. The variable "λ" find the linear combination of observed units given the smaller value of "φ" or fraction of inputs consumed.

The linear program is called input oriented model[15] with constant returns to scale (CRS).[16] The first restriction says that a DMU j_0 cannot use more resources than any other DMU or a linear combination of DMUs. The second restriction means that no other DMU or combination of DMUs has at least the same amount of output as DMU j_0. At the minimum φ = 1 and $S_r^- = S_i^+$ for all *i* and *r*. If at the minimum the slack variables are non zero, the solution is Weakly Efficient. Our estimation resulted in Fully Efficient,[17] which means that the slack variables (S_i^+, S_r^-) are zero at the minimum.

Many authors used this technique as a proxy of measuring efficiency. Ferrier and Lovell (1990), Drugger (1974), Parkan (1987), Sherman (1984) and Sherman and Gold (1985), use linear programming for the banking system. Also, Charnes, Cooper, Sun and Huan (1990) used the same techniques to analyze the operation of large banks.

There are other ways of calculating measures of efficiency. DeYoung (1998) and Chen (2001) calculated the efficiency of banks in the US system by introducing stochastic elements (Cost Efficiency Analysis). Authors like Berger and Mester (1999) used Profit Efficiency instead of Cost efficiency because it takes better into account revenues and cost. The latter analysis for these authors may mislead the findings.

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14 See the paper of Charnes, Cooper and Rhode (1978) for a more complete explanation of this problem.

15 There is another approach besides the input oriented model which is called output oriented model. The maximization of outputs is the dual of the linear program introduced by Charnes, Cooper and Rhode (1978).

16 There are models that include Variable Returns to Scale (VRS) instead of CRS. VRS signifies that in a production process, the operations will follow increasing or decreasing returns to scale. Note also that, some firms that are not efficient in the models so far, may become efficient if we allow variable returns to scale assumption (relaxing the CRS assumption).

17 See these definitions in Cooper, Seiford and Zhu (2004).

Moreover, Cost Efficiency estimation may also be inefficient during this period of deregulation because mergers and acquisition of banks affected negatively the results.[18]

Profit efficiency is also not perfect at all for us because it can be too complicated to evaluate since this estimation requires a vector of prices. Some banks may distort their prices after deregulation given that they have gained control by branching out of state (Berger and Mester, 2003). Our estimation does not need a vector of prices and consequently, the results are not biased due to this variable. DEA responds to technological changes and we are aware of mergers and technological changes during the period in study.[19]

DEA has some advantages in comparison to their competitors. It does not need any functional form between input and output[20] or between the stochastic components like competing estimation requires (i.e. Cost and Profit Efficiency). For Ferrier and Lovell (1990), linear programming can envelop better the data than the translog of stochastic methods. These authors found that the ranking of efficiency scores for linear programming and stochastic methods are positive correlated.[21]

However, there are some disadvantages in the formulation of DEA models. It may be computational intensive for large samples and the assumption of constant returns to scale may be too demanding.

In section 4.3 we showed how our DEA scores are reliable and consistent which guarantee they are suitable in the study.

4.2. Data description

The inputs and outputs required for the DEA estimation are obtained from the Federal Reserve Bank of Chicago. It consists of annual observations from 1984-1997. The data is available for all banks regulated by the Federal Reserve System, Federal Deposit Insurance Corporation, and the Comptroller of the Currency. Information prior to 1984 is not reliable given that some institutions started updating their information in that year. The period of analysis ends in 1997, which is three years after the enactment of the Riegle Neal Act. According to the banking literature, changes in Bank Management can take up to three years to be reflected in the bank's indicators.

We incorporate all banks in the US financial statement. However we eliminate banks with financial statements in blank. The new sample consists of 14,320 banks for 1984 and 9,567 for 1997. The number of banks in the sample dropped from one year to another as result of mergers, acquisitions or failures.

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18 When a large bank merges or acquires a smaller one, it incurs in some extra cost of investment that affect negatively its efficiency.

19 We will prove that our estimation can respond efficiently to any external shock like technological progress. Also, in a Logit analysis developed further, we consider the mergers and acquisition to provide a robust estimation of a failure prediction.

20 See Charnes, Cooper and Rhode (1978).

21 Ferrier and Lovell (1990) conclude that liner programming is not stochastic but can interpret noise as inefficiency.

Studies about bank efficiency use inputs and outputs according to the essential intermediary function of the bank. The model approximates the bank management decision making process by incorporating the necessary input allocation and product mix decisions needed to attract deposits and make favorable loans and investments. Berger and Mester (2003) and Barr, Killgo and Siems (1999) and other studies on bank efficiency use the same variables.[22] Banks' inputs are interest expenses, non-interest expenses, salary expenses, premises and fixed assets and purchase funds (large deposits). The outputs are Interest and non-interest incomes are considered bank's outputs. We did not include earning assets because there is not data available for this variable during the period under study.

4.3. Data Envelopment Analysis estimation results

TABLE 1
DEA INDICATORS SUMMARY RESULTS

Year	Banks	Mean	Min	Max	First Quartile	Median	Third Quartile
1984	14320	0.331	0.118	1.000	0.276	0.315	0.412
1985	14220	0.394	0.040	1.000	0.353	0.407	0.461
1986	14435	0.431	0.088	1.000	0.407	0.433	0.463
1987	13943	0.530	0.029	1.000	0.503	0.537	0.575
1988	13382	0.555	0.094	1.000	0.532	0.570	0.605
1989	12978	0.118	0.038	1.000	0.108	0.115	0.125
1990	12605	0.491	0.123	1.000	0.458	0.493	0.533
1991	12198	0.398	0.132	1.000	0.375	0.399	0.429
1992	11827	0.493	0.163	1.000	0.469	0.499	0.531
1993	11422	0.531	0.180	1.000	0.504	0.537	0.574
1994	10946	0.437	0.024	1.000	0.406	0.442	0.482
1995	10416	0.322	0.126	1.000	0.295	0.317	0.347
1996	9990	0.441	0.148	1.000	0.418	0.442	0.470
1997	9567	0.347	0.041	1.000	0.328	0.348	0.371

Table 1 shows a summary of the DEA scores for the period 1984-1997.[23] The most efficient bank (DMU) receives a DEA score of one while the less efficient will receive a DEA score less than one. For example a score of efficiency of 0.80 means that the bank is wasting 20% of the resources in order to produce a given output.

In 1984, average efficiency in the US banking system, as measured by the average DEA score, was 0.331. Average efficiency decreased in 1989 to 0.118.

[22] However, there are another approaches besides the intermediary approach used in this paper.

[23] To calculate the DEA scores and its bootstrapping, we have used the R program and the commands that Prof. Wilson (2005) has available on his web.

This result can be attributed to the FIRREA Act of 1989, which affected negatively the purchase of assets.

The FIRREA Act was enacted to restructure the savings and loan association regulatory system. This act imposed stricter accounting and other standards on banks, imposing that for every dollar purchase in asset, 10% goes to capital. We consider the purchase of premised and fixed asset in the construction of efficiency scores.

Some authors analyze the effect of FIRREA on efficiency like Cebenoyan, Cooperman, and Register (1993) who find a significant positive relationship between this act and inefficiency.[24] They used cost frontier analysis in contrast to Wilson and Wheelock (1999) who analyze how technical efficiency is affected during this period of regulations. Technical efficiency is more appropriate to get rid of any disturbance of prices.

Our DEA estimates capture technical efficiency during the period of FIRREA, branch deregulation and other acts. The scope of this paper is to find how these changes in business conditions have an effect on bank's optimal choice of inputs and outputs.

During 1995, the DEA average score was 0.322 which is still low in comparison with the first period in study. This result may be the consequence of mergers. Big banks acquire smaller institutions but at the beginning, they incur some costs that disappear in the long run (see Berger and Mester, 2003).

Berger and Mester (2003) have similar results to us for their Profit Efficiency estimates. However, the same authors got contrary results of efficiency when they use Cost Efficiency estimates. The investment in technology during the period of deregulation may have underestimated efficiency.[25]

The range of fluctuation of the score is quite large. The maximum value is one for 1984, and the minimum value is 0.118, for the same period. In 1995, the minimum score was 0.126. The variability in the scores for some institutions can be attributed to outliers but we have confidence in our indicators because we run a test of difference in quartiles and we verify that there is a significant difference between the extreme quartiles.[26] The evolution of the efficiency indicators by quartiles is shown in Figure 2. In addition, we run a Bootstrap[27] for the first 340 banks and the ranking of the estimated scores do not differ with the simulated DEAs. Therefore, our efficient indicators can respond to sampling variations of the estimated frontier.

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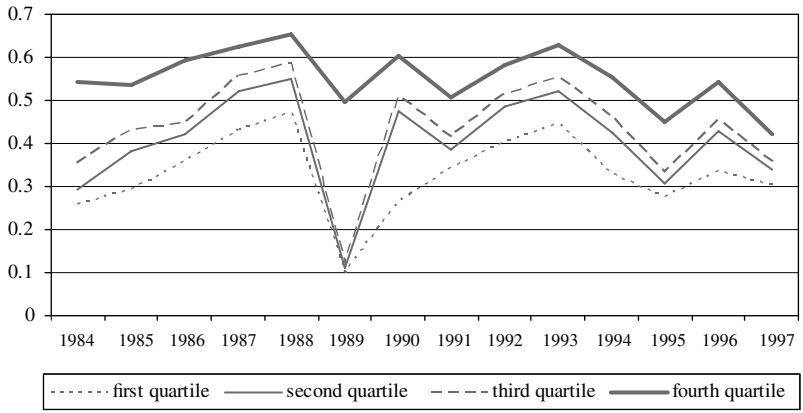
24 The justification of this result is that FIRREA clean up inefficient banks from the system.

25 They obtain that Cost efficiency decreases during 1991-1997 in comparison to 1984-1991. Profit efficiency increase during 1991-1997, which is similar to our results. However, the prices vector considered in the latter estimation can mislead the results during the deregulation period due to changes in monopoly power when branching is allowed.

26 This guarantees reliability of our DEA scores because the efficiency scores show a consistent measure over the time.

27 Bootstrapping is based on the idea of repeatedly simulating data generating process (DGP), by re-sampling and plugging the original estimator to each simulated sample so that the resulting estimates mimic the sampling distribution of the original estimator. We follow the Bootstrap commands posted by Wilson (2005).

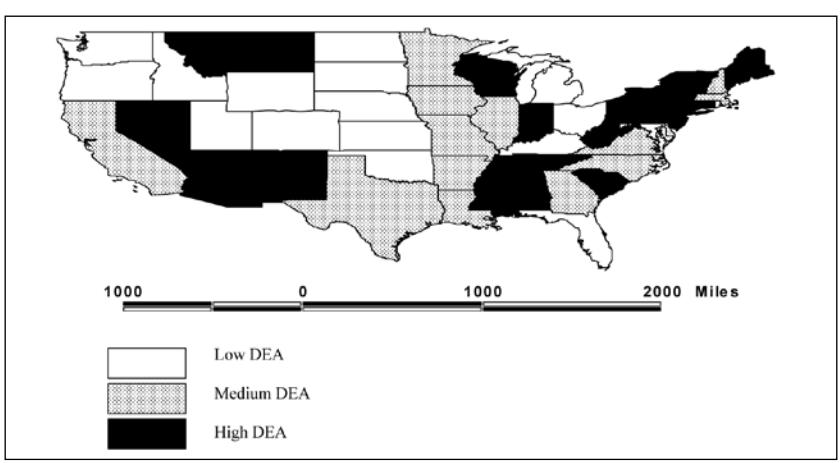
FIGURE 2
DEA BY QUARTILES



Note: The difference between the average DEA for the first and the last quartile is significant for each year.

Figure 3, shows average DEA scores by states for 1984. We can see at a first look that in average some states are efficient in the North but there are inefficient banks in average in the South. In particular, states like Maine, Connecticut, Rhode Island, New Jersey, Pennsylvania, South Carolina, Alabama and Delaware had the most efficient banks on average. The least efficient banks were located in North Dakota, South Dakota, Wyoming, Utah, Colorado and Idaho. States in the North and South East are the most efficient. The inefficient banks are primarily located in the plains (Midwest and South West).

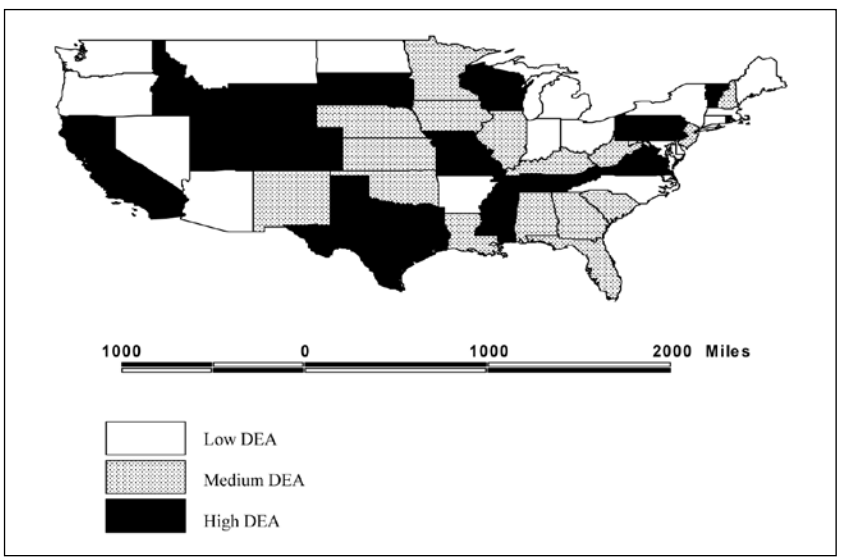
FIGURE 3
AVERAGE DEA SCORES BY STATES (1984)



Note: The map has being constructed by averaging bank's DEA in that state. High DEA reflects states with the most efficient score on average.

The situation changed in 1997 and figure 4 shows how the efficiency indicators changes for this year, three years after the federal deregulation.

FIGURE 4
AVERAGE DEA SCORES BY STATES (1997)



Note: The map has being constructed by averaging bank's DEA in that state. High DEA reflects states with the most efficient score on average.

The map changed and some states gained efficiency by comparing their DEA in 1984 against their score in 1997. States in the West, North and Midwest have become more efficient over time. This result will be analyzed in detail with an empirical model in the next section.

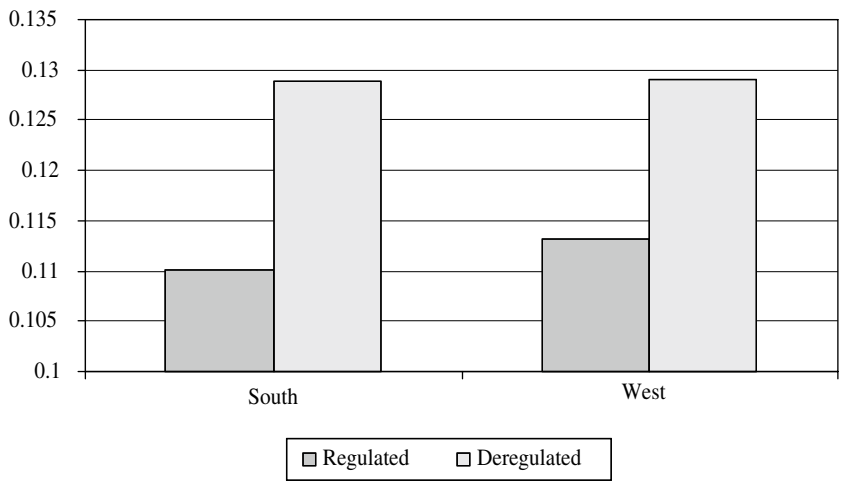
V. Empirical Model

5.1 Determinants of Bank Efficiency

In this section, we test how efficiency is affected by the deregulation of the bank system. Our hypothesis is that deregulation improves efficiency. Figure 5 below shows that efficiency increased when the banks are deregulated regardless of location. We only show South and West because by 1989 the other two regions (North and Midwest) did not have any restriction to open branches outside the state. Following this graph, we can infer that deregulation affected more certain regions than others. Some regions (i.e North) had more banking

concentration because they were able to diversify with branches across states[28] then deregulation did not affect efficiency like it happened to West and South during 1989.

FIGURE 5
DEA FOR REGIONS



Note: The values correspond to 1989. We dropped the North and Midwest regions because, at that time, all banks in the North and Midwest were deregulated by enacting state laws. The regional division of the states is a standard division.

In order to see the effects of the deregulation and the determinants of efficiency in a more detailed analysis, we run the following pooled regression:

$$DEA_{ijt} = \beta_0 + \beta_1 DEREGULATION_{jt} + \beta_2 FIRREA_t + \beta_3 DISCOUNT_t + \beta_5 NORTH_{ij}$$
$$+\beta_6 MIDWEST_{ij} + \beta_7 SOUTH_{ij} + \beta_9 Log(ASSET)_{ijt} + \varepsilon_{ijt}$$

The subindexes 'i', 'j' and 't' refer to a particular bank, state, and time period. The endogenous variable (DEA) is the efficiency score previously estimated for each period and for each bank in the sample. DEREGULATION is a dummy variable that captures the release of branching restrictions. If state j relaxed law branching restrictions in period T, this variable becomes 1 for every $t \geq T$, otherwise it is equal to 0. For example, in 1986 Alabama established the interstate bank constraint. Then, for any bank in Alabama, the dummy DEREGULATION takes the value of one from 1986 onwards. By 1994, most of the states had released the branching restriction as shown in Table 2.

[28] They were able to open branches in state that eliminated the restrictions to open branches as well.

TABLE 2
INTERSTATE BRANCHING DEREGULATION BY STATE.

State	Deregulation	State	Deregulation
Alabama	1981	Montana	1990
Alaska	1970	Nevada	1970
Arizona	1970	New Hampshire	1987
Arkansas	1994	New Jersey	1977
California	1970	New Mexico	1991
Colorado	1991	New York	1976
Connecticut	1980	North Carolina	1970
Delaware	1970	North Dakota	1987
District of Columbia	1970	Ohio	1979
Florida	1988	Oklahoma	1988
Georgia	1983	Oregon	1985
Idaho	1970	Pennsylvania	1982
Illinois	1988	Rhode Island	1970
Indiana	1989	South Carolina	1970
Iowa	1994	South Dakota	1970
Kansas	1987	Tennessee	1985
Kentucky	1990	Texas	1988
Louisiana	1988	Utah	1981
Maine	1975	Vermont	1970
Maryland	1970	Virginia	1978
Massachusetts	1984	Washington	1985
Michigan	1987	West Virginia	1987
Minnesota	1993	Wisconsin	1990
Mississippi	1986	Wyoming	1988
Missouri	1990		

Source: Kroszner and Strahan (1999). The year express when full intrastate branching is permitted. Intrastate branching means that a bank can have more than one office within its home state if and only if the other state allows to branch.

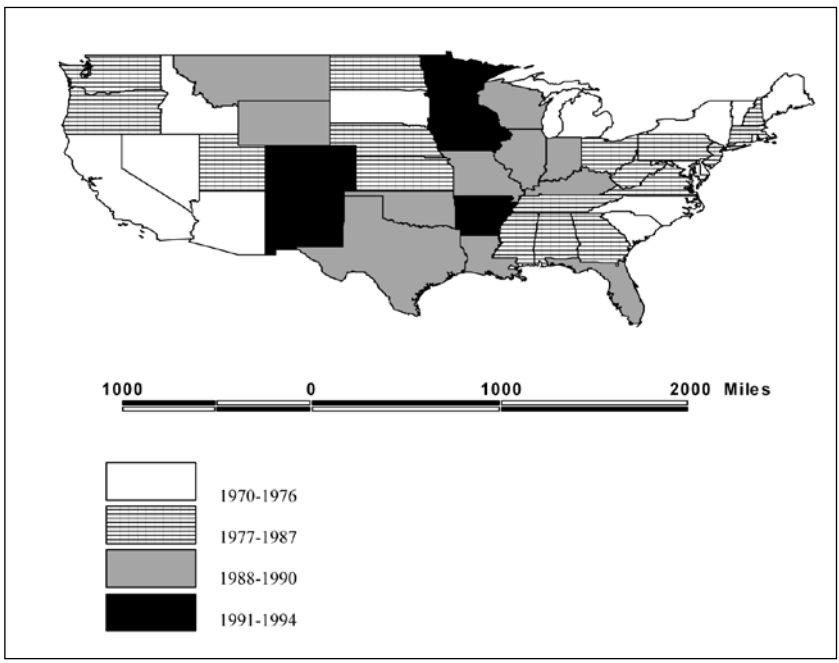
According to our hypothesis, we expect this variable to be positive.

Spatial regional pattern of branching deregulation can be verified by observing Figure 6. The map indicates the year when states started to deregulate branching restrictions. Figure 6, shows that many states in the South and Midwest (mainly the plain area) deregulated the branching system after 1988, while states in the West and Northeast deregulated earlier. The "Special Interest" argument discussed by Kroszner and Strahan (1999), previously explained[29], may justify why the Plain Areas (Midwest and South West) were the last regions to deregulate.

In order to determine whether bank's location matters in terms of efficiency, North, South, Midwest and West regional dummies are introduced.

[29] This "Special Interest" argument is introduced in section 1 and discussed in detail in section 2.

FIGURE 6
INTRASTATE BRANCHING ALLOWED BY MERGER AND ACQUISITIONS



The variable FIRREA is a dummy variable that takes the value of 1 from 1988-1997 for all banks. This dummy reflects the Federal Institutions Reform, Recovery and Enforcement Act of 1989. FIRREA was enacted to provide for the resolution of failed savings and loans institutions. This Act imposes some restrictions in the banks' assets and capital formation which are directly related to the construction of our DEA scores.

External macroeconomic factors also affect efficiency. In our model we control for discount rate (DISCOUNT). The latter indicator represents a good proxy of monetary policy.[30] For instance, an expansionary monetary policy would reduce the bank cost and consequently increase efficiency.

The logarithm of assets reflects the effect of size on efficiency. If this coefficient is positive then, efficiency increases with the size of the bank.

The estimation of the regression is performed by using Newey-West Estimator and we control the panel with year dummies for the two models.[31] The estimator

[30] There is a consensus in the literature about how relaxed monetary policy help banks to reduce their costs. See Bernanke and Blinder (1992) also in Friedman and Schwartz (1963), Sims (1972) and Christiano and Ljungqvist (1988).

[31] In addition, I have considered fix effects in all the specifications shown in Table 3. Our purpose is to capture fix and between effects in the panel estimation.

provides a general covariance matrix estimator that is consistent in the presence of both heteroskedasticity and autocorrelation of unknown form.

The variable assets and regional dummies are constructed using the data taken from Federal Reserve Bank of Chicago. The Deregulation dummy is constructed according to the table presented in Kroszner and Strahan (1999). The data for discount rate is obtained from International Financial Statistics (2005).

A. *Results*

Table 3 shows two models. The first model considers internal and external factors and the second model considers regional effects. We will study next how bank failure is affected by regional factors, deregulation and internal factors.

Our panel is unbalanced because some banks disappear along the period under study due to mergers acquisitions or bank failure. The results in Table 3 indicate that the deregulation variable increased bank's efficiency. Branch deregulation improves efficiency no matter the location or size of the bank. The results support the efficiency argument proposed by the opponents of branching restriction.

The Discount Rate has an expected negative role on efficiency. A high discount rate increases the banks' cost negatively affecting banks' efficiency. Chen, Mason and Higgins (2001) obtain similar results. Therefore, macroeconomic factors do have an influence on the banking system.

FIRREA seems to have reduced efficiency. The reason is that this act regulates the purchase of assets for more capital requirement. Purchase of assets is one of the inputs in the elaboration of DEA scores. Thus; FIRREA is producing a negative effect on banks' efficiency during the period of study.

The dummies for the South and Midwest region do not give any significant coefficient. The dummy for North has a negative impact on efficiency. A bank located in the North has a lower efficiency relative to the West.

However, if we consider size and region at the same time, our results indicate that bigger banks are more efficient because the variable log(Assets) is positively correlated to efficiency. In relation to the last result, Figure 7 shows how the distribution of banks by size varies. In particular, we show how "small banks"[32] varies across the regions and verify that 73% of these "small banks" are located in the South and Midwest.

The smallest banks, which are mainly located in the South and Midwest, were the most inefficient. This inefficiency may have increased when the bank is restricted to open a branch. The special interest argument, discussed earlier, could have an explanation of the result. Basically, these banks located in the plain areas were the last to deregulated because they were in favor of branching restriction. Therefore, these regions kept the most inefficient banks by avoiding the entry of competition in the area.

[32] We consider a bank small if it has less than US$ 100 millions in assets (1996 = 100).

TABLE 3
DETERMINANTS OF DEA SCORES: POOL ESTIMATIONS[33]

Variables	Dependent Variable: DEA	
	Model 1	Model 2
Constant	0.497 ***	0.505 ***
	(0.0049)	(0.0045)
Deregulation	0.090 ***	0.089 ***
	(0.0015)	(0.0015)
Dummy of FIRREA	–0.106 ***	–0.106 ***
	(0.0025)	(0.0025)
Discount Rate	–0.018 ***	–0.018 ***
	(0.0006)	(0.0006)
Dummy of North	–0.011 ***	
	(0.0014)	
Dummy of Midwest	–0.002	
	(0.0011)	
Dummy of South	0.001	
	(0.0011)	
Log (Assets)	0.001 ***	0.001
	(0.0003)	(0.0003)
Observations	171,833	171,833
R^2	0.158	0.157

*** Significant at 1%.
** Significant at 5%.
* Significant at 10%.

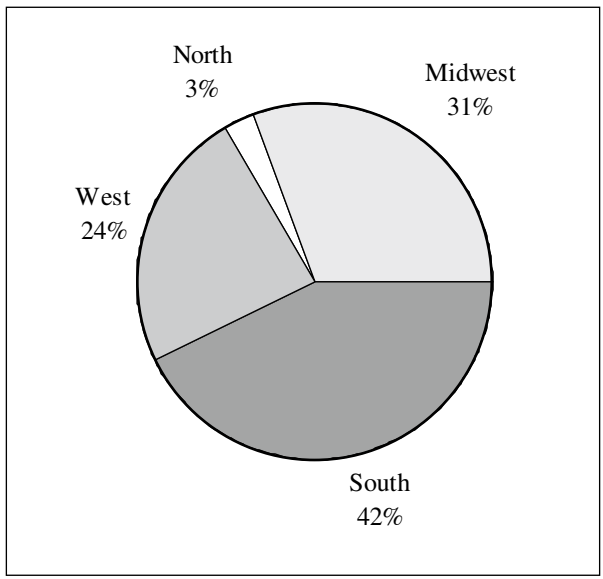
5.2. Bank Bankruptcy Analysis

In this section, we examine the causes of bank failures in the US during 1984-1997. This period is particularly interesting to analyze because at that time most states passed laws relaxing branching restrictions.

Figure 8, shows a very interesting preliminary result. Most of the banks that failed during the eighties were located in the South and Midwest. In 1984, eighty five banks located in these two regions failed and this number increased to seven hundred and forty in 1989. Another interesting result is that over most part of the period, banks located in the North failed less in comparison with

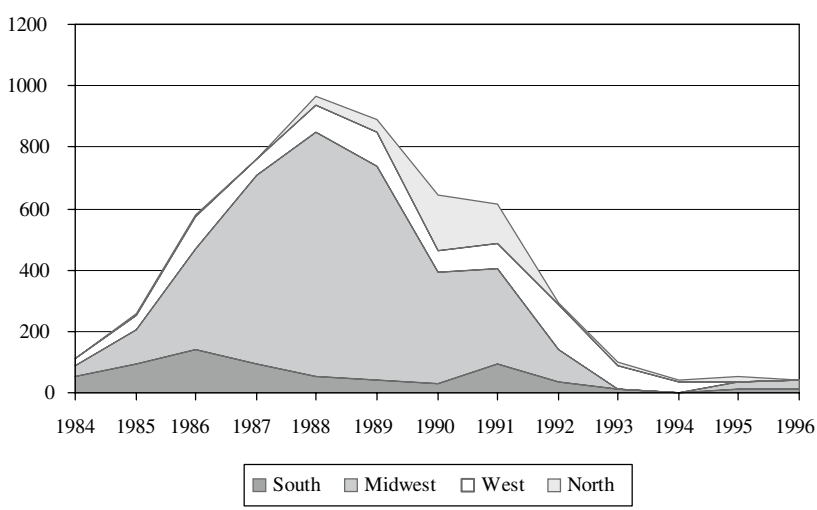
[33] The estimation consider year dummies and fix effects.

FIGURE 7
BANKS BY REGIONS WITH ASSETS BELOW US100 MILL.



Note: We consider banks that in 1984 hold assets below US$100 Mill. The amount of assets is expressed in nominal terms.

FIGURE 8
NUMBER OF FAILING BANKS BY REGION



Note: The failing institutions are not merged or acquired.

those in other regions. Maybe the agreement in the North which Tart (1995) refer to reduced the number of failing banks in the region.[34]

One possible explanation of why banks in the South failed more over the time in study is provided by Kroszner and Strahan (1999) and Garret, Wagner and Wheelock (2004) they argue how "special interest" groups affect the decision of a bank to opt for a restriction to open a branch. They claim that, small banks in the South and Midwest might have an interest to avoid the entry of large banks that can drive them out of the business. The regional "special interest" explained by Kroszner and Strahan (1999) could have induced them to loose competitiveness and make them fail. We will verify with a Logit Model whether most of the banks in the South and Midwest were more exposed to failure relative to other regions.

Again by just looking at the data, we find that most of the banks that failed are those with assets smaller than US $100 millions (see Figure 9). The big banks were less exposed to failure. In 1984, there were 107 failing financial institutions with less than US $100 millions in contrast to zero failing banks with assets bigger than US $400 millions. A similar pattern is observed in the following years. The latter observation indicates that the probability of failure should be smaller for big banks.

In 1984 there were 14,320 banks in total, but the number is reduced to 9,567 in 1997. The failure of banks as a consequence of the deregulation or due to the banks' internal factors will be analyzed using a Logit model. However, merges and acquisitions can introduce some noise in the study.

In order to obtain the most accurate analysis in the Logit Model,[35] we clean the data of banks acquired or merged in order to avoid any bias in the estimation. The new data contains banks that never fail from 1984-1997, or banks who failed and could not get acquired or merged.[36]

Bank's health has been evaluated using the Capital adequacy, Asset quality, Management quality, Earning ability, and Liquidity position ratio (C.A.M.E.L.). However, the assessment of management quality introduces some difficulties into the analysis. The most important problem consists on measuring management quality. The assessment of management quality would require a good professional judgment of the bank's compliance to policies and procedures, risk taking, strategic plans, and decisions.

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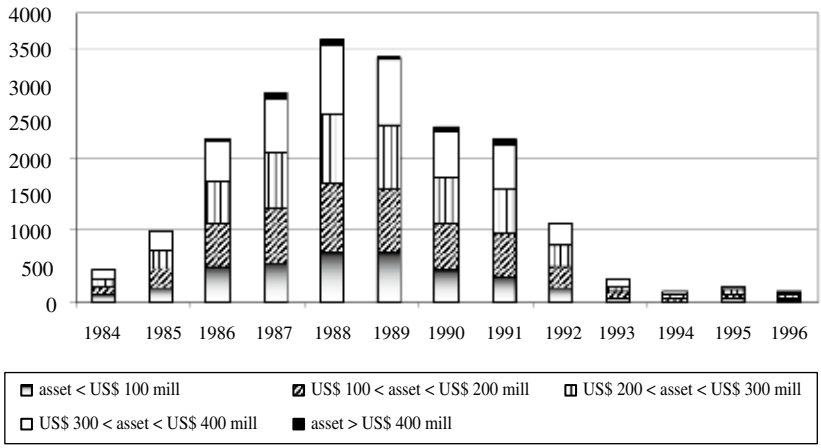
34 We explain in section 2 how the states in the North tried to avoid the negative effect of branch regulation by making reciprocal agreements which allow banks to open branches in the states that belong the agreement.

35 A Logit Model is implemented to calculate the probability of failure. Economists and financial analysts have been analyzing the determinants of bankruptcy for decades (Altman, 1968). Logit and Probit models have been used by banks' examiners to predict bank failure (see Martin, 1977; Hanweck, 1977 and Pantalone and Platt, 1987). We use Logit Models in this case in order to avoid convergence problems caused with Probit models. In some cases there are ranges where we cannot define probabilities. Therefore, a Logistic Model is very useful and popular in the banking literature.

36 We use a definition of failure that comes from FDIC and states that in a Failure, entity ceases to exist. Resolution was arranged by the FDIC, RTC, NCUA, State or other regulatory agency.

FIGURE 9
NUMBER OF FAILING BANKS BY SIZE



Note: The failing institutions are not merged or acquired. The size intervals are constructed in real dollars (1996 = 100).

In this paper, we consider DEA scores as proxies of management quality. We assume that efficiency scores should be able to identify whether the bank is processing multiple input-outputs in an efficient manner. Wilson and Wheelock (1995) developed an analysis of failure with hazard models for the decade of 1930's. They used linear programming (DEA) as a proxy of management.

For capital adequacy, we use capital as a ratio of asset. This variable has been extremely important in the explanation of failures in the US system. Authors like Altman (1968) and Shumway (2001) proceed in a similar way. Mishkin and Eakins (1999) also points out the importance of this variable. A drop in the ratio of capital divided by assets would force bank insolvency.[37]

For asset quality, we use nonperforming loans (NPL) as a ratio of assets. Most of the literature considers this variable as a good proxy of asset quality because when most loans are bad and assets are dropping, it poses a considerable problem for the bank. In addition, a higher ratio of NPL is a sign that the bank is incurring in riskier activities that may be a signal of weakness. It is widely accepted that banking failure can be explained by this variable.

We use profits as a ratio of Capital, to proxy earning ability, which is the typical return to Capital (ROE) indicator. The measure is used by Martin (1977), Wilson and Wheelock (2000), and others. A higher ratio of profits as a ratio of Capital reduces the likelihood of failure.

For liquidity, we use loan as a ratio of deposits. This indicator reflects the ability to support loan growth with deposits. Deposits are the main way to fund

[37] The greater is the capital the better the bank's ability to absorb loan losses before becoming insolvent.

their loans and operations. Higher values of this ratio imply that there are fewer additional deposits to fund loans, implying lower liquidity which increases the likelihood of failure. Conversely, if a bank has a greater amount of cash available and other reserves to deposits (lower ratio of loan to deposit) then it may be better protected against large or sudden deposit withdrawals, and hence reduce the probability of failure.

The dummy FAIL takes a value equal to one three years before a bank fails and zero otherwise. This is standard procedure followed in the literature. It has been used for example by Martin (1977) and Pantalone (1987).

The variable DEREGULATION is introduced here to determine whether deregulation increases or reduces the probability of failure. Following the argument of portfolio diversification discussed in section 2, we may expect this variable to be negative. The proponents of branch banking believe that the release of the branching restriction reduces the risk diversification in bank portfolio and improves the quality of loans. Consequently, we should expect a reduction in the bank's failure when deregulation of branch restriction comes up.[38]

Regional effect is considered by adding dummies for each region of the U.S. The Year Control is a dummy that control for some structural changes from 1984 to 1997.[39]

Considering all the variables, the Logit regression becomes:

$$FAIL_{ijt} = \beta_0 + \beta_2 DEA_{ijt} + \beta_6[CAPITAL_{ijt} / ASSET_{ijt}] + \beta_7[NPL_{ijt} / ASSET_{ijt}] +$$
$$\beta_8[PROFIT_{ijt} / ASSET_{ijt}] + \beta_9[LOAN_{ijt} / DEPOSIT_{ijt}] + \beta_1 DEREGULATION_{jt}$$
$$+\beta_3 NORTH_{ij} + \beta_4 MIDWEST_{ij} + \beta_5 SOUTH_{ij} + \beta_{10} YEAR_CONTROL_t + \varepsilon_{ijt}$$

The error term ε_{ijt} is assumed to be normally distributed with the respective properties of a white noise.

A. *Results*

The results of the Logit Estimation are shown in Table 4. The four models can predict correctly in overall 92.8%, 93.8%, 92.9%, 93.9% observations respectively. This means that the failure predictions of the models are quite accurate.

The pooled estimation does not show any significant coefficient for the DEA scores (in Model 1 and 3). However, the variable DEREGULATION variable shows a negative sign in Models 2 and 4. It implies that failure decreased with the release of branching restrictions. The result goes along the line of Ennis (2004),[40] who claims that changes in bank regulation during the 80's decreased the risk exposure of banks.

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38 There is not a study in the literature that analyses the direct impact of deregulation on bank's failure.

39 It is also used to capture any systemic determinants of failure not otherwise accounted in the model.

40 Ennis (2001) also states that branching deregulation induced banks to face a trade off between higher operating costs and improvements in the loan portfolio. Also, Ennis and Malek (2005) show how big banks tend to reduce its probability of failure after branch deregulation.

TABLE 4
DETERMINANTS OF BANK FAILURE: THREE YEAR LOGIT MODEL

	Dependent Variable : Dummy of Failure			
Variables	Model 1	Model 2	Model 3	Model 4
Constant	–23.285 *** (0.1543)	–22.415 *** (0.1279)	–22.749 *** (0.166)	–22.621 *** (0.1417)
DEA	0.155 (0.2549)		0.092 (0.2573)	
Capital/Assets	–36.289 *** (0.9902)	–36.842 *** (0.992)	–33.817 *** (0.9721)	–34.419 *** (0.9754)
Nonperforming Loans/Assets	25.739 *** (0.8483)	24.996 *** (0.8512)	26.579 *** (0.8596)	25.677 *** (0.8633)
Profits/Capital	–47.192 *** (1.9010)	–47.677 *** (1.8845)	–44.387 *** (1.877)	–44.786 *** (1.8596)
Inverse (Loans/Deposits)	–1.944 *** (0.1218)	–1.953 *** (0.1224)	–1.967 *** (0.1261)	–1.9084 *** (0.1262)
Deregulation		–0.753 *** (0.0649)		–0.812 *** (0.0676)
Dummy of North			–0.103 (0.1060)	–0.059 (0.1084)
Dummy of Midwest			0.479 *** (0.0679)	0.458 *** (0.0679)
Dummy of South			–0.920 *** (0.0804)	–0.958 *** (0.0804)
Year Dummies	Yes	Yes	Yes	Yes
Observations	119,559	119,559	119,559	119,559
McFadden's LRI	0.4245	0.4290	0.4475	0.4524

*** Significant at 1%.
** Significant at 5%.
* Significant at 10%.

The magnitude of the deregulation effect is shown in Table 5. The marginal effect of this variable is -0.753 for the second model and -0.812 for the last model.[41] The differences between the models are explained by the regional dummies which are included only in the last model[42].

TABLE 5
MARGINAL EFFECTS OF THE LOGIT MODEL

	Dependent Variable : Dummy of Failure			
Variables	Model 1	Model 2	Model 3	Model 4
Capital/Assets	0.017 ***	0.021 ***	0.019 ***	0.014 ***
Nonperforming Loans/ Assets	0.001 ***	0.002 ***	0.002 ***	0.001 ***
Profits/Capital	0.002 ***	0.003 ***	0.003 ***	0.002 ***
Inverse (Loans/ Deposits)	0.116 ***	0.143 ***	0.127 ***	0.096 ***
DEA	0.157		0.086	
Deregulation		0.098 ***		0.129 ***
Dummy of North			0.018	0.014
Dummy of Midwest			0.073 ***	0.057 ***
Dummy of South			0.089 ***	0.067 ***

*** Significant at 1%.
** Significant at 5%.
* Significant at 10%.

All the variables from the C.A.M.E.L are significantly different than zero and have the correct sign. The marginal effect for Capital/Asset was negative, which means that the higher Capital as a ratio of Assets implies a reduction in the risk of failure. The shares of nonperforming loans gave the right sign which means that good asset quality reduces the probability of failure.

The Profits as a ratio of capital gave the expected negative sign as well as the inverse of the variable Loan/Deposits. We rescale by taking the inverse of Loan/Deposits in order to get a coefficient comparable with the other variables. The negative coefficient of the inverse of Loans/Deposits implies that higher deposits support loans and therefore reduces the probability of failure.

Models 3 and 4 show the results for the Dummy variables. The Midwest and South variables have positive and negative sign respectively. It means that a bank located in the Midwest has a higher probability of failure with

41 See Table 5 for further details.

42 The results give the same sign even if we consider a dummy FAIL within one year and two years before failure.

respect to another in the West. The Dummy for the North was not significant but shows that a bank located in the North decreases its probability of failure with respect to the West. Regional agreements in the North may have helped to this result.

VI. Conclusions

When the restriction for opening a branch or subsidiary was released, banks were able to improve their efficiency. This result differs from DeYoung (1998) in the sense that everybody suffers at the same level and there were not banks exempt from inefficiencies as a consequence of deregulation.

The inefficiency of many U.S. banks was overcome by state deregulation. In addition, banks in the South and Midwest were more inefficient in absolute number than those in the North and West region. The North region made agreements among themselves to avoid the negative consequences of the McFadden Act (1933). These agreements could have neutralized the reduction of inefficiency and consequently reduced to zero the probability of failure in that particular region.

The deregulation can explain the feature that U.S. Banks became more competitive, even when compared to European Banks. Mulloy (1995) cites the fact that in 1983, three U.S. commercial banks were among the world's top twenty in asset size and by the end of 1988 no U.S. bank was ranked among the world's top twenty.

"Special interest" groups may have played an important role in the South and Midwest (plain areas). Politicians from that part of the country were trying to restrict the entry of big banks in the region. This may have produced a negative effect in the performance of the US banks. Bank Competition became more important and the Riegle Neal reflected the necessity to homogenize the branch deregulation which started in 1970.

This paper analyzes a relevant episode of US banks' regulation. Developing economies may learn from this experience. Latin-American banking regulators have to be aware that avoiding bank concentration brings some negative effects in bank´s efficiency and raises the probability of failure.

Central banks would consider the analysis of this paper to avoid committing policy mistakes that lead to costly government intervention.

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