Bank Branching Deregulation: A Spatial Competition Model

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Abstract This paper develops a theoretical model of spatial competition between banks that attempts to explain the rationale behind the implementation of federal branching restrictions in the U.S. banking industry in 1927, and their subsequent elimination in 1994. The model considers two different settings. The first one assumes that banks cannot open a branch in another state or region, and the second one considers that there are no branching restrictions. We derive the Nash Equilibria when banks compete in interest rates offered to investors located in different regions and determine winners and losers in each case. We also examine the conditions under which banks would find it profitable to open a branch in another region in terms of the costs of performing long-distance transactions. We show that when these costs decline (for instance, as a result of technological innovations in the banking industry), banks do not find it attractive to open branches elsewhere. Hence, any regulation that prevents branching restrictions simply becomes obsolete. In light of the conclusions of the model, the elimination of these restrictions can be understood as an attempt to bring regulatory standards in accordance with economic reality.

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1 Introduction

The U.S. banking industry has undergone in the last thirty years through a long process of deregulation. This paper focuses on one aspect of such process: the deregulation of bank branching restrictions. In 1927, the McFadden Act introduced federal restrictions on interstate banking. This legislation prevented U.S. commercial banks from establishing branches in other states, unless explicitly allowed by state law. Since the early 1980s, many states allowed different forms of interstate banking through the subscription of reciprocal regional agreements[1]. Finally, in 1994, another federal law, the Riegle-Neal Interstate Banking and Branching Efficiency Act (1994), permitted as of June 1997 nationwide branch banking. In this paper we develop a theoretical model that attempts to explain the rationale behind the law that originally prohibited bank branching, and the subsequent decision to eliminate the restrictions. The model synthesizes the discussion between proponents and opponents of bank branching restrictions in a spatial competition model. Our goal is to examine the effectiveness of this kind regulation in a context where banks have the alternative to target customers from a single location.

Even though the interstate bank branching restriction prevented banks from opening offices across states, it could not stop local consumers from operating with banks located elsewhere if the opportunities offered by these banks were attractive enough. However, banking transactions with non-residents are necessarily performed at higher costs. The paper exploits the idea that even though local banks were protected from direct competition, distant banks could still cap-

[1] See, for example, Tart (1995).

ture some of the local customers as long as it was not too costly to perform long distance transactions.

Since the McFadden Act of 1927, dramatic changes have been taking place in the banking industry. Improvements in transportation, communication, and computer technology have remarkably changed the way the banking industry operates. The advances generated, among other things, a significant decline in the cost of performing long-distance transactions. As a result, banks may no longer find it desirable to open branches elsewhere to serve distant customers, so any law that prevents banks from doing so would be obsolete and irrelevant. Our model permits us to evaluate precisely how the technological changes evidenced in the banking sector affected banks' incentives to open branches in other regions[2].

One of the conclusions in our paper is consistent with the idea that some regulations are simply eliminated because they became obsolete and outdated given the technological state of affairs. The removal of such restrictions would not have a real effect and, in fact, nobody will oppose it. It would just set the rules in accordance with economic reality[3].

The question addressed in this paper is not new. It has previously been considered by a number of different authors. For example, our work is closely related to Petersen and Rajan (2002), who find that the distance between small firms and their lenders has systematically increased over the period 1973 to 1993. They claim that such effect can be attributed to technological improvements in the banking industry: greater use of computers and communication equipments. As

[2] Senzel (1992) and Rollinger (1996) among others, provide evidence supporting the idea that technological advances made geographical restrictions irrelevant. For instance, improvements in the communication technology have made it possible for banks to use electronic methods to transfer funds. These systems became available to bank customers as customer bank communication terminals (CBCT), automated teller machines (ATM), point of sale terminals (POS), etc.

[3] We realize that the argument in our paper is rather extreme. Our goal is, however, to point out that the real effects in the banking industry were mostly driven by technological changes and the deregulation process was more a consequence rather than an effect of the changes.

a result, they argue, the incentives to preserve geographical restrictions on bank branching are greatly diminished.

Kane (1996) follows a public-choice approach to explain the changes in rules and regulations. The lobbying pressure of three interest groups, small to medium banks, large banks, and consumers, ultimately shape the regulatory environment. Kane (1996) claims that restrictions were not removed until technology improvements had changed the "preexisting balance of lobbying pressure". Calomiris and Ramirez (2004) also employ an interest-group explanation. Instead of focusing on the incentives of small banks to lobby for protection, they claim that certain types of borrowers would actually benefit from the entry barriers. In particular, branching restrictions create strategic advantages for those who own immobile factors of production. Kroszner and Strahan (1999) find evidence that interest group factors largely explain the timing of state-level deregulation of bank branching restrictions. They also identify communications and information processing technology as important factors driving the process of barrier relaxation. They suggest that as a result of the technological advances, large banks gained strength as an interest group in detriment of small banks that have traditionally benefited from the branching restrictions. The pressure to eliminate these restrictions, they claim, should be higher in those states with fewer small banks, so state bank deregulation should be observed earlier in those states[4].

Our theoretical model follows the line of reasoning found in the literature on credible spatial preemption[5]. The general argument states that in a spatial competition model firms may find it profitable to concentrate their activities in a single location. Entry into another region leads to competition with other firms, which in turn, affects the demand for its product in the original geographical

[4] Ennis (2001) provides a theoretical justification for the coexistence of both small local community banks and big national diversified banks in a deregulated environment. The explanation is based on the fact that banks of different sizes have different abilities in monitoring investors.

[5] See, for example, Judd (1985).

market and may, consequently, reduce the firm's aggregate profits. In fact, as we will show in the paper, the decision to expand geographically will depend on transportation costs or, in our case, the costs of performing long-distance transactions.

The organization of the paper is as follows. Section 2 provides a brief description of the changes implemented in the banking sector in terms of interstate branching restrictions. Section 3 presents the basic setup. Section 4 solves the spatial competition model, and section 5 extends the original framework to incorporate difference in operating costs across banks and setup costs. Finally, section 6 concludes.

2 Bank branching deregulation: brief historical review

The discussion about bank branching restrictions in the U.S. can be traced back to 1864, when the Congress passed the first major national banking legislation in the United States[6]. The National Banking Act of 1864 provided banks (among other things) the alternative to choose between federal or state chartering legal scheme. In other words, they were able to choose the level of government that would regulate their operations. The McFadden Act of 1927 applied this principle to branch banking regulation.

In general, the Act prevented national banks from branching. However, they were allowed to establish offices in other sates if and only if a state law permits a state chartered bank to take the same action.

The McFadden Act was passed by Congress after long debates between opponents and proponents of branching restrictions[7]. Proponents argued that bank branches would not be able to serve the needs of their host communities. They believed that banking services must be provided at unit banks because they

[6] See Rollinger (1996) for a thorough description of the history of banking regulation.
[7] See Senzel (1992) and Mulloy (1995).

would be more familiar with the needs of a particular community. Opponents of branching restrictions stressed the necessity of risk diversification. Branching, they claimed, would allow the banking system to transfer loanable funds from areas of low demand to areas with a higher level of need. However, those in favor of the branching restrictions characterized these transfers as money draining away from rural communities that will eventually be used for speculative investments in far away home office cities[8].

The most important argument in the bank branching debate was the efficiency problem. Those against branching restrictions considered that individual branches could participate in multiple markets and offer services to specific market needs in a manner that would be too risky and costly for local unit banks. The proponents of branch restrictions believed that branches generated market concentration. They feared that concentration of resources would reduce competition and thereby reduce the quality and quantity of services provided to a community.

Several banks attempted in many different ways to avoid the bank branching restriction exploiting the fact that the law was not very precise on some issues[9]. Amendments were introduced later to solve a number of ambiguities present in the regulation. After some time, the branching restriction could no longer be sustained. Bank failures spread out around the country. Moreover, US banks were becoming notably more inefficient than European banks. Foreign investment in

[8] See Gilbert (2000).

[9] Tart (1995) describes several specific attempts put into practice by different banks to avoid the regulation. The First National Bank was sued for collecting cash and checks in a car service. The bank also established "secured receptacles" where customers could leave deposits to be picked up by the bank later. Some time after these episodes, different Courts decided that this car service constituted a branch. However, due to the vagueness of the law, Court verdicts were also ambiguous. For instance, the Bay National Bank and Trust Co. was allowed to uphold the operation of an armored car service because this service was performed by a third party. There were other attempts to escape the branching restrictions like Bank Holding Companies (BHS), ATM and Loan Production Offices.

the banking sector dramatically dropped because the restriction did not discriminate among domestic and international banks[10]. In addition, technological progress in the banking industry made it clear that the geographical restrictions to open a branch or subsidiary in other states should be relaxed or eliminated. Senzel (1992) and Kroszner and Strahan (1996), for instance, claim that technological progress was one of the major reasons that explain the change of the status quo in terms of bank regulation.

The deregulation process started in the early 1970s. The first step consisted on the elimination of intrastate branching restrictions[11]. Then, the deregulation process extended to interstate branching restrictions. Cross-state ownership of banks was not permitted until the early 1980s. At that time, many states passed different laws allowing the entry of out-of state banks as long as other states reciprocate, i.e., if their banks were also given the opportunity to operate in those states[12]. In 1994, the deregulatory process was completed with the Riegle-Neal Act that permitted nationwide branching as of June 1997.

Some restrictions are still imposed in the formation of branches or the conversion of a bank holding company into a branch in order to prevent bank concentration. For instance, a branch cannot have 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. In addition, the Federal Reserve is 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.

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[10] See Mulloy (1995).

[11] By 1994, most states permitted intrastate branching (Strahan (2003)).

[12] In fact, Maine was the first state to pass a law like this in 1978, but not state reciprocated, so the interstate deregulation process was delayed until 1982 when Alaska and New York passed similar laws. See Kane (1996), Kroszner and Strahan (1999), and Strahan (2003).

3 The model

To explain the rationale behind the implementation of the federal branching restrictions in the U.S. banking industry in 1927, and their subsequent elimination in 1994, we develop a spatial competition model between banks. We consider an economy with two banks, 1 and 2, and two regions, A and B. Initially, bank 1 exclusively locates in region A and 2 in region B. Each region is populated by a mass of local investors, which is normalized to one. Investors in each region can borrow from either bank located in regions A or B. Bank j charges an interest rate $r_j^i \geq 0$ to investors in region i. The operating costs of bank j are $c_j \geq 0$. If investors borrow from a bank that is located in the other region, they incur in a transportation cost $t > 0$, which is charged to the loan interest rate. The parameter t represents the cost of performing long-distance transactions. Investment projects in each region yield[13] a gross return equal to $\beta > 0$. Investors borrow from the bank that offers the lowest interest rate. The net return to investors is β minus the interest rate. Investors can always choose not to borrow, in which case they obtain zero profits.

We consider two different settings. First, we assume that banks cannot expand their activities to other regions, i.e., banks can only locate in one single region and cannot open a branch elsewhere. Even though banks are physically restricted from operating in other places, they can still target distant consumers from their own locations. However, in this case, banks face an additional cost represented by the cost of performing long-distance transactions. Thus, bank 1 and 2 choose, respectively, r_1^A and r_2^B. Investors observe the interest rates offered by the banks and choose the action that maximizes their payoffs, which, in this case, are given by

[13] For simplicity, the return to investors is assumed to be the same across regions.

$$U^A \equiv \begin{cases} \beta - r_1^A & \text{if borrow from bank 1,} \\ \beta - r_2^B - t & \text{if borrom from bank 2,} \\ 0 & \text{otherwise.} \end{cases}$$

$$U^B \equiv \begin{cases} \beta - r_1^A - t & \text{if borrow from bank 1,} \\ \beta - r_2^B & \text{if borrom from bank 2,} \\ 0 & \text{otherwise.} \end{cases} \tag{1}$$

Given the investors' behavior, banks compete in interest rates (Bertrand competition).

Alternatively, we consider an environment where bank branching restrictions are no longer present. Specifically, suppose that bank 1 has the alternative of opening a branch in region B. We assume in this section that, for exogenously given reasons, bank 2 still only operates[14] in B. Therefore, without branching constraints, bank 1 will choose the best alternative among the following options: (i) continue operating exclusively in region A, or (ii) operate in both regions at the same time. If bank 1 chooses not to enter region B (i.e., case i)), then the game explained before is played, i.e., banks determine the level of r_1^A and r_2^B and investors decide the best action according to (1). If, on the other hand, bank 1 enters region B, then bank 1 chooses r_1^A and r_1^B and bank 2 chooses r_2^B. In this situation, investors' utilities are given by

$$U^A \equiv \begin{cases} \beta - r_1^A & \text{if borrow from bank 1 in } A, \\ \beta - r_1^B - t & \text{if borrow from bank 1 in } B, \\ \beta - r_2^B - t & \text{if borrow from bank 2 in } B, \\ 0 & \text{otherwise.} \end{cases}$$

[14] Bank 2 is considered a local bank. In the next section, we allow operation costs to differ across banks and bank 2 is assumed to be the "least efficient".

$$U^B \equiv \begin{cases} \beta - r_1^A - t & \text{if borrow from bank 1 in } A, \\ \beta - r_1^B & \text{if borrow from bank 1 in } B, \\ \beta - r_2^B & \text{if borrow from bank 2 in } B, \\ 0 & \text{otherwise.} \end{cases} \quad (2)$$

As before, consumers/investors decide the best action after observing the interest rates offered by the banks.

The figure below outlines the extensive-form representation of the previous games.

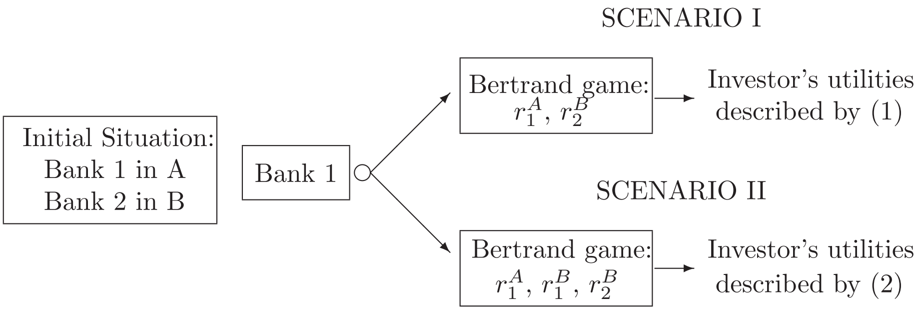

Figure 1: Extensive form representation of the game.

Scenario I takes place if bank 1 does not enter region B. In this case, banks 1 and 2 play a Bertrand game anticipating investors' actions. In other words, they choose r_1^A and r_2^B considering that investors select the action that maximizes their utilities according to (1). In the presence of branching restrictions, this is the only alternative for bank 1. But without these constraints, bank 1 will also evaluate the possibility of entering region B, in which case the game represented by Scenario II is played. In this case, a different Bertrand game takes place where banks simultaneously choose r_1^A, r_1^B, and r2B given that investors select the best alternative as indicated by (2). Anticipating these outcomes, bank 1 determines at the beginning of the game whether it is profitable or not to open another office in region B.

Our objective is to evaluate how the results change when the cost of performing long-distance transactions, t, declines (relative to β)[15]. Therefore, in first place, we derive the sub-game perfect Nash Equilibria for different relationships between the exogenous variables and t and calculate investors' welfare and banks' profits in the two environments described above: with and without branching restrictions. Next, we establish the conditions that would induce bank 1 to open a branch in region B, and determine who would benefit and lose if bank 1 decided to take this action. Finally, we compare the different possible outcomes. In light of these results, we will evaluate the effectiveness of the regulation that prohibits banks to open branches in other places. In other words, if bank 1 obtains higher profits in Scenario I than in Scenario II, then the branching constraint would not be binding.

The next section considers a simplified version of the model in which banks' operating costs and fix cost are equal to zero. This model captures the essential arguments of the discussion on branching restrictions. The following section extends the basic framework by assuming that operating costs differ across banks and by assuming that bank 1 must pay a fixed cost when it decides to open a branch in region B.

4 The model with identical costs

In this section, we assume that banks' operation costs (and fixed costs) are zero, i.e., $c_j = 0$, for $j = 1, 2$. As explained before, we obtain the sub-game perfect Nash

[15] For banking transactions, this cost has significantly decreased in the last 50 years, which may have affected banks' incentives to open branches elsewhere. We assume that bank location is exogenously determined in our model. A Nash Equilibrium may not exist if banks also select their location. Some papers show the existence of a Nash Equilibrium under certain specific assumptions. See, for example, Prescott (1979).

Equilibria, which implies solving the game using backward induction. At the end of the game, investors choose the action that maximizes their utilities according to (1) or (2). In deciding the interest rates, banks anticipate the investors' behavior. The competition between banks critically depends on whether bank 1 enters or not region B. Scenario I represents the sub-game in which bank 1 locates in A and bank 2 in B. Scenario II, on the other hand, represents a situation where bank 1 opens an office in region B. The following two subsections derive the Bertrand Nash Equilibrium and compare the solutions obtained in the two scenarios.

4.1 Scenario I: bank 1 operates in A and bank 2 operates in B

In this case, the payoffs for different actions available to investors in A and B are described by (1). They choose the action that maximizes their utilities. Recall that they do not borrow from a bank if the net return is negative[16].

Suppose that $(i) t < \beta$; (ii) $t = \beta$; and (iii) $\beta < t$ represents three different cases that correspond, respectively, to low, medium, and high transaction or transportation costs. In addition, we assume that $\beta < 2t$. The following proposition describes the Bertrand equilibrium (r_1^A, r_2^B) and the resulting equilibrium payoffs for consumers and banks.

Proposition 1 *Consider the duopoly sub-game in which bank 1 locates in region A and bank 2 in B. For all cases (i) $t < \beta < 2t$, (ii) $t = \beta < 2t$; and (iii) $\beta < t < 2t$, the equilibrium interest rates are $r_1^A = r_2^B = \beta$, investors in A borrow from bank 1, investors in B borrow from bank 2, investors' welfare in both regions is 0, and banks' profits are β.*

Proof Case (i): $t < \beta < 2t$. We need to show that no bank can increase its profit by undercutting the price of the other bank. Suppose that bank 2 chooses $r_2^B = \beta$.

[16] We assume that if investors are indifferent between borrowing from any bank, they will actually borrow from the local one.

If bank 1 would like to attract investors located in region B, the interest rate has to be at most the interest rate that they can get in region B (r_2^B) minus t, i.e., $r_1^A = r_2^B - t = \beta - t$. In this case, profits for bank A would be given by $\pi_1^A = 2(\beta - t)$. However, when it does not undercut and charges $r_1^A = \beta$, profits become $\pi_1^A = \beta$, which are higher than $2(\beta - t)$ because $\beta < 2t$. A similar argument applies to bank 2. Hence, (r_1^A, r_2^B) are the equilibrium rates, $U^A = U^B = 0$, and $\pi_1^A = \pi_2^B = \beta$. Case (ii): $t = \beta < 2t$. If bank 1 undercuts, then it would set again $r_1^A = \beta - t = 0$, so that $\pi_1^A = 0$. If, on the other hand, it does not undercut, then $r_1^A = \beta > 0$, and $\pi_1^A = \beta > 0$. Hence, we obtain the same results as in (i). Case (iii): $\beta < t < 2t$. If bank 1 undercuts, then it would set $r_1^A = \beta - t < 0$, and obtain $\pi_1^A < 0$; if it does not undercut, $r_1^A = \beta > 0$, and obtain $\pi_1^A = \beta > 0$. Thus, the previous results still hold. □

Hence, given that banks exclusively operate in one area, they will end up charging the highest possible interest rate to local investors, which is given by β.

4.2 Scenario II: bank 1 opens a branch in region B

Now, we examine a situation where bank 1 opens a branch in region B. The utility of investors located in A and B are given by (2). Suppose that $t < \beta < 2t$. Since two banks operate in B, price competition drives interest rates to zero in that region, i.e., $r_1^B = r_2^B = 0$. Thus, bank 1 will never be able to attract all investors in B. Given that investors in A have the possibility of borrowing at 0 interest rates from any bank in B, the highest interest rate bank 1 can charge in region A is $r_1^A = t$. For this interest rate, the utility of investors in A is $U^A = \beta - t$ when they borrow from bank 1, and $U^A = \beta - t - r_j^B = \beta - t$ when they borrow from bank j in B, so they are indifferent between the two alternatives[17]. The same reasoning applies when $t = \beta < 2t$. If $\beta < t < 2t$, the highest interest rate

[17] If this is the case, investor in A will decide to borrow from the local home. Therefore, bank 1 located in region A attracts only investors from region A.

that bank 1 can charge is β since investors have a zero reservation utility. In these last two cases, the utility of those residing in A is zero. The following proposition summarizes the results.

Proposition 2 *Consider the duopoly sub-game in which bank* 1 *locates in regions* A *and* B *and bank* 2 *locates in region* B. *Then,*
(i) if $t < \beta < 2t$, *the equilibrium interest rates are* $r_1^A = t, r_1^B = r_2^B = 0$, *investors in* A *borrow from bank* 1, *investors in* B *borrow either from bank* 1 *or bank* 2 *in* B, *investors' utility in region* A *is* $(\beta - t) > 0$, *investors' utility in region* B *is* β, *bank* 1*'s profits are* t, *and bank* 2*'s profits are 0;*
(ii) if $t = \beta < 2t$, *equilibrium interest rates are* $r_1^A = t, r_1^B = r_2^B = 0$, *investors in* A *borrow from bank* 1, *investors in* B *borrow either from bank* 1 *or bank* 2 *in* B, *investors' utility in region* A *is 0, investor's utility in region* B *is 0, bank* 1*'s profits are* $t = \beta$, *and bank* 2*'s profits are 0;*
(iii) if $\beta < t < 2t$, *the equilibrium interest rates are* $r_1^A = \beta, r_1^B = r_2^B = 0$, *investors in* A *borrow from bank* 1, *investors in* B *borrow either from bank* 1 *or bank* 2 *in* B, *investors' utility in region* A *is 0, investor's utility in region* B *is* β, *bank* 1*'s profits are* β, *and bank* 2*'s profits are 0.*

4.3 Comparing the results

Next, we compare the results obtained in Scenarios I and II, which will allow us not only to determine who benefits and who loses in both situations, but also examine whether it would be profitable for bank 1 to open a branch in region B or not. The outcomes of the last two models are summarized in Table 1 below.

The first column of the table indicates the two different scenarios. The second column considers different relationships between β and t. The last five columns present the Nash Equilibrium and the payoffs for each one of the cases. Four interesting observations are worth emphasizing.

Bank Location	Condition	NE	Investor Welfare		Bank Profits	
			Region A	Region B	Bank 1	Bank 2
Scenario I:	$t < \beta < 2t$	$r_1^A = r_2^B = \beta$	0	0	β	β
Bank 1 in A	$t = \beta < 2t$	$r_1^A = r_2^B = \beta$	0	0	$\beta = t$	$\beta = t$
Bank 2 in B	$\beta < t < 2t$	$r_1^A = r_2^B = \beta$	0	0	B	β
Scenario II:	$t < \beta < 2t$	$r_1^A = t$ $r_1^B = r_2^B = 0$	$\beta - t$	β	t	0
Bank 1 in A and B	$t = \beta < 2t$	$r_1^A = t$ $r_1^B = r_2^B = 0$	0	β	$\beta = t$	0
Bank 2 in B	$\beta < t < 2t$	$r_1^A = t$ $r_1^B = r_2^B = 0$	0	β	B	0

Table 1: **Summary of results**: $c_1 = c_2 = 0$.

First, investors in region B are always strictly better-off in Scenario II, while investors in region A are never worse-off. In fact, if $t < \beta < 2t$, their welfare increases to $(\beta - t) > 0$ when bank 1 opens a branch in B. This result is explained by the fact that Bertrand competition in region B drives interest rates down, benefiting residents of that region. Aggregate investor welfare is unambiguously higher in Scenario II. Second, profits of the immobile bank located in region B are lower for every case in Scenario II. Finally, total welfare, as measured by the sum of investors' utilities and banks' profits is equal to 2β in all cases.

Bank 1, at the beginning of the game, decides whether to operate in region B or not by comparing profits obtained in Scenario I and II. It is not profitable for bank 1 to open a branch when $t < \beta < 2t$. However, it is indifferent between Scenarios I and II when $\beta\ leq\ t < 2t$. The intuition behind this last result is clear. When bank 1 enters the market in region B, the interest rate falls to zero in that region. Given this reduction in the interest rate, investors in A would be tempted to borrow from B. Hence, bank 1 in A would need to reduce the interest rate in A to prevent this kind of behavior. If $t < \beta < 2t$, bank 1 would suffer a profit reduction as a result of this action. Only when transactions costs are high, i.e., $\beta\ leq\ t < 2t$, bank 1 will open a branch in another region since profits are the same in the two scenarios. The last result is restated as a proposition below.

Proposition 3 *It is not profitable for bank 1 to open a branch in region B when t is low, in particular, if $t < \beta < 2t$. If $\beta \leq t < 2t$, bank 1 is indifferent between Scenarios I and II.*

Thus, any regulation that prevents banks from opening branches or subsidiaries in other regions would only make sense if transportation costs or the cost of performing long-distance transactions is large.

Note that this simple model can identify those individuals that benefited from the regulation of bank branching introduced by the McFadden Act in 1929. According to our results, branching restrictions would only benefit banks in region B. Therefore, bank owners in regions that could be threatened by the entry of big banks would presumably promote branching restrictions. However, these restrictions are relevant only when transaction costs are high. Only in this case will banks find it profitable to open branches. Transactions costs were definitely high at the beginning of the 1900s. Therefore, the implementation of branching restrictions at that time would be largely supported by “local banks” because banks from other regions would otherwise open branches driving the profits of local banks to zero. The decline in these costs due to technological improvements in the banking industry made the branching restrictions irrelevant and obsolete as banks will prefer to operate from a single location.

A few papers have used similar explanations to justify the enforcement of different regulations in the banking sector. Kane (1996), for instance, uses a special interest group theory to explain why regulatory measures were implemented and why it took so long to get rid of these restrictions. Kane (1996) also believes that there was no reason to maintain the branching restrictions due to the technological advances in the banking sector[18]. Kroszner and Strahan (1998) find that interest group factors related to the relative strength of potential winners (which are basically large banks) and losers (small banks) can explain the timing of branching deregulation across states during the last four decades.

5 The model with heterogeneous operating costs and positive set-up costs

Now we extend the previous model by assuming that banks 1 and 2 have different operating or variable costs. Specifically[19], $c_2 > c_1 = 0$. We also consider values of the parameters such that[20] $c_2 < \beta < 2t$. Table 2 shows the equilibrium interest

[18] However, Kane (1996) does not consider the spatial competition in prices.
[19] This assumption attempts to capture the idea that the bank that actually has the alternative to open a branch in another region, in this case bank 1, is effectively the bank with lower operating costs or more efficient.
[20] If $\beta < c_2$, then bank 2 will decide not to operate at all.

rates, investors' welfare and profits in the two scenarios described previously[21]. In solving the game, we use the following rule for splitting up consumers between banks when interest rates are equal: if residents of A and B are indifferent between banks located in different regions, then they will borrow from the bank located in their respective region; in Scenario II, if residents in B are indifferent between borrowing from bank 1 or 2, then the rule assigns all consumers to bank 1 in that region[22].

Most of the results are similar to the previous ones. For instance, investors in B become better-off, investors in region A are never worse-off, and bank 2 in B has lower profits in Scenario II. However, there are a few exceptions. First of all, bank 2 is now forced to leave the market when bank 1 opens a branch in region B. In Scenario II, the best response by bank 2 consists on setting any interest rate greater than or equal to c_2. Consequently, nobody borrows from bank 2 and its profits are zero. Second, total welfare, calculated as the sum of investors' utility and banks' profits are higher in Scenario II. In Scenario I, total welfare is $2\beta - c_2$, while in Scenario II, it becomes 2β. Third, bank 1's profits are higher in Scenario II when $\beta \leq c2 + t < 2t$, while profits are higher in Scenario I if and only if t is sufficiently small, i.e., $t < \beta - 2c_2$ (or t is such that $2c_2 + t < \beta$). For this last condition to be relevant, we also require $\beta > 2c_2$. Note that if the latter inequality does not hold, it will always be profitable for bank 1 to open a branch

[21] The equilibria are obtained in a similar way as in Section 3. We do not include the derivations here, but they are available upon request.

[22] To simplify the derivations, we assume a specific division of consumers between banks when they charge the same interest rates. The idea of splitting up consumers in the way specified in the text is justified on the grounds that, if r_i^j is a continuous variable, then an equilibrium does not exist, i.e., bank 1 would want to choose an interest rate very close to c_2, but not equal to c_2. For instance, bank 1 would pick $r_1^B = c_2 - \epsilon$, where ϵ is positive and very close to zero. However, such ϵ does not exist. If, on the other hand, we assume that bank 1 gets all the consumers when $r_1^B = r_1^A = c_2$, then there is no discontinuity at c_2 and an equilibrium exist. Alternatively, we could have worked with a grid of discrete interest rates (instead of a continuum of interest rates). It is easy to show that, in this case, the equilibria in pure strategies will converge to the proposed solutions when the grid becomes finer.

Bank Location	Condition	NE	Investor Welfare		Bank Profits	
			Region A	Region B	Bank 1	Bank 2
Scenario I:	$c_2 + t < \beta < 2t$	$r_1^A = r_2^B = \beta$	0	0	B	$\beta - c_2$
Bank 1 in A	$c_2 + t < \beta < 2t$	$r_1^A = r_2^B = \beta$	0	0	B	$\beta - c_2$
Bank 2 in B	$\beta < c_2 + t < 2t$	$r_1^A = r_2^B = \beta$	0	0	B	$\beta - c_2$
Scenario II:	$c_2 + t < \beta < 2t$	$r_1^A = c_2 + t$ $r_1^B = c_2, r_2^B \geq c_2$	$\beta - c_2 - t$	$\beta - c_2$	$2c_2 + t$	0
Bank 1 in A and B	$c_2 + t = \beta < 2t$	$r_1^A = \beta$ $r_1^B = r_2^B = 0$	0	$\beta - c_2$	$\beta + c_2$	0
Bank 2 in B	$\beta < c_2 + t < 2t$	$r_1^A = \beta$ $r_1^B = r_2^B = 0$	0	$\beta - c_2$	$\beta + c_2$	0

Table 2: **Heterogeneous variable costs**: : $c_2 > c_1 = 0, \beta > c_2$.

in region B. Thus, in order for Scenario I to be preferred to Scenario II for bank 1 when $c_2 + t < \beta$, t and c_2 both have to be sufficiently low. Hence, the more efficient bank would only open a branch when t or c_2 are sufficiently large. The following proposition summarizes this last result.

Proposition 4 *Bank 1 maximizes its profit by opening a branch in region B when c_2 and t are such that $\beta \leq 2c_2 + t$. It maximizes profits by completely withdrawing from region B if $2c_2 + t < \beta$.*

The outcome of this model also reveals that bank branching would lead to bank concentration if transaction costs are relatively high and/or local banks are very "inefficient" in the sense that their operating costs c_2 are large. In this case, banks from other locations would have an incentive to open branches and inefficient local banks will be forced out of the market[23]. On the other hand, the elimination of the branching restrictions do not have any effect if transactions costs are sufficiently low given that big or efficient banks no longer have an incentive to open branches elsewhere.

Therefore, technological changes in the banking made, in some way, the MacFadden Act (1927) obsolete as branching restrictions are no longer binding when the cost of performing long-distance transactions is low enough. The necessity to update banking regulation in terms of the advances verified in the sector resulted in the Riegle Neal Act of 1994. Our model predicts that this law should not have had any significant effect given that it just eliminated a restriction that was no longer binding.

Now suppose that if bank 1 opens a branch in B, it faces a setup cost equal to θ. Then, at the beginning of the game, bank 1 will decide to open an office in B if profits in Scenario II minus θ are at least as big as those obtain Scenario II. In this way, Proposition 4 should be restated as follows:

[23] Ennis (2001) also claims that technology progress tend to induce small banks to disappear.

Proposition 5 *Bank* 1 *maximizes its profit by opening a branch in region* B *when* c_2 *and* t *are such that* $\beta \leq 2c_2 + t - \theta$. *It maximizes profits by completely withdrawing from region* B *if* $2c_2 + t - \theta < \beta$.

As a result, the consideration of setup costs simply decreases the likelihood of bank 1 entering into region B when no branching restrictions are present. Again, the argument that bank branching regulation play no significant role under these conditions is reinforced. However, as it is clear from the model, it would still not prevent local banks from being forced out of the market.

6 Conclusions

The paper develops a spatial competition model in which banks compete in prices. Two different scenarios are considered. The first one assumes that banks cannot open a branch or a subsidiary in another region. The second scenario assumes that there are no branching restrictions. We derive the Nash Equilibria and determine winners and losers in each case. Additionally, we examine whether the incentives to open a branch are affected when the cost of performing long-distance transactions decreases, as evidenced in the banking sector.

The model concludes that branching restrictions are not binding when technological advances reduced the cost of performing long-distance transactions. This means that the MacFadden Act of 1927, which prevented banks from opening branches in other states, becomes completely obsolete under these conditions. The necessity to update banking regulation in terms of the advances verified in the sector resulted in the Riegle Neal Act of 1994. Our model predicts that this law only updated the legislation and made it consistent with the economic reality in the banking sector. In other words, it just eliminates a restriction that was no longer binding.

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