A Model of Retail Banking Competition*

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Abstract

This paper develops a model of competition in retail banking, in which banks compete first in branching and then in prices. The structure of the industry is analyzed, in particular with respect to number of banks and their branching size. The model relates the gain from increasing the size of the network to the profits of a latter stage in which banks compete in prices. It is shown that for small market sizes unit banking is an equilibrium, whereas for larger market size branching bank prevails. Moreover the model predicts that banking deregulation results in higher degrees of concentration and larger average branching size of banks. Finally this framework allow us to evaluate the impact of regulation (branching restrictions, capital requirements and deposit insurance) on the structure of the banking industry as well as to explain the historical evolution of UK and US banking industries.

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I hate closing branches. They are the biggest competitive advantage we've got. Mr Pitman of Lloyds Bank (The Economist - 2/5/92)

1 Introduction

The purpose of this paper is to analyze the strategic behaviour of banks in the retail market, but more importantly the outcome in terms of industry structure that derives from it. Branching is undoubtedly an important feature in retail banking, although there are few attempts to incorporate it into the analysis of banking competition. Even if I do not believe that branching distinguishes banks from other firms, I think that it captures an important aspect of retail banking competition. A bank in fact can attract clients in two ways: either by topping its rival deposit interest rate or by increasing the size of its branch network.

In this paper I develop a model of branching competition. It consists of a two stage game in which at first banks decide how many branches to open, and then compete in prices. One may for example assume that opening a branch entails a more durable decision than setting prices. On one hand the number of branches affects the demand for the individual branch, on the other the choice of how many branches to open is closely related to the outcome of price competition. The higher are the profits from price competition, the higher will be the incentive to increase the number of branches. Given a general functional specification of branching costs, two symmetric equilibria can arise for different market size: the branching and the unit banking equilibria.

One of the recurrent issues in banking literature, especially for regulatory purposes, is as a matter of fact the choice between unit bank and branching bank. This paper contributes to that discussion in that it derives the choice between unit and branching banking endogenously and points to some of the reasons for the industry to develop in one way or the other. Looking at the history of US and the UK for example the banking industry started from a unit banking system and then evolved into a branching banking one. In our model this is due to an increase in the market size for given setup costs. Hence the pattern of branch ownership may drastically change with an increase in market size. The ownership of a larger network size, here has a positive impact on profits of the bank, because it allows to jointly maximize profits among branches. This externality however is not strong enough to offset the decrease in concentration due to new entries that follows from an increase of the market size. In particular the degree of concentration declines monotonically with an increase in the market size. Hence, in the limit the industry will become more and
more fragmented as the market size increases.

One important implication of the model is that banking deregulation, namely an increase in the toughness of price competition, implies an higher degree of concentration and a larger branching network of banks. The intuition being the following: a tougher price competition reduces profits, hence in equilibrium there will be fewer firms. We show moreover that when colluding, banks internalize the effect of opening new branches on their rivals. Therefore, when collusion is banned banks tend to set larger branching networks.

However I believe that the structure of the banking industry, by being tightly regulated, cannot be explained only on the ground of banking competition. Structural regulation (conduct, entry regulation, capital requirements etc) affects the shape of the industry toghether with the rivalry mechanism. I suggest to look at some of these regulatory measures, by studying their effect on the degree of concentration of the industry and the size of the banks. It is shown that branching restrictions increases both gross profits and the degree of concentration. Higher capital requirements implies an increase in the degree of concentration and possibly a reduction in the average size of the branching network. Moreover if we interpret deposit insurance as the variable cost of branching, then we must expect a reduction in the average size of the bank.

Next section discusses the relation with the literature. In section 3 a model of retail banking is developed. Section 4 discusses the implications for regulation and finally in section 5 some empirical predictions conclude the paper.

2 Relation to the literature

This paper is an attempt to model the evolution of the structure of the banking industry, by studying toghether competition among banks and the decision to enter the market. It is therefore related to the literature on banking competition.

There are several attempts to model banking competition from an industrial organization point of view. On one hand Repullo (1990), Montgomery (1990), Sussman (1990), de Palma, Uctum (1992), Schmid (1994) and Chiappori, Perez-Castrillo, Verdier (1995) to cite only some, apply models of horizontal differentiation to banking. The only difference between banks and firms being that banks compete in two markets instead of one, i.e. deposit and loan market. By assuming a perfectly competitive interbank market, complete independence of the two activities of the bank is obtained. The predictions of these models are that banking industry should be very

\[1\text{Chiappori et al.}(1995)\text{ actually show that in a regulated industry, banks may be better off by}\]
fragmented, that is, as the market size increases, the degree of concentration falls. On
the other hand few papers, as Gerhig (1990) and Matutes, Vives (1991), introduce
a network externality to explain the possibility that asymmetric configurations arise
in banking. Contrary to them we do not allow for asymmetric equilibria, because
we focus on the entry decision to study the impact of the network externality on the
dynamics of the industry.

This paper focuses on the evolution of the structure of the industry and intro-
duces branching competition, as a source of network externality, to see whether the
fragmented outcome is robust to this new ingredient.

There are few theoretical attempts to study the effect of branching competition
in banking. Gale (1992) for example compares, branching to unit banking. His main
result, driven by the search behaviour of depositors, is that branching bank supplies
the service at a more competitive rate than unit bank. However the two configurations
are exogenously assumed instead of being derived as equilibrium outcomes. In this
paper not only we derive the two configurations endogenously, but also we study
the evolution of the industry when branching is an important feature of banking
competition. Nakamura, Parigi (1992) explain in a theoretical model the coexistence
of unit and branching banks because depositors have heterogeneous preferences and
only a fraction of them travel among locations. Their model on the other hand is not
dynamic, since they don’t study entry into the industry. Cabral, Majure (1993) focus
on branching competition, by studying a general reaction function with branches as
argument. Their empirical analysis is concerned with the estimation of the branching
reaction function and patterns of branching. They argue that price competition was
not important in Portugal because of interest rate regulation, hence they can focus on
a pure location game and conclude that Portuguese banking industry about 1990 was
not in equilibrium, but they do not explain why. Finally Schmid (1994) and Chiappori
et al. (1995) study models of monopolistic competition where branching coincides
with new entry, therefore ruling out competition between multi-branch banks.

3 The model

There are \( q+1 \) banks in the economy and the total number of branches in the industry
is \( N \). The number of banks and number of branches however is endogeneous and is to
be determined as solution to the model. Each bank owns \( n_i \) branches. Each branch
supplying tied sales contracts, abandoning in this way the separation theorem. We will refer to
their model without tied-sales contracts.
supplies a single product, which represents a bundle of services sold at that branch. Moreover each branch is located at a different place and we allow only for one branch to locate exactly there.

This is a rather abstract location model where each branch competes with every other branch, but in fact it is very similar to a monopolistic competition model. In this respect Hotelling line is a particular case where firms compete only with neighbours.\(^2\)

Each branch faces the following demand\(^3\)

\[
x_i(N) = S \frac{a(2 - c) + c \sum_{j \neq i} p_j - p_i[2 + c(N - 2)]}{\beta(2 - c)[2 + c(N - 1)]}
\]

where \(c \in [0, 2]\) is the degree of substitutability between products offered by different branches (in particular \(c = 0\) is the case of local monopolists, whereas \(c = 2\) is the Bertrand competition case), \(p_i\) is the price at that branch, \(p_j\) the price at a different branch and \(S\) is a measure of the size of the market.\(^4\) It is important to notice that, with this demand, if an additional branch is opened, it is possible to capture new customers. It is indeed easy to show that the total demand in the market increases with the total number of branches, i.e. that \(\sum_{s=1}^{N} x_s(N)\) is increasing in \(N\) at fixed prices. This effect is not present for example in spatial models, as the Salop circle, where an increase in the number of products crowds further the market, inducing only a business stealing effect. Here an increase in the number of branches may correspond to opening new niches in the industry, where before nobody was operating. However with this demand function there is an important relation between the expansion effect and the business stealing effect. When the degree of substitutability between...

\(^2\)It is possible to replicate several of the results presented here in a Salop's model of spatial competition, where banks locate along a circle of size \(S\). However we need to assume (i) that branches of the same bank locate close to each other, (ii) that every time a new branch is opened every other branch relocate along the circle in order to maintain symmetric locations and (iii) finally that banks cannot price discriminate among branches. One important difference with the model presented here is that the market doesn't expand when a new branch is opened. Hence the model presented here is more general in the sense that it allows for both an expansion effect and a competition effect. Chiappori et al. (1995) have a model of monopolistic competition where banks locate along the circle. However they rule out multibranch banks, while focusing on new entry. They explain that multi-branch banks will not occur in their model because the network externality is not too strong. Our understanding of their result is that in their model branching does not have an expansion, but only a competition effect.

\(^3\)This demand function derives from preferences for different goods used in Shaked-Sutton (1990) to model the demand for a single output of a multiproduct firm. In their paper a firm sells different products, but one can think of a bank opening several branches. This function allows for depositors to deposit at different branches at the same time. Or differently one can think that even for branches at the same location, consumers perceive differences. Notice that the parameter \(c\) is a measure of this perceived difference. The smaller is \(c\) the least substitutable are different branches.

\(^4\)\(S\) is a scalar that measures market size. An increase in \(S\) induces an isodiscastic shift of the demand. We will need this shift for the comparative statics analysis.
products offered at different branches increases, $\epsilon$ higher, the more important becomes the business stealing effect, the less the expansion effect. In this sense, this abstract model of monopolistic competition is more general than the correspondent spatial model.

In the first stage the bank decides how many branches to open. There are costs to be sunk at this stage, given by a fixed cost of entry $\sigma$, corresponding to the cost of opening the first branch, or the cost of entering the market, plus a variable cost, $\epsilon$, for each additional branch. The sunk costs are represented by the following function

$$F(n) = \sigma + \epsilon(n - 1) \quad n \geq 1$$

(2)

This cost function has several advantages. On one side it is simple enough to describe branching costs; on the other side it is general enough to allow for either economies or diseconomies of scale. The relation between the cost of entry and the variable cost determines whether there are economies of scale in branching. In particular we have economies of scale when $\sigma \geq \epsilon$.\(^5\)

In the first stage banks decide the size of their branching network, whereas in the second stage they compete in prices. We think of the branching decision as a long term decision, whereas price decisions can be taken with more flexibility. In other words, the decision of opening a branch is more irreversible, because it is very costly to close a branch.\(^6\)

The game is solved backwards: next subsection derives the reduced form of the profits from the price competition game, given that banks have already set their branch network; afterwards we derive the Nash equilibria of the branching game, i.e. the subgame perfect equilibria of the two stage game.

### 3.1 Price competition

Without loss of generality, we assume that the bank doesn’t price discriminate between different branches. This doesn’t affect any of the results since we concentrate

\(^5\)There are few empirical attempts to estimate branching costs in banking. Nelson (1985) for example estimates a cost function which incorporates branching costs for a sample of US banks. He founds that there are economies of scale at the branch level, but there are no economies from expanding the branching network. This result, although not a direct test of branching costs, implies constant average costs per branch as the number of branches increases, i.e. $\sigma = \epsilon$. On the other hand Schmal (1994) directly tests the elasticity of branching with respect to costs and finds diseconomies of scale in branching, i.e. $\sigma < \epsilon$.

\(^6\)We do not model the decision to close branches. However we are aware that this point, disregarded by the literature, has received lot of attention by practitioners and may therefore deserve some thoughts. See for example a study by Boston Consulting Group (1992).
on symmetric equilibria in prices and branches. The bank maximizes joint profits along its branches, i.e. coordinate the price decision among its branches avoiding that its own branches steal business to each others. The possibility of jointly maximizing profits among the branches owned by the same bank explains the gain of choosing a larger branching network. Here we assume that the externality of having a larger network size comes from the supply side. However one can use this model to tell a different story as for example that there are gains from diversification due to an increased value of the assets because of a smaller probability of bankruptcy or that depositors value more a larger branching network because they value the access to their bank account at different locations. These different stories have all the same effect on the reduced form of profits, namely that profits increase with the size of the branching network.

Let’s assume that $q$ banks set price $\bar{p}$ and own $\bar{n}$ branches, while bank 1, the deviant, sets price $p_1$ and owns $n_1$ branches. The problem for bank 1 is to choose the price that maximizes the profits of its $n_1$ branches

$$\max_{p_1} \sum_{s=1}^{n_1} p_s x_s(N)$$

s.t. $p_s = \bar{p}$ $s = n_1 + 1, \ldots, N$

When we solve the symmetric problem for each of the others $q$ banks, we have a system of FOCs, from which we get that in equilibrium the ratio of prices is

$$\frac{p_1}{\bar{p}} = \frac{2\gamma - c\bar{n}}{2\gamma - cn_1} \tag{3}$$

where $\gamma = 2 - c + cN$ and $N = q\bar{n} + n_1$.\footnote{The computations are reported in the Appendix.}

**Result 1** The ratio of prices $p_1/\bar{p}$ is increasing in $n_1$, that is the bank can charge a higher price by increasing the number of branches it owns.

**Proof** Let’s define $\lambda$ the inverse of the ratio in equation (3); then it is easy to show that $d\lambda/dn_1 < 0$.\hfill \square

In this model there is at work a mechanism similar to that of a vertical differentiation model.\footnote{See Sutton (1991) as reference for the general properties of vertical differentiation models. Notice that this result implies that the price of financial intermediation at the bank level should be increasing in the number of branches. Schm id (1994) shows evidence contrasting with this result. Our understanding is that he captures the effect of an increase in the number of banks on the equilibrium price of intermediation, therefore the effect of an increase in competition.} In equilibrium the deviant firm manages, by increasing the number of
branches, to charge an higher price. In a vertical differentiation model the firm that chooses higher quality, can in equilibrium set an higher price.

As a result of the price competition game, the deviant bank sets price

\[ p_1 = \frac{\alpha(2 - c)}{2(2 - c) + c\tilde{q}(2 - \lambda)} \]

and earns per-branch profits

\[ \pi(n_1/\tilde{n}) = S\frac{\alpha^2(2 - c)[2 - c + c\tilde{q}]}{\beta\gamma[2(2 - c) + c\tilde{q}(2 - \lambda)]^2} \tag{4} \]

where \( \gamma = 2 - c + cN \). From equation (4), we can derive the properties of the per-branch profits and total revenues. First of all let us define the total gross profits over the branching network of bank 1, as revenues \( R_1 = n_1\pi(n_1/\tilde{n}) \), where \( n_1 \) is the number of branches of bank 1 and \( \tilde{n} \) the number of branches of the competitors.

**Result 2** Per-branch profits \( \pi_1(n_1/\tilde{n}) \) are decreasing at a decreasing rate in \( n_1 \), moreover total revenues \( R_1(n_1/\tilde{n}) = n_1\pi_1 \) are increasing and concave in \( n_1 \), for \( c \in (\alpha, \bar{c}) \).

**Proof** In the Appendix.

For given number of branches, the price tends to the marginal cost, set to zero for sake of simplicity, when the number of banks goes to infinity.\(^9\) Hence as the number of banks and/or branches in the industry increases without any limit, the price converges to the competitive price and profits goes to zero as well.

### 3.2 Branching competition: unit vs branching

Each bank faces the following trade-off when deciding to open an additional branch: on one side its overall profits increase as a result of a larger market share by capturing new clients, which improves its monopoly power and, as a consequence, its ability to extract more surplus by charging higher prices to the old clientele; on the other hand it incurs in losses due to “cannibalism”, namely the fact that the new branch steals business to the preexisting branches. On top of this there are costs to be sunk when new branches are opened.

Let’s therefore solve the first stage of the game, the branching game, which helps evaluating the solution to the trade-off. The deviant firm has to decide how many branches to open, given the optimal number of branches of all the non deviant banks. The problem has two symmetric subgame perfect equilibria (SPE). A first SPE is the

\(^9\)This follows from the fact that as \( q \to \infty, \lambda \to 1 \).
unit banking equilibrium, in which each bank opens only one branch, \( n = 1 \). In this case the sunk costs are \( \sigma \) and we get as a result that the degree of concentration, which for the symmetric equilibrium is the inverse of the number of banks in the industry, decreases when the market size increases.

The second SPE is the branching banking equilibrium, in which each bank opens more than one branch, \( n > 1 \). Here the sunk costs are endogenously determined. Also in this case, when the market size increases relatively to the entry costs, there is no lower bound to the degree of concentration of the industry. This result contrasts with the result in the vertical differentiation models, where there could be a limit to the number of firm that can enter the market.\(^{10}\)

We treat the number of branches as a continuum variable, although the results for the symmetric equilibria do not depend on this assumption.

The condition to get a unit banking (UB) equilibrium is that

\[
(i) \quad \frac{\partial R_1(n_1/\bar{n})}{\partial n_1} < \frac{dF(n_1)}{dn_1} \quad n_1 = \bar{n} \geq 1
\]

The condition states that if the marginal benefit from opening an additional branch is overweighted by its marginal cost, then the deviant bank has no incentive to open more than one branch.

We are interested in the structure of the industry, i.e. number of banks and network size, hence we must add a free entry condition. As a consequence we require each bank in the industry to recover at least its entry cost. The following condition on profits must hold

\[
(ii) \quad R_1(n_1/\bar{n}) \geq \sigma \quad n_1 = \bar{n} = 1
\]

These two conditions imply that at \( n > 1 \), the total profits are flatter than the sunk costs and so the unit branching solution maximizes the profits of the deviant.

We must check that for \( n_1 = 1 \), the sunk costs are recovered by the profits, which in this case are \( \sigma \). It is easy to show that this condition could be satisfied with both economies or diseconomies of scale in branching, that is for almost any value of \( (\sigma, \epsilon) \).\(^{11}\) However there is a restriction on the degree of substitutability, i.e. \( \bar{c} \in (0, \bar{c}) \).

\(^{10}\)In the BB equilibrium the sunk costs are endogeneous, hence it is natural to compare the properties of this equilibrium to the results in vertical differentiation models. We refer to Sutton(1991) for the analysis of the impact of exogenous and endogenous sunk costs on the industry structure.

\(^{11}\)There is in fact a restriction,

\[
\frac{\sigma - \epsilon}{\sigma} \leq \frac{1}{2 + \frac{q}{3 + 2q}}
\]
If \( c = 2 \) for example, \( R_1 = 0 \) and therefore there is no room for more than one firm in the market. Hence \( \tilde{c} \) is the upper limit to the degree of competition, compatible with the fact that each firm has to recover \( \sigma \).\(^{12}\) We can finally establish the following result for the UB equilibrium

**Proposition 1** If conditions (i) and (ii) are satisfied, the degree of concentration decreases as the market size increases relatively to the entry cost, \( \sigma \), for a given degree of competition \( c \in (0, \tilde{c}) \), i.e.

\[
\frac{d(1/q)}{d(S/\sigma)} \leq 0
\]

**Proof** In the Appendix.

As the market size increases there will always be at least one firm that finds profitable to enter the industry by setting one branch. The number of firms that enter the industry will be determined by their ability to recover their sunk costs. However, since individual profits are decreasing in the number of banks, there is a maximum number of banks, for a given market size, that will recover the sunk costs. Hence as the market size increases the number of firms that are able to recover the entry cost increases.

However it could turn out that condition (i) is not satisfied, hence an alternative SPE could arise, that is one in which banks open several branches. The condition to get a **branching banking (BB)** equilibrium is that

\[
(iii) \quad \frac{\partial R_1(n_1/\tilde{n})}{\partial n_1} = \frac{dF(n_1)}{dn_1} \quad n_1 = \tilde{n} > 1
\]

This condition implies that the bank opens additional branches, whenever its rivals open \( \tilde{n} \), up to the point where the marginal benefit from opening another branch equates the marginal cost. Again for the free entry condition, sunk costs must at least be recovered,

\[
(iv) \quad R_1(n_1/\tilde{n}) \geq \sigma + \epsilon(n_1 - 1) \quad n_1 = \tilde{n}
\]

Notice that now for \( n_1 > 1 \), the sunk costs are larger than \( \sigma \). It is important to define under which conditions this equilibrium may appear, when the number of banks is endogeneously determined.

\(^{12}\)We will discuss this condition in next subsection, since it constitutes the argument of Proposition 3.
Result 3 Necessary condition to have a BB equilibrium is that there are economies of scale in branching, i.e. $\sigma \geq \epsilon$.

Proof In the Appendix.

This result is entirely due to the zero profit condition being binding at the equilibrium. If we fix the number of banks, then we don’t need economies of scale to have a BB equilibrium. For example it is easy to show that for a monopolist it could be optimal to set more than one branch even if there are diseconomies of scale in branching. When we let the number of banks to be determined endogenously instead, the sunk costs must be just recovered and so there is no room for extra profits, that is per-branch profits cover just the average branching cost. And as per-branch profits are decreasing in the number of branches, since total gross profits $R_1$ are increasing and concave in $n_1$, the average cost must be decreasing as well.

We can now establish an important result.

Proposition 2 If condition (iii) and (iv) are satisfied the degree of concentration decreases when market size increases relatively to sunk costs.

Proof In the Appendix.

When market size increases relatively to sunk costs, the degree of concentration decreases monotonically with the market size. The explanation is, as market size increases, deviations from the UB equilibrium become more and more profitable up to a point where a deviant would gain by increasing the size of its branching network. However the speed at which the total profits increase is not matched by an increase in the sunk costs. Hence at this new equilibrium there will be always a firm that finds profitable to enter this industry.

3.3 Discussion

This model sheds light on the reasons why branching banks emerge in the industry. The analysis is confined here to the two symmetric equilibria, hence one has to be careful in interpreting the comparative statics results as it could be the case that, when a symmetric configuration breaks, an asymmetric configuration emerges. Nevertheless the model predicts that branching banks could emerge because market size increases relatively to sunk costs.

Leaving aside reasons linked to entry regulation, the model explains why the type of competition, from price to branching competition, may change drastically with an increase in the size of the market and give rise to a different industry structure.
In this model there are two important factors that affect the shape of the industry: increased competition and market expansion. Let’s now analyze the effect of an increase in the degree of competition on both the degree of concentration and the size of the network. First of all, let us show that for a given network size, an increase in the toughness of competition increases the degree of concentration of the industry.

**Proposition 3** An increase in the degree of substitutability between products of different branches, i.e. an increase in $c \in (0, \bar{c})$, for given market size, entry cost and number of branches, gives rise to an increase in the degree of concentration, both in the UB and the BB equilibrium. But if $c > \bar{c}$, there is no symmetric equilibrium.

**Proof** In the Appendix.

The parameter $c$ represent the degree of substitutability among the services at different branches. It could be used to indicate the degree of toughness of competition. An increase in $c$ affects the decision to enter the market, for given branching size, namely there will be exit from the industry. The intuition is simply, by increasing the toughness of price competition, the total profits in the second stage shrinks. Hence not all banks will be able to recover the same sunk costs. In the BB equilibrium the discussion is complicated by the fact that banks can also decide to reduce their branching network. I will discuss this point separately. Let us discuss now what happens to the BB equilibrium when either $c > \bar{c}$ or $c = 0$. In the first case, when $c > \bar{c}$, competition is too fierce to allow to recover the sunk costs. For example when $c = 2$ the total profits are zero because price competition in the second stage is too tough (Bertrand competition), therefore there is no room for more than one firm in the market. Hence there is no equilibrium with more than one firm in the market.

In the other case, $c = 0$, we have several isolated markets and we can think either to a monopolist, who sets branches in separate markets.

What will be the effect of an increase of competition on the size of the branching network of banks? The way to discuss this point is by introducing the analysis of the case when firms jointly maximize their profits.

**Collusion** When firms collude, they take both the price decision and the branching decision while jointly maximizing profits. There is an externality from opening a branch in oligopoly due to $c$, the degree of substitutability among branch services. In oligopoly by opening a new branch the bank steals from its other branches, but more importantly from its rival banks. When we consider joint profit maximization this effect is internalized. Hence presumably we must expect on average a smaller network size when banks collude. This is precisely what we show in the following proposition.
Proposition 4 When banks collude they set a smaller branching network, than when they act non-cooperatively.

Proof In the Appendix.

The intuition is, by increasing the size of its own network a bank reduces the profits of the rivals. In competition, banks do not take into account this effect, while when they coordinate on the size of their branching neworks, they internalize it. The network of each bank will therefore be smaller when banks do not compete. This effect allows us to derive the prediction that deregulation will affect the size of the network, in that firms will choose a larger branching network. There is somehow an inefficiency in oligopoly, namely "over-branching" due to the fact that banks use their network as well as interest rates as strategic variables to compete with their rivals.

Notice that when banks collude the solution coincides with the monopoly solution, where each bank opens $N/(q + 1)$ branches.

It could be useful to briefly discuss the monopoly solution. At monopoly the bank can decide the size of the branching network, simply by taking into account the externality of opening a branch on its other branches. The smaller is $c$, i.e. the measure of the business stealing effect, the less costly is to open new branches. In that case the bank decides to open as many branches as possible, given that there are not too big diseconomies of scale. However when the market size is very small the marginal benefit from opening a new branch is also small. We can conclude that a monopolist is more likely to set a large branching network the smaller is $c$, the larger is the market size and the larger are the economies of scale in branching. The same can be said about a bank facing competing rivals, except that, when we consider the zero profit condition, in order to derive endogenously the number of banks, we need exactly economies of scale in branching.

4 Implications for regulation

Let us consider now the implications for regulation. I am interested in the effect of regulation on the structure of the industry, however there are various type of regulations. There are direct ways to intervene on the shape of the industry, as for example entry regulation (fixing the number of banks that can enter the industry) or branching restrictions (bounds on the network size of a bank). Other ways of

\[^{13}\text{This is equivalent to say that branches are strategic substitutes.}\]
intervening are more indirect, as for example capital requirements or deposit insurance premia, but still affect the shape of the industry. I want to discuss the effect of some of these regulations on the shape of the industry. I should mention that these interventions were not meant for structural purposes, but that nevertheless have an important impact on the structure of the market.

I will discuss therefore direct ways of affecting the shape of the industry, as for example branching restrictions, as well as indirect ways, namely capital requirements and deposit insurance premia.

First of all, let us discuss the effect of branching restrictions, which has a direct impact both on entry and branching. Branching restrictions have the short run effect of reducing the bank profits, while in the long run by causing exit from the industry they bust profits and increase concentration in the industry. The effect is analyzed starting from a BB equilibrium, where let say \( n^* \) is the branching size in equilibrium. Restricting the branching network of a subset of banks, means that those banks will set \( \bar{n} < n^* \). As in the BB equilibrium there must be economies of scale in branching, this increases the average cost of branching, henceforth defined as \( AVC(n) = F(n)/n \). In the short run therefore those banks will face negative net profits. However in the long run there will be exit from the industry, and the firms that survive in the industry and adapt to the new equilibrium, will have to earn higher profits in the long run equilibrium, because of the no entry condition.

Let us now go to indirect regulations that still affects the shape of the industry. Capital requirements are interpreted here as the cost of entering the market, \( \sigma \). An increase in the capital standards has exactly the same effect of a reduction in the market size. Hence it increases the degree of concentration and reduces the network size at equilibrium.

An increase in the capital requirements is considered a measure of prudential regulation that works as a protection for the creditors in case the bank fails. This should presumably reduce the probability of bank failures, by reducing the incentive

\[14\] There has been some discussion in the empirical literature on the effect of relaxing branching restrictions on the structure of the industry in US. See for example Hanau, Rhoades (1992) and Berger et al.(1995). Schmid (1994) shows that branching restrictions reduce welfare. The reason is that, while profits increase due to diseconomies of scale in branching, consumers surplus decreases proportionally more, because of less variety.

\[15\] This can be easily derived by observing that \( AVC(n) \) does not depend upon other banks branches. Hence to match higher sunk costs, as required by condition (iv), in equilibrium profits will have to be higher.

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to take on risk by the bank, improving therefore the stability of the banking system. An alternative way to increase the stability of the banking system is to rise the cost of entry, hence increasing the degree of concentration. If we believe in the structure-conduct-performance paradigm, an increase in concentration has a positive impact on banks profits, hence reducing the probability of bankruptcy. Our analysis suggests that, when considering entry as well, this conclusion may not be true anymore. To recover increased setup costs, profits should be higher. However this works through a reduction in the number of firms and per-capita branches, while not affecting the degree of competition in the industry, which in our model is given by \( c \). In conclusion, capital requirements favour a more concentrated industry, although it doesn’t affect the net profitability of the industry and hence the stability of the system, since sunk costs are also higher.

It could also well be that capital requirements are not uniform for different bank sizes. In particular larger banks can have relatively lower capital requirements because for example it is often argued that they are less risky. The effect of this can be easily analized in our framework. Suppose that the fixed sunk cost is now a function of the network size, i.e. \( \sigma = \sigma(n) \) and that \( \frac{d\sigma(n)}{dn} < 0 \). Then condition (iii) for the BB equilibrium is satisfied for lower branching sizes. In other words, there would be an incentive to set a larger branching network with respect to the case where \( \sigma \) is fixed.

**Deposit insurance** affects indirectly the structure of the industry, in that it changes the variable costs of branching, \( \epsilon \) (also capital requirements could be interpreted as a proportional cost of providing deposits). We interpret deposit insurance as a premium that the bank has to pay proportionally to its market share. An increase in \( \epsilon \) affects condition (iii) in the BB equilibrium. In particular an increase in the deposit insurance premium raises the marginal cost of opening a new branch, eventually driving towards the UB equilibrium.¹⁶

¹⁶This argument was actually used by one politician to favour the introduction of deposit insurance in US. Representative Goldsborough in 1933 said

We decided that if we had a bank-deposit insurance bill it would not only tend to restore the confidence of American people in the banks and in the business integrity of the country, but if bank deposits were insured and if all the people knew that a reservoir of the assets of every bank in the US was supporting the deposits at their bank, it would tend to restrain the tendency to bank branching.

from Fischer(1968), pg 51. Support to this argument is found in a recent paper by Economides et al (1993).
5 Empirical predictions of the model

The model presented in this paper has some implications either for the historical evolution of the banking industry either for for cross-countries comparisons.

5.1 Historical evolution of the industry

The branching model predicts that the passage from unit banking to branching banking is mainly due to an increase in the market size. We can find through various sources on the US and UK banking history that an increase in the market size, affected the incentive to set more branches. Among the reasons for the steadily rise in the proportion of branching banks Fischer (1968) lists the urbanization of America and the tremendous expansion of the nonfarm household, the rising household income, the increase in the size of many of the banks’ business customers. Bali, Capie (1982) on the other side study the evolution of the degree of concentration in the UK banking system in the history. They claim that one explanation for the amalgamation phenomena in the UK, i.e. the origin of large branching banks, could be the increase in the market size.

Moreover the model suggests that, as the market size increases, there is eventually an incentive for a deviant to switch from price competition to branching competition. One way to assess the model would then be to find the case of a deviant who starts to respond to price competition by increasing the size of its network. In the american banking industry history we can find an example of this around the twenties.\textsuperscript{17} At the beginning banks were competing in prices. When in some States branching regulation was relaxed, we find account of few banks that started to use branching as a strategic advantage.

5.2 Cross-countries predictions

As far as cross-section comparisons, the model predicts for the banking industry that we should observe an inverse relation between the degree of concentration and the market size.

More importantly the model predicts that deregulation, namely a departure from the collusive solution towards the non-cooperative one, should lead to an increase in the degree of concentration. The way to test this prediction would be to compare the

\textsuperscript{17}Fischer (1968) analyzes the history of the US banking system, whereas Sykes (1926) the UK.
relation between market size and degree of concentration across a period, where there has been an increase in some measure of competition.

Finally with respect to branching, the model predicts that as the market size increases there is a decrease in the degree of concentration in branching. Concentration in branching, measured as percentage of branches of the Top 5 banks, increases if there is a redistribution of branches from the smaller banks to the larger or if there are less firms in the industry. In the model an increase in market size is accompanied to an increase both in the average size of the network and more importantly in the number of banks; as a result we can exclude a positive relation between market size and concentration in branching.

Finally the model predicts that as the toughness of price competition increases, the size of the branching network increases.

6 Conclusions

We think that branching is an important feature in banking competition. It could explain the emergence of unit vs branching firms in the banking industry. In particular the model presented relates the gain from increasing the size of the network to the profits of a latter stage in which banks compete in prices. We have studied the influence of different factors on the shape of the industry equilibrium. An increase in the market size may lead towards branching banking equilibrium. This model has important implications for deregulation. Does in particular deregulation, here interpreted as increase in the degree of substitutability between products of different branches, help in terms of efficiency of the industry? More competition here implies that banks will be larger. On the other hand deregulation should also lead to an increase in concentration.

The model links the analysis of the multiproduct firm to vertical differentiation. Here the branching decision can be seen as a way to enhance demand. However branching doesn’t explain a tendency towards more concentrated outcome as in the vertical differentiation literature. Here in the limit, the degree of concentration decreases as the market size increases, also in the BB equilibrium, namely when the sunk costs are endogenous. More importantly the model has some implications for the branching process in the banking industry. For example it predicts that when the

\[ \sum_{i=1}^{5} \frac{n_i}{N} = \frac{2}{5}, \]

which decreases as market size increases.

\[18\] In the BB equilibrium the degree of concentration in branching is \( \sum_{i=1}^{5} \frac{n_i}{N} = \frac{2}{5} \), which decreases as market size increases.
degree of competition increases, there will be an increase in the number of branches of each single bank.¹⁹

¹⁹This contrasts with Neven (1989) and Chiappori et al. (1995), who both claim that in a regulated banking system there is a tendency to “overinvest” in branching.
7 Appendix

Solution of the price competition game  From the problem of the deviant bank we derive the following first order condition with respect to the price

\[ \alpha(2 - c) - 2[(2 - c) + c\bar{q}]p_1 + c\bar{q}p_1 = O \]

Moreover solving the equivalent problem for any of the non-deviant banks, for example for bank 2, namely

\[ \max_{p_s} \sum_{s=2}^{n_2} p_s \bar{x}_s(N) \]
\[ s.t. \quad p_s = \bar{p} \quad s \neq n_2 \]

we get the following first order condition:

\[ \alpha(2 - c) + cn_1p_1 - [2(2 - c) + c\bar{q}(q - 1) + 2cn_1]\bar{p} = O \]

Finally subtracting the second FOC to the first one, we get the ratio in (3). \[ \Box \]

Proof of Result 1  By taking the derivative of \( \pi_1 \) with respect to \( n_1 \), we get

\[ \pi_1' < 0, \pi_1'' < 0 \]

From this it follows that

\[ R_1' = \pi_1 + n_1\pi_1' \geq 0 \]

whenever the elasticity of \( \pi_1 \) is smaller than 1; and that

\[ R_1'' = 2\pi_1' + n_1\pi_1'' \leq 0 \]

Notice moreover that when \( c = 0 \), \( R_1 > 0 \) and \( R_1' > 0 \), while for \( c = 2 \), \( R_1 = R_1' = 0 \). \[ \Box \]

Proof of Proposition 1  If \( c \in (0, \bar{c}) \), then from (ii) it must be true that

\[ \frac{S}{\sigma} \frac{\alpha^2}{\bar{\beta}} (2 - c) \left( \frac{2 - c + cq}{2 + cq} \right) = \left[ 2(2 - c) + \alpha q \right]^2 \]

And it is easy to show that for \( q > 0 \), if \( S/\sigma \) increases then \( q \) must increase as well. \[ \Box \]

Proof of Result 3  From the zero profit condition (iv) for \( n_1 \neq 0 \) we can write

\[ \pi_1 = \epsilon + \frac{\sigma - \epsilon}{n_1} \]
and since (iii) can be rewritten as

$$\pi_1 + n_1 \frac{d\pi_1}{dn_1} = \epsilon$$

Combining the equations above, we get

$$\frac{d\pi_1}{dn_1} = \frac{\sigma - \epsilon}{n_1^2}$$

From the fact that the per-branch profits are decreasing with respect to $n_1$, we know that the LHS is positive, hence for both (iii) and (iv) to hold, it must be the case that $\sigma > \epsilon$. \square

**Proof of Proposition 2** At the BB equilibrium, conditions (iii) and (iv) must both be fulfilled. If we substitute (iv) into (iii), we get

$$\frac{2 - c + cnq}{2 - c + cn(q + 1)} - \frac{2c^2n^2q}{[2(2 - c) + cn(2q + 1)][2(2 - c) + cnq]} = \frac{F - (\sigma - \epsilon)}{F}$$

The above equation defines an implicit relation between $n$ and $q$ at the BB equilibrium. One can show that this relation implies that $\frac{dn}{dq} > 0$. When $S$ increases, using (iv), $n$ must increase as well. From the above expression, one can derive that $D[RHS]_n > 0$ whereas $D[LHS]_n < 0$ and $D[RHS]_q > 0$. Hence to get the result $q$ must increase. From (iv), when $S/\sigma$ increases, $q$ increases. Hence $1/q$ decreases with $S/\sigma$. \square

**Proof of Proposition 3** For the UB equilibrium it is enough to show that condition (ii) will be fulfilled with a smaller $q$. We know that at $c = 2$, $R_1 = 0$. On the other hand when $c = 0$ we get the monopoly profits. Moreover the relation is smooth in $c$. It follows that if $c$ increases then $dR_1/dc < 0$. But for given market size, if $c$ increases, then (ii) is not satisfied anymore, hence there will be exit from the industry.

For the BB equilibrium, we could show that for given branching size there will be, for the same argument as above, exit from the industry. \square

**Proof of Proposition 4** When firms jointly maximize their profits, the FOC for the choice of the number of branches is given by

$$\frac{dR_i(n_i/\bar{n})}{dn_i} + \sum_{j \neq i} n_j \frac{\partial \pi_j(n_j/\bar{n})}{\partial n_i} - \epsilon = 0$$

It can be shown from the case $q=1$, that

$$\frac{\partial \pi_j(n_j/\bar{n})}{\partial n_i} \leq 0$$

Since from Result 2 we know that $R_i$ is concave in $n_i$, the optimal number of branches when there is collusion is smaller than in the BB equilibrium. \square
References


[27] Sykes J. (1926), THE AMALGAMATION MOVEMENT IN ENGLISH BANKING, 1825-1924, P.S.King and Sons, London