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Deregulation and product differentiation in the banking industry

Abstract

This paper analyzes the relationship between banking deregulation and product differentiation. We model banking competition by assuming both horizontal and vertical differentiation. The horizontal component is related to branching decisions whereas the vertical differentiation component is built-in to capture consumer's satisfaction for dealing with particular bank types. We then perform an empirical analysis on the deregulation of the Spanish Banking System. We show that the direct channel from deregulation to competition successfully promoted competitive behavior among the different types of banking institutions in Spain. However, banks responded by exacerbating their differences in other dimensions, in particular in the loan market in favor of private banks. We finally estimate banks' knowledge of demand equations and find out that private banks were more accurate than savings banks in estimating customers preferences. We hypothesize that this better knowledge has conferred private banks an advantage over savings banks for successfully differentiating private banks' products.

Keywords: deregulation, competition, banking industry, product differentiation, horizontal and vertical differentiation.
JEL Classification: G21, L13.

Introduction

The complex changes that the world economy has undergone in the last three decades, encouraged by the globalization and liberalization of the markets, have largely affected the banking system. In this context, the authorities have put forward a wide set of regulatory measures. Regulating the banking industry has been a complex task due basically to two reasons: (i) because the different goals that regulators have implemented might conflict with one another, and (ii) because the banking industry is an heterogeneous entity composed of different types of banking institutions, i.e. we may observe in a particular banking industry the coexistence of private or commercial banks, savings banks, credit cooperatives, etc.

Referred to the first reason, for instance, the banking industry in most countries has been subject to a tight set of regulations oriented to soften competition (Vives (1991) and Fischer and Pfeil (2004)). Most of those regulatory measures aimed at improving the stability of the banking system since it is quite difficult to envision a strong economy without a good financial system. Because a strong financial system can not be solely driven by the market forces, authorities, agreeing on the public interest, have developed a set of different regulatory instruments. These instruments, following Freixas and Rochet (1996), refer to restrictions on the strategic variables of banking institutions (interest rates and branching decisions) as well as portfolio, capital requirements and regulatory monitoring.

Conversely, at the same time in the last two decades the regulatory authorities have implemented a series of deregulation changes in the banking market in order to foster competition and to enhance financial integration, as, for instance, in the European Union and the States.

On the other hand, the coexistence of different types of banking institutions in the banking industry, whose types differ in a number of respects – the ownership structure and the management of the bank activities being the most salient[1] – has led regulators to develop a set of different regulatory/deregulatory bodies that in fact have contributed to exacerbate their differences.

Based on this new and complex situation, a number of papers have focused on how specific deregulatory iniciatives have affected banking industry in a diversity of ways[2]: (i) their effect on the conduct of the banking institutions, where conduct comprises pricing, offering and the availability of loans and/or deposits (Jayaratne and Strahan (1998), Garret et al. (2004), among others), (ii) their effect on bank's strategies, where strategies concern market presence and structure, and deal with the entry, location, composition and heterogeneity in bank presence in the market (Levine (2003), Barth et al. (2004) and Sapienza (2004), among others), and (iii) their effect on financial stability and development (Black and Strahan (2002), Stiroh and Strahan (2003), Buch (2003) among others).

One of the main goals of regulators has been to provide the economy with an efficient and competitive banking system. This way customers in the economy would have access to quality services at competitive prices and, hence, the economic growth of the economy could approach its potential.

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[1] This phenomenon is quite common, see, for example, the case of Spain, France, USA and Germany.
[2] See Degryse and Ongena (2007) for an excellent review of the empirical findings in the literature on this issue.

So, one of the main efforts undertaken by regulators in the past decades has been the deregulation of the banking system along with the harmonization of the different regulatory bodies of the different types of banking institutions.

Bearing in mind this fact, a gross body of literature has focused on the analysis of competition in banking. However, this literature has been more orientated to the analysis of competition in banking *per se* rather than looking for the relationship between deregulation and competitive behavior in the banking industry. Particularly, by leaving behind the Structure-Conduct-Performance paradigm, an important change took place in the early 90's in modeling competition with the aim to capture the "special nature of banking competition" since from the previous literature "it can be argued that the standard competitive paradigm is not appropriate for the banking industry" (Vives (1991), Allen et al. (2001), and Carletti (2007)). However, in the literature that deals with competition and strategy, and despite the fact that theoretical models investigating product differentiation in banking are already highly developed and rich in testable hypothesis, the empirical work is still rather limited (see Carletti (2007)).

Moreover, in the area of product differentiation most of the theoretical and empirical studies have focused on the traditional one-dimensional product differentiation in banking, either horizontal or vertical product differentiation[1]. However, although most banking products epitomize both types of differentiation (Degryse (1996)), only a small number of papers have extended the one-dimensional models towards multi-dimensional product differentiation (Degryse (1996), Kim and Vale (2001) and Kim et al. (2005), among others). In this literature, the central issue addressed as horizontal differentiation has been the location of branches, whereas those considered in vertical differentiation models are reputation, ATM network or the possibility of remote access.

However, vertical differentiation coming as a result of different types of banks has been addressed only by Cohen and Mazzeo (2004) who extend previous research (Cohen and Mazzeo (2003)) by differentiating among different types of competitors – multi-market bank, single market banks and thrifts – by allowing for a separate profit function for competitors of each type in each market. These authors focus on the cross-type effects measuring how banks of one type affect the profits of other-type banks. Their result suggests that differentiation between bank types is an important feature of banking markets.

This paper attempts to contribute to the literature which deals with competition and strategy as well as the one concerned with regulation. In particular, our main goal is to study the relationship between deregulation and multidimensional product differentiation. To this end, we model banking competition by assuming both horizontal and vertical differentiation.

On one hand, the *horizontal component* is introduced to make explicit branching decisions across different geographical markets. It is done by considering that banks compete spatially through the opening of branches in several geographical markets. Customers' preferences in this model a la Salop will depend on the branch products prices (positively on the deposits interest rates and negatively on the loans interest rates) and (negatively) on the branch distance.

On the other hand, *vertical differentiation* is considered to cope with the heterogeneity of bank types. It is introduced by allowing consumers' preferences to depend on the type of the banking institution they are dealing with by considering that the relevant interest rate for customers' decisions is the sum of the *explicit* interest rate and the *implicit* interest rate. The first is the one posted by banking institutions, whereas the latter reflects customers' "satisfaction" for dealing with a particular type of banking institution. Furthermore, we allow implicit interest rates to be specific to the banks products.

These two types of product differentiation can be related in a easy way to deregulation. The differentiation could be a result of deregulation and/or of strategies adopted for facing the new environment that deregulation carried out. For instance, the asymmetric regulation the different types of banking institutions were subjected to. From the point of view of the banking institutions, this source is exogenous. Hence, by homogenizing the different regulatory bodies, the different types of banking institutions can be expected to become more homogeneous, sweeping away the exogenous source of product differentiation.

This direct channel from deregulation to competition enhancement might have, however, a negative effect. By applying the fact that differentiating the product is one way to escape from competitive pressures (concept well known in the industrial organization theory) to the banking industry, we can see that product differentiation would allow banks to gain higher prices for their

[1] For instance, for horizontal differentiation see Barros (1999), Kim and Vale (2001), Cesari and Chizzolini (2002), Canhoto (2004), Coccorese (2005), among others; for vertical differentiation see Billett, Fllannery and Garfikel (1995), Kim et al. (2005), Carletti (2007), among others.

services. Given that a basic driving force in the banking industry is that banking institutions, in order to preserve/gain market power, can react to the deregulating effort by exacerbating their product differentiation in other dimensions. They could, for example, increase the quality of their services. Hence, when considering both sources of product differentiation, the total effect of the deregulation effort is not univocally determined.

The second part of the paper will be devoted to the analysis of a plausible reason for the different skills of banking institutions for successfully differentiating their products. It is true that an optimal adaptation to a new environment created by the deregulation measures requires a good knowledge of the demand functions. Hence, it can be hypothesized that a better knowledge carries a better adaptation and consequently implies a better differentiation. We estimate banks knowledge of demand equations and find out that private banks were more accurate than savings banks in estimating customers preferences.

The methodology developed in this paper for assessing both the direct and indirect effects of the deregulation process on the competitive behavior of the banking industry is applied to the Spanish banking sector in order to estimate the total effect of the Spanish deregulation process. The Spanish banking sector is a good target for our exercise because it is an example of a banking industry which has undergone a complex deregulation process which has involved the homogenization of the different regulation bodies.

Finally, we want to stress that our analysis is performed by taking into account the whole complexity of the banking activities. Following Kim et al. (2007), we contemplate the multiproduct and multimarket characteristics of the bank institutions. That is, we consider that: (i) banks are multiproduct firms, as they offer deposits and loans, and (ii) banks are multimarket firms, as they can operate in several geographical markets (either they can operate in different regional markets within a given country or they can operate in different countries).

Our application to the Spanish Banking System shows two salient results: (i) by the late nineties, the implicit interest rates have substantially decreased, showing that customers considered the different types of banking institutions to be more homogeneous in comparison to the situation in the late eighties. This implies the success of the deregulation process in enhancing competitive behavior, and (ii) Spanish banking institutions managed to differentiate their deposits as a response to authorities effort to promote competition among them. However, they failed in alleviating the competitive pressure for loans.

The rest of the paper is as follows. Section 1 develops a competition model in the banking industry. The empirical analysis and the estimations results are in Sections 2 and 3, respectively. Section 4 shows the results, whereas the final section concludes.

1. The model

In accordance with the introduction above, we next develop a theoretical model of banking competition incorporating both horizontal and vertical differentiation. The basic ingredient is that bank products are characterized by two features: (i) the bank location and (ii) the type of the banking institution. To accommodate these two features, we develop a generalized Salop model (1979) on spatial competition by assuming that from the consumer's point of view, the relevant interest rate of a bank product is a combination of the *explicit* interest rate, i.e. the one posted by the bank, and the *implicit* interest rate, which is type dependant, and which captures the consumer satisfaction for dealing with a particular bank type.

Note that this simple specification encompasses both the horizontal and vertical product differentiation, the horizontal component being captured by the distance between the consumer and the bank and the vertical dimension being represented by the consumers preferences on dealing with a particular type of banking institution beyond the product price. In this section we first formalize these ideas and second we show how to measure the degrees of vertical and horizontal differentiation.

1.1. The theoretical model. We assume that banks operate in several geographical markets (indexed by k). The banking system is heterogeneous in the sense that there are different types of banking institutions; let T = $\{t_1, t_2, \ldots, t_p\}$ be the set of possible types. We assume that banking institutions utilize three strategic variables: deposits and loans (explicit) interest rate and number of branches in each geographic market. We restrict banks to establish the same interest rates in each of its branches regardless of their (geographic) location[1].

In each market κ there is a continuity of customers, distributed uniformly around the unit circle. The total volume of deposits in region κ is ∂_k. Customers deposit one monetary unit in each branch, incurring transportation cost $\alpha_k x$,

[1] It is a matter of fact that the institutions we deal with set same interest rates across their branches. See, for example, Coello (1994) and Kim et al. (2007).

proportional to the distance x between the depositor and the branch. Total volume of loans in region κ is λ_k. Borrowers borrow one monetary unit of loan incurring transportation cost $\beta_k x$. We allow for different transportation cost to be associated with different loans and deposits due to different customers' transaction frequencies.

Regarding customers' preferences, they are assumed to depend on the distance and on the *effective* interest rate of the branch, which is defined as the sum of the *explicit* interest rate (the one posted by banks) and the *implicit* interest rate of the branch (which captures the "satisfaction" for dealing with branch b of banking institution i). Specifically, we consider the following functional form for the utility obtained by a consumer which deals with branch b of banking institution i at distance x.

$$u = \begin{cases} r_i^D + \upsilon_i^D - \alpha_k x & \textit{for deposists} \\ -r_i^L + \upsilon_i^L - \beta_k x & \textit{for loans} \end{cases},$$

where $r_i^D\left(r_i^L\right)$ is the explicit deposit (loan) interest rate, α_k and β_k are the transportation costs for deposits and loans, respectively, x is the distance to the branch and υ_i^D and υ_i^L are the implicit interest rates for deposits and loans of banking institution i respectively[1].

Focus now on market k. Let N_k be the number of banking institutions in market k. Let n_{ik} be the number of branches of banking institution i in region k, and finally let n_k be the total number of branches in region k. For given distribution of the n_k branches around the circle, explicit interest rates $(r_1^D,...,r_{N_k}^D)$ and $(r_1^L,...,r_{N_k}^L)$ for deposits (D) and loans (L) respectively, implicit interest rates $(\upsilon_1^D,...,\upsilon_{N_k}^D)$ and $(\upsilon_1^L,...,\upsilon_{N_k}^L)$ for deposits (D) and loans (L) respectively, we can determine the deposits and loans quantity of a given banking institution. This is the sum of the deposits and loans demand of its branches. Hence, we first proceed to compute the deposits and loans of any branch b.

We find it convenient to define the function $B(b)$ which assigns to each branch b the banking institution to which it belongs. Hence, for given branch b belonging to banking institution i, $B(b)=i$.

We need to specify the location of the indifferent customer, that is, the one indifferent between going to branch b or to a neighbor branch. Let $m_{b,b+1}$ denote the distance between branch b and $b+1$. Then, the location of such an indifferent customer is defined by

$$\frac{1}{2}m_{b,b+1} + \frac{r_{B(b)}^D - r_{B(b+1)}^D}{2\alpha_k} + \frac{\upsilon_{B(b)}^D - \upsilon_{B(b+1)}^D}{2\alpha_k}$$

for the case of deposits and

$$\frac{1}{2}m_{b,b+1} + \frac{r_{B(b+1)}^L - r_{B(b)}^L}{2\beta_k} + \frac{\upsilon_{B(b)}^L - \upsilon_{B(b+1)}^L}{2\beta_k}$$

for the case of loans.

To facilitate the analysis we assume branches to be symmetrically distributed on the unit circle and branches distribution to be random and uniform[2]. Under these assumptions, the expected[3] volume of deposits and loans for branch b belonging to banking institution $B(b)$ in region κ are as follows

$$D_b = \delta_k\left(\frac{1}{n_k} + \sum_{j\neq B(b)} \frac{n_{jk}}{n_k - 1}\frac{(r_{B(b)}^D - r_j^D) + (\upsilon_{B(b)}^D - \upsilon_j^D)}{\alpha_k}\right) \tag{1}$$

$$L_b = \lambda_k\left(\frac{1}{n_k} + \sum_{j\neq B(b)} \frac{n_{jk}}{n_k - 1}\frac{(r_{B(b)}^L - r_j^L) + (\upsilon_{B(b)}^L - \upsilon_j^L)}{\beta_k}\right) \tag{2}$$

By adding up the quantity of deposits and loans of bank i in every geographic market – bank i has n_{ik} (ex-ante identical) branches in region k – we obtain the demand of deposits and loans of bank i in the banking system.

They are the following

[1] See Fudenberg and Tirole (2000).

[2] This is a common practice in empirical spatial models. See, e.g., Barros (1999), Chiapprori et al. (1995) and Kim et al. (2007).

[3] Expectation operators are suppressed for brevity.

$$D_i = \sum_k D_{ik} = \sum_k \delta_k \frac{n_{ik}}{n_k} + \sum_k \sum_{j \neq i} \delta_k \frac{n_{ik} n_{jk}}{n_k - 1} \frac{(r_i^D - r_j^D) + (\upsilon_i^D - \upsilon_j^D)}{\alpha_k},$$

$$L_i = \sum_k L_{ik} = \sum_k \lambda_k \frac{n_{ik}}{n_k} + \sum_k \sum_{j \neq i} \lambda_k \frac{n_{ik} n_{jk}}{n_k - 1} \frac{(r_i^L - r_j^L) + (\upsilon_i^L - \upsilon_j^L)}{\beta_k}.$$

Note that deposit and loan volumes are a function of the relevant variables: own and rival effective interest rates and own and rival number of branches.

1.2. Measuring product differentiation. From the demand equations above we can measure the degree of vertical and horizontal differentiation. The degree of horizontal differentiation is obtained from the comparison between the own and cross price elasticities for deposits and loans. More specifically, we will look at the absolute value of the ratio cross price elasticity to own price elasticity.

For banking institution *i* and rival bank *R*, the ratio for deposits is

$$\eta_{i,R}^D = \left| \frac{\frac{\partial D_i}{\partial r_R^D} \frac{r_R^D}{D_i}}{\frac{\partial D_i}{\partial r_i^D} \frac{r_i^D}{D_i}} \right| = \frac{\sum_k \frac{\delta_k}{\alpha_k} \frac{n_{ik} n_{Rk}}{n_k - 1}}{\sum_k \frac{\delta_k}{\alpha_k} \frac{n_{ik}(n_k - n_{ik})}{n_k - 1}} \frac{r_R^D}{r_i^D}$$

whereas for loans is

$$\eta_{i,R}^L = \left| \frac{\frac{\partial L_i}{\partial r_R^L} \frac{r_R^L}{L_i}}{\frac{\partial L_i}{\partial r_i^L} \frac{r_i^L}{L_i}} \right| = \frac{\sum_k \frac{\lambda_k}{\beta_k} \frac{n_{ik} n_{Rk}}{n_k - 1}}{\sum_k \frac{\lambda_k}{\beta_k} \frac{n_{ik}(n_k - n_{ik})}{n_k - 1}} \frac{r_R^L}{r_i^L}.$$

Note that the ratio $\eta_{i,R}^D$ ($\eta_{i,R}^L$) measures the degree of substitutability between the deposits (loans) offered by bank *i* and the deposit (loan) offered by bank *R*. The higher the ratio, the higher the substitutability between the products and, therefore, the less the product differentiation, which basically reflects a greater competition between banking institutions *i* and *R*.

As regards the degree of vertical differentiation, it is true that it is directly given by the implicit interest rates, the higher the implicit interest rate, the less the competitive pressure among the different types of banking institutions. However, given that the implicit interest rates are defined over the types of banking institutions, there is no a one-to-one correspondence between explicit interest rates and implicit interest rates for a banking institution in a particular market. The substitutability between those interest rates will be determined by the degree of types heterogeneity in the market. We now compute for a given market *k*, the decrease Φ_κ in the explicit interest rate of a given banking institution which is equivalent to a one unit increase in the implicit interest rate. This value is[1]

$$\Phi_k = \frac{\sum_{j \text{ such that } T(j) \neq T(i)} n_{jk}}{\sum_{j \neq 1} n_{jk}},$$

where the function *T(i)* is defined in a way such that assigns to any bank *i* its type.

The rationale behind the above expression is that whereas a movement in the explicit interest rates affects the competition with all other banks, a variation in the implicit interest rate only affects competition with the banking institutions of different types. There are two polar cases: the first one corresponds to the situation in which all banks in the market belong to the same type. In this case, Φ_κ=0, meaning that there are no gains associated to changes in the implicit interest rates. The second case corresponds to the situation in which the types of all banks except bank *i* are different from the type of bank *i*. In this case, there is a one-to-one correspondence between bank *i*'s implicit and explicit interest rates. All other cases are in between these two polar cases.

In the next section, we formulate the demand equations in a manner amenable for empirical estimation.

2. Empirical analysis

2.1. The empirical model. Based on the above model, our first empirical exercise is oriented to estimate the variables that determine consumers' optimal behavior (valuations and transportation costs) which will allow us to obtain information concerning consumers' preferences. This empirical exercise requires to formulate a system of equations comprising two equations, one for the total deposits demand and the other for the total loans demand for each bank and year[1] in the *k* markets simultaneously. The deposits and loans demand function of bank *i* in period *t* can be rewritten as follows:

[1] The above expression comes from the following equality $D_{ik}(r_i^D, r_{-i}^D, \upsilon_i^D, \upsilon_{-i}^D) = D_{ik}(r_i^D - \Phi_k, r_{-i}^D, \upsilon_i^D + 1, \upsilon_{-i}^D)$.

$$\sum_k \left(\frac{D_{ik}}{\delta_k} - \frac{n_{ik}}{n_k}\right)\frac{n_k - 1}{n_{ik}} = \sum_k \sum_{j \neq i} \frac{n_{jk}}{\alpha_k}\left[\left(r_i^D - r_j^D\right) + \left(\upsilon_i^D - \upsilon_j^D\right)\right],$$

$$\sum_k \left(\frac{L_{ik}}{\lambda_k} - \frac{n_{ik}}{n_k}\right)\frac{n_k - 1}{n_{ik}} = \sum_k \sum_{j \neq i} \frac{n_{jk}}{\beta_k}\left[\left(r_i^L - r_j^L\right) + \left(\upsilon_i^L - \upsilon_j^L\right)\right].$$

Note that in these equations, the left-hand sides are known, whereas the right-hand sides contain unknown parameters, i.e. the consumers' valuations parameters (the implicit interest rates) for deposits and loans, $\upsilon_i^D - \upsilon_j^D$ and $\upsilon_i^L - \upsilon_j^L$ and the transportation costs of deposits and loans, α_k, β_k, respectively. For our econometric implementation, we will assume that (i) the implicit interest rates are plain parameters[2], and (ii) transportation costs are linear functions of market characteristics.

Regarding the implicit interest rates, the following more compact notation will be used:

$$\upsilon_i^D - \upsilon_j^D = \gamma_k^D,$$

$$\upsilon_i^L - \upsilon_j^L = \gamma_k^L.$$

As regards transportation costs, and following closely Barros (1999) and Kim et al. (2007), we assume that, *ceteris paribus,* the larger the geographic area, *(KM_k),* the higher the transportation costs to consumers. Also, transportation cost could change in terms of the level of the region's wealth as well as of the region's urban development. The region's wealth development *(WE_k)* is measured as the participation of the real gross domestic product of each region over the real aggregated gross domestic product of the country. Finally, the percentage of the inhabitants in each local region *(UR_k)*, who reside in areas with more than 20.000 inhabitants, is included as an explanatory variable for transportation costs which measures the level of the region's urban development. Accordingly, transportation costs in regional market *k* are given by

$$\left.\begin{aligned} \alpha_k^{-1} &= \alpha_0 + \alpha_1 KM_k + \alpha_2 WE_k + \alpha_3 UR_k \\ \beta_k^{-1} &= \beta_0 + \beta_1 KM_k + \beta_2 WE_k + \beta_3 UR_k \end{aligned}\right\}.$$

The deposits demand equation to estimate is therefore

$$A_i^D = \sum_k \left[\alpha_0 + \alpha_1 KM_k + \alpha_2 WE_k + \alpha_3 UR_k\right]\left[B_{ik}^D + \gamma_k^D C_{ik}\right] + \varepsilon_i^D,$$

where

$$A_i^D = \sum_k \left(\frac{D_{ik}}{\delta_k} - \frac{n_{ik}}{n_k}\right)\frac{n_k - 1}{n_{ik}},$$

$$B_{ik}^D = \sum_{j \neq 1} n_{jk}\left(r_i^D - r_j^D\right)$$

and C_{ik} is the number of branches in regional market *k* which are of a different type (from bank *i*'s type). Similarly, the loan equation to be estimated is

$$A_i^L = \sum_k \left[\beta_0 + \beta_1 KM_k + \beta_2 WE_k + \beta_3 UR_k\right]\left[-B_{ik}^L + \gamma_k^L C_{ik}\right] + \varepsilon_i^L$$

with

$$A_i^L = \sum_k \left(\frac{L_{ik}}{\lambda_k} - \frac{n_{ik}}{n_k}\right)\frac{n_k - 1}{n_{ik}},$$

$$B_{ik}^L = \sum_{j \neq 1} n_{jk}\left(r_i^L - r_j^L\right).$$

2.2. Application to the Spanish banking system. The Spanish Banking System (SBS) consists of commercial banks (which include both private and foreign banks), savings banks, and credit cooperatives. Given that the private commercial banks and savings banks jointly account for about 95% of total banking assets, we focus on them in this paper. Hence, in our empirical exercise we will have two types of banking institutions and correspondingly two implicit interest rates, υ_{SB} for savings banks and υ_{PB} for private banks (i.e. private commercial banks). We will be able to estimate the implicit interest rate differential. In our case, it will be $\upsilon_{SB} - \upsilon_{PB}$. We now elaborate why the Spanish banking system is a good target for our exercise.

The SBS has undertaken an important regulatory and structural change during the 80's with important implications for the competitive situation within the system. The SBS was gradually deregulated during the 1970s and 1980s[3]. Until 1988 savings banks were restricted to operate within a unique regional market, whereas private commercial banks could

[1] We do not introduce subscripts for year t for simplicity.

[2] Future research will need to allow implicit interest rates to depend on quality variables, as other papers have suggested (see, for example, Coello (1995)). In this paper, and as a first step, we assume they have no further structure.

[3] Among the elements that characterize the situation of the SBS at the beginning of the 80's we can find a high degree of regulation in the financial activities, where the ability to set up interest rate of loan and deposits as well as the expansion branches (in the case of savings banks) were highly constrained. In particular, in 1981 and 1987, loan and deposit interest rates and commissions were deregulated for both types of institutions.

operate nationwide[1]. In 1989 deregulatory changes allowed saving banks to open branches anywhere in the country[2], becoming this year when the SBS got the total liberalization in terms of setting interest rate freely and opening branches along the whole Spanish territory for all types of institutions. This made the year 1988 the representative year for the pre-deregulatory year[3].

On the other hand, as has been documented elsewhere (see Raj et al. (1979)) it may take as long as 10 years to converge to a new long-run equilibrium following legislative or regulatory changes. Then, we take 1998 as representative of the deregulated period[4].

2.3. Data. The data on the number of branches, deposits volume, loans volume and interests rate for deposits and loans come from the annual publications "Consejo Superior Bancario" and "Anuario de la Confederacion de Cajas de Ahorros". Our sample contains 130 savings banks and 101 private banks totaling 231 observations. We are including the total set of savings banks that existed in 1988 and 1998, but we have deleted some private banks for questionable data. The sample used for the case of private banks represents 92% of total assets of private banks in both years.

The information concerning squared kilometers, real gross domestic product and number of inhabitants in each local market is taken from the "Boletin Estadistico del Instituto Nacional de Estadistica". The Spanish administrative division yields a total of 17 regions; accordingly, the number of geographic markets we use in our empirical analysis is 17.

3. Estimation results

Table 1 below displays the estimate of the implicit interest rate differentials, which is given by the estimation of the valuation consumer's preferences for banking institutions ($\upsilon_{SB} - \upsilon_{PB}$) for deposits and loans, respectively. By the late eighties, at the end of the regulated period, the implicit differential for deposits is 0.045, whereas for loans is – 0.070. This implies an asymmetry in customers preferences: for operating in the deposit market consumers preferred savings banks[5], whereas for loans operations they preferred private banks. These differentials are equivalent to an explicit interest rate advantage of 2.23% in deposits for savings banks and of 3.50% in loans for private banks.

Table 1. Evolution of the implicit differential

Product	1988	1998
Deposits	0.045*	-0.026*
Loans	–0.070**	0.012*

Notes: * Statistical significance at the 1% level. ** Statistical significance at the 5% level.

This picture is in sharp contrast with the deregulated period, as we observe (i) preference reversal, i.e. by the late nineties customers preferred private banks for deposit operations but savings banks for loans; and (ii) a decline in the implicit differentials. This decline is actually quite substantial as for deposits the differential is halved whereas the loans implicit differential is reduced by a factor of 5. As we see, the implicit differentials are almost negligible by the late nineties, amounting to an explicit interest rate advantage of 1.3% at most.

We interpret this substantial decline in the interest rate advantage as a signal of the success of the Spanish regulatory agency in promoting a more competitive behavior. A more homogeneous regulation has implied a less differentiated banking sector and, therefore, a more competitive behavior.

We next analyze banks reaction to the deregulation process by computing the evolution of the degree of horizontal differentiation. As we pointed out above, the degree of horizontal differentiation is obtained from the comparison between the own and cross price elasticities for deposits and loans. Thus, the first task is to calculate the own and cross price elasticities, where we need information about the estimated transportation costs and the estimated implicit differentials. Table 2 below displays the estimates for the transportation costs in both points of time associated with the 17 regional markets of loans and deposits. Results exhibit different transportation costs for loans and deposits, most of which are statistically significant at any level.

[1] In 1974, the opening of private bank branches was liberalized.

[2] More details of this process may be found in Gual and Neven (1992).

[3] Actually, several studies reveal that the impact of the deregulation measures on the SBS is not evident until 1989. For instance, Salas and Saurina (2004) show that the liberalization measures undertaken from 1978 (when foreign banks entrance was allowed although with many limitations) to 1988 (including the liberalization of interest rates in 1981 and 1987) had not effect on reducing the market power and economic profits of Spanish banks during the 80s. Also, Fuentelsaz (1996) shows that the change in the competitive behavior of the SBS did not occur until 1989.

[4] The asymmetric situation between savings and private banks in terms of regulation measures at the begining of the period infers even more differences between those two types of banking institutions, however, even that, both types of institutions consider the other institution as a serious rival since private commercial and saving banks were fighting to capture deposits and loans in the same regional markets, and that the traces of this fight can be evidenced by looking at the different evolution of the market shares of savings and private banks during the eighties (see Caminal, Gual and Vives (1992)). For instance, Coello (1996) finds that the conjectural crossed elasticities of these two types of institutions were significantly different from zero, meaning that the other type of institution was a truly competitor.

[5] This result agrees with findings by Coello (1994).

Table 2. Estimation of the transportation costs

Deposits			Loans		
Parameter	1988	1998	Parameter	1988	1998
α_0	0.0176**	0.0267*	β_0	-0.0273**	-0.0383**
α_1	0.1121**	0.0431	β_1	0.0127	0.1483
α_2	0.0835*	0.0755*	β_2	0.0671**	0.0304
α_3	-0.0367*	-0.0138	β_3	0.0221**	0.0437*

Notes: * Statistical significance at the 1% level. ** Statistical significance at the 5% level.

This information along with the estimates of the implicit differentials are used for computing the own and cross price elasticities, which are displayed in Tables 3a and 3b below.

Table 3a. Estimation of own price elasticities

Savings banks			Private banks		
Own	1988	1998	Own	1988	1998
Deposits	0.2652	0.9956	Deposits	0.5142	0.8138
	(0.005)			(0.005)	
Loans	-2.5188	-1.6464	Loans	-1.2899	-1.6701
	(0.005)			(0.05)	

Notes: * Entries in parentheses are statistical significance levels for the non-parametric test of difference between means (Greene (1993)).

Table 3b. Estimation of the cross price elasticities

Savings banks			Private banks		
Cross	1988	1998	Cross	1988	1998
Deposits	-0.0608	-0.0206	Deposits	-0.0369	-0.0215
	(0.005)			(0.05)	
Loans	0.0492	0.0722	Loans	0.0267	0.0556
	(0.005)			(0.01)	

Notes: * Entries in parentheses are statistical significance levels for the non-parametric test of difference between means (Greene (1993)).

Using these elasticities, we can compute the cross to own elasticities ratio to obtain information about the degree of substitutability of the products offered by the different types of banking institutions. Table 4 displays the absolute value of these ratios for the regulated and deregulated years.

Table 4. Evolution of horizontal differentiation

Products	Savings banks		Private banks	
	1988	1998	1988	1998
Deposits	0.072	0.026	0.229	0.021
Loans	0.021	0.033	0.019	0.044

We start by analyzing the market for deposits. We see that despite their different starting points, by the end of the nineties both private and savings banks did manage to differentiate their deposits on equal basis. This result is even more striking for savings banks whose ratio at the end of the nineties decreased by a factor of 10. In contrast, private banks reduction was by a factor of 3.

However, the situation is quite different in the loans market. Despite their similar starting points for private and savings banks, neither of them could fully alleviate the competitive pressure in the market for loans. The situation is even worse for savings banks as their ratio got multiplied by 2.

The overall picture that we obtain from our analysis is that the direct channel from deregulation to competition successfully promoted competitive behavior among the different types of banking institutions. From the point of view of the vertical differentiation, at the end of the nineties we only observe negligible advantages in terms of explicit interest rates. Regarding horizontal differentiation, the situation in the deposits market is quite homogeneous across types, whereas private banks have an advantage in the loans market.

In the next section, we take a step back by incorporating in our econometric exercise conditions arising from banks' optimal behavior. Note that so far, these conditions are absent in our empirical model as we have estimated the relevant parameters assuming consumers' optimal behavior. Our aim is to contrast these estimations with those coming from the first order conditions of banks optimal behavior.

4. On banks optimal behavior

Note that the analysis undertaken so far has remained silent as to the banking behavior, i.e. we have taken as given banks strategic variables, and have obtained the demand equations by assuming that consumers maximize their utility. Now, we assume that banking behavior is also optimal in the sense that it comes from the maximization of a profit function.

To this respect, it is important to note that in the profit maximization problem that yields banks optimal behavior, a number of variables appear that are crucial in the determination of customers' behavior: the implicit interest rates and the transportation costs. Hence, when banks decide on interest rates and branches, they must possess beliefs about these variables. Quite obviously, different beliefs will give rise to different decisions on interest rates and branches. In this section, we aim at estimating these beliefs.

To keep things relatively simple, we assume several restrictive assumptions about bank behavior: (i) banks are myopic in the sense that they are interested in the maximization of the per-period profit, and (ii) banks simultaneously determine their strategies.

With these assumptions, we now write bank *i*'s profit at a given point in time

$$\pi_i = (r_i^L - r)\sum_k L_{ik} + \left[r(1-\xi) - r_i^D\right]\sum_k D_{ik} - c_i(\sum_k L_{ik}, \sum_k D_{ik}, w),$$

where r is the market interest rate, ξ is the mandatory legal reserve requirement, and $c_i(\cdot)$ is the cost function whose arguments are the total quantity of deposits ($\sum_k D_{ik}$), the total quantity of loans ($\sum_k L_{ik}$) and the vector of input prices (w).

The first order conditions are the following:

$$\frac{\partial \pi_i}{\partial r_i^D} = \sum_k ((\frac{\delta_k}{\tilde{\alpha}_k} n_{ik} \frac{n_k - n_{ik}}{n_k - 1})(r(1-\xi) - r_i^D - \frac{\partial c_i(\cdot)}{\partial D_i}) - \delta_k (\frac{n_{ik}}{n_k} + \sum_{j\neq 1} \frac{n_{ik} n_{jk}}{n_k - 1} \frac{r_i^D - r_j^D + \tilde{\upsilon}_i^D - \tilde{\upsilon}_j^D}{\tilde{\alpha}_k})) = 0,$$

$$\frac{\partial \pi_i}{\partial r_i^L} = \sum_k ((-\frac{\lambda_k}{\tilde{\beta}_k} n_{ik} \frac{n_k - n_{ik}}{n_k - 1})(r_i^L - r - \frac{\partial c_i(\cdot)}{\partial L_i}) - \lambda_k (\frac{n_{ik}}{n_k} - \sum_{j\neq 1} \frac{n_{ik} n_{jk}}{n_k - 1} \frac{r_i^L - r_j^L - \tilde{\upsilon}_i^L + \tilde{\upsilon}_j^L}{\tilde{\beta}_k})) = 0,$$

$$\frac{\partial \pi_{it}}{\partial n_{ik}} = \delta_k (\frac{n_k - n_{ik}}{n_k^2} + \frac{1}{\tilde{\alpha}_k} \frac{n_k - n_{ik} - 1}{(n_k - 1)^2} \sum_{j\neq i} n_{jk} (r_i^D - r_j^D + \tilde{\upsilon}_i^D - \tilde{\upsilon}_j^D)) \times (r(1-\xi) - r_i^D - \frac{\partial c_i(\cdot)}{\partial D_i}) +$$

$$+ \lambda_k (\frac{n_k - n_{ik}}{n_k^2} - \frac{1}{\tilde{\beta}_k} \frac{n_k - n_{ik} - 1}{(n_k - 1)^2} \sum_{j\neq i} n_{jk} (r_i^L - r_j^L - \tilde{\upsilon}_i^L + \tilde{\upsilon}_j^L))(r_i^L - r - \frac{\partial c_i(\cdot)}{\partial L_i}) = 0, \ \forall k$$

where $\tilde{\alpha}_k$ and $\tilde{\beta}_k$ are the beliefs that banking institutions hold about the transportation costs for deposits and loans, respectively, and $\tilde{\upsilon}_i^D$ and $\tilde{\upsilon}_i^L$ are their beliefs about the implicit interest rates.

The above three first order conditions are estimated simultaneously. Joint estimation is necessary in order to provide estimates for all parameters. Given that we are considering different types of banking institutions, we proceed to estimate the equations separately for each type.

Note that the first order conditions include marginal cost of deposit and loans, $\frac{\partial c_i(\cdot)}{\partial D_i}$ and $\frac{\partial c_i(\cdot)}{\partial L_i}$. Then, we need to estimate the model in two stages: (i) In the first stage the marginal costs of loans and deposits are estimated, and (ii) the estimated marginal costs are used as data in the second stage, where the first order equations are estimated.

In the first stage we estimate the cost function jointly with its cost share equations[1]. The point estimates of the loans and deposits marginal costs for private banks are 0.06146 (0.0439) respectively and for savings banks 0.0667 (0.03594) for 1988, and 0.0511 (0.0421) for private banks and 0.04167 (0.03155) for savings banks, respectively for 1998.

In the second stage, a stochastic error term is added to each first order condition. These error terms are assumed to have zero mean with finite variance and to be uncorrelated with any of the explanatory variables. Maximum likelihood estimates are computed under the assumption of normal distribution. Joint estimation, using a system of seemingly unrelated regressions (Zeller (1992)) exploits cross equation correlations thereby enhancing estimate's efficiency[2].

The above first order equations are reformulated as follows:

$$D_i = \sum_k (\frac{\delta_k}{\tilde{\alpha}_k} n_{ik} \frac{n_k - n_{ik}}{n_k - 1}) E_i^D + \epsilon_{1i}$$

$$L_i = \sum_k (-\frac{\lambda_k}{\tilde{\beta}_k} n_{ik} \frac{n_k - n_{ik}}{n_k - 1}) E_i^L + \epsilon_{2i}$$

$$-(\lambda_k E_i^L + \delta_k E_i^D) \frac{n_k - n_{ik}}{n_k^2} = -\frac{\lambda_k}{\tilde{\beta}_k} \frac{n_k - n_{ik} - 1}{(n_k - 1)^2} \sum_{j\neq i} n_{jk} (r_i^L - r_j^L - \tilde{\upsilon}_i^L + \tilde{\upsilon}_j^L) E_i^L$$

$$+ \frac{\delta_k}{\tilde{\alpha}_k} \frac{n_k - n_{ik} - 1}{(n_k - 1)^2} \sum_{j\neq i} n_{jk} (r_i^D - r_j^D + \tilde{\upsilon}_i^D - \tilde{\upsilon}_j^D) E_i^D + \epsilon_{3i}, \ \forall k$$

[1] To estimate the marginal cost a translog cost function is used. Various approaches exist in the banking literature as to the definition of inputs and outputs. We have adopted the value added approach in modeling bank production (Berger and Humphrey, 1992). Two variable inputs, labor and physical capital, are used. Expenditures on these inputs comprise all of the operating banking costs. Prices of inputs are obtained by dividing expenses on each input by the respective quantities. The output variables include loans (home loans, other loans, and interbank loans) and deposits. Operating costs are defined as the sum of expenses on labor and physical capital.

[2] As the instruments of the endogenous variables their respective lags have been used.

where

$$E_i^D = r(1-\xi) - r_i^D - \frac{\partial c_i(\cdot)}{\partial D_i},$$

$$E_i^L = r_i^L - r - \frac{\partial c_i(\cdot)}{\partial L_i}.$$

Table 5 displays the belief estimates, where PB and SB should be read as the beliefs on implicit differential hold by private banks and savings banks, respectively.

Table 5. Beliefs estimates

Deposits	1988	1998	Loans	1988	1998
α_0	-0.0173*	-0.0399*	β_0	0.0068*	0.0466*
α_1	0.0798*	0.1430*	β_1	-0.0047*	0.1479*
α_2	0.1011*	0.1367*	β_2	-0.0716*	-0.2091*
α_3	-0.0104*	0.0104*	β_3	0.0111*	-0.0006*
PB	-0.0953*	-0.0519*	PB	-0.0464*	0.0171*
SB	-0.0953*	0.0895*	SB	-0.0464*	-0.0795*
ADJ.R^2	0.3460	0.8794	ADJ.R^2	0.7949	0.5958

Notes: * Statistical significance at the 1% level. ** Statistical significance at the 5% level.

In the regulated period, we observe that both types of institutions held the same beliefs about the implicit differential. They believed in the superiority of private banks for providing services both in the deposits and loans markets. These beliefs imply an explicit interest rate advantage for private banks of 5% in deposits and 2.3% in loans. We can see that with respect to loans, beliefs were roughly speaking accurate (the explicit interest rate advantage was around 3.50%, from Table 1 in section 3) although banking institutions were quite wrong with respect to the deposits market, believing private banks to be superior while it was the opposite in practice.

However, by the end of the nineties, private and savings banks no longer share beliefs about the implicit differential. Only private banks were accurate in estimating customers preferences, that as we saw in section 3 (Table 1), were asymmetric in the sense that customers preferred savings banks for loans and private banks for deposits. In fact, private banks accurately predicted the implicit differential for loans although overestimated it for deposits. On the contrary, savings banks hold wrong beliefs about the implicit differentials in both markets.

The overall picture that emerges from our analysis is that private banks hold more accurate beliefs than savings banks about the determinants of customers' behavior throughout the deregulated period. We can therefore hypothesize that this superior knowledge of customers' behavior is responsible for the better differentiation of private banks product.

Conclusions

We have empirically analyzed the relationship between deregulation and competition in the Spanish banking system throughout the evolution of the degree of product differentiation. Within the deregulation process, two different sources for product differentiation have been considered. The first comes from the asymmetric regulation of the different types of banking institutions. This asymmetry might confer some types a superiority in their business with respect to the other types. The deregulation process, by sweeping away the regulatory asymmetry, is expected to foster competition among banks. However, banks could indeed react to the deregulation process by differentiating their products in other dimensions.

Given that the regulatory instruments were aimed at restricting the use of the various strategic variables of banks, we have developed a theoretical model of banking competition contemplating the multiproduct and multimarket nature of the banking activity. In our model, the effect of the asymmetric regulation is captured by a vertical differentiation component, specifically by the implicit interest rate, a component of the effective interest rate. In addition, horizontal differentiation is allowed by letting banks open branches in different markets.

In our model, the degree of vertical differentiation is directly measured by the implicit interest rate. The higher the implicit interest rate, the less the competition between types of banking institutions. Regarding the degree of horizontal differentiation, we measure it through the ratio of cross price elasticity to own price elasticity. The larger the ratio, the higher the substitutability between the products offered by the different banks, and, therefore, the higher the competition among them.

The deposits and loans equations that emanate from our model have been estimated for the Spanish Banking System in two points of time, one corresponding to the regulated period (1988) and the other to the deregulated period (1998). The Spanish banking sector has been a good target for our exercise because it is an example of banking industry which has undergone a complex deregulation process which has involved the homogenization of the different regulation bodies.

Three salient results are obtained from our empirical exercise: (i) By the late nineties, the implicit interest rates have substantially decreased, showing that customers considered the different types of banking institutions to be more homogeneous in comparison to the situation in the late eighties. This implies the success of the deregulation process in enhancing competitive behavior, (ii) Spanish banking institutions have managed to differentiate their

deposits as a response to authorities effort to promote competition among them. However, they failed in alleviating the competitive pressure for loans, and (iii) Private banks have managed to differentiate their products in a better way than savings banks. The better adaptation of private banks to the deregulated environment is the result of a better knowledge of the variables that determine banks customers behavior.

Overall, our model, by considering multidimensional product differentiation, has allowed to link product differentiation to banking deregulation. Moreover, our empirical exercise has allowed us to assess how accurate banks' beliefs on customer behavior were during the deregulation process. Such comparison gives us the opportunity to shed light on the true nature of banking competition.

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