International Journal of Industrial Organization
17 (1999) 335–352

Multimarket competition in banking, with an example from the Portuguese market

Pedro Pita Barros*

Faculdade de Economia, Universidade Nova de Lisboa, Travessa Estêvão Pinto, Campolide, P-1070 Lisboa, Portugal

Accepted 4 July 1997

Abstract

Banks typically have more than one branch and their activities usually span over several markets. This multilocational nature of banks generates equilibrium price dispersion. The paper proposes a spatial competition model to explain price differences across banks in the deposits market. The model allows to separate two different sources of observed market power: collusion in the industry and product differentiation induced by location in local markets. An application to Portuguese commercial banking is reported as an illustration.

Keywords: Multimarket competition; Market power; Banking

JEL classification: L13; G21

1. Introduction

The banking industry presents characteristics that make it different from other economic sectors. One such characteristic is the multilocational nature of its activities and the importance of localized competition. Typically, some banks have more branches and cover a more extensive territory while others have fewer branches, concentrated in a few locations. Therefore, not all banks operate in every

*Tel.: +351-1-3833624; fax: +351-1-3886073; e-mail: ppbarros@fe.unl.pt

0167-7187/99/$ – see front matter
PII: S0167-7187(97)00035-0

local market. The existence of local markets give banks more market power than a unified national market and assessment of the exercise or market power should take this phenomenon into account, as it has strong implications for economic policy. So far, this element of banking competition has been largely neglected.

The European Commission has enacted two important Directives, aimed at creating an integrated market and stimulating cross-border activities. The main motivation behind the support of a European banking market is the expectation that competition will foster introduction of new and better services and will bring prices down. In fact, considerable gains from the Common Market program have been predicted. Fulfillment of such expected gains from price reductions depends crucially on the source of market power. If it lies in the branch structure, it may prove more difficult to obtain such gains than if high prices are due to collusive behavior. A full evaluation of the effects of this program is still to be carried out. Preliminary assessments suggest, however, that few cross-country effects have emerged (Gual and Neven, 1993). One possible explanation is precisely the degree of local market power that incumbents have.

This paper proposes a structural model that allows the distinction between conduct and market structure to be made as a determinant for the prevalence of markups over marginal cost. The analysis presented is related to the literature on market power measurement in banking.[1] Recent empirical research has found localized competition effects and spatial competition variables to be of importance to explain market power in the banking industry.[2] The approach proposed is new, as prior literature has not presented any treatment of localized competition in banking.[3] A simple example illustrates the issue. Consider two different markets with a single bank established in each of them. Suppose consumers do not shop across markets. In this case, the monopoly price emerges in equilibrium in each market. Market segmentation and local market power is at the basis of the result. Suppose now that both banks have an outlet in each market. Competition between firms will bring the price down. However, the monopoly price can be sustained if banks collude. The outside observer looks only at the price outcome and if he sees the monopoly price is unable to sort out which of the explanations is present in the data. Thus, resorting to the explicit introduction of local market characteristics becomes the key to understanding the market allocation when localized competition is significant.

Very different policy implications result from each source of market power. If monopoly markups are sustained by market segmentation due to local market features, then policies aimed at promoting entry and/or reducing market segmentation should be considered. On the other hand, if the monopoly price outcome is

[1] Recent examples are Shaffer and DiSalvo (1994); Lloyd-Williams et al. (1994) and Berg and Kim (1994).

[2] Fuentelsaz and Salas (1992); Barros and Leite (1994); Hannan and Liang (1993).

[3] This is a problem quite distinct from multimarket contact issues, as it will be apparent below.

due to some collusive agreement among banks, authorities should pursue policies directed at breaking up such agreements.

An application to the Portuguese market is presented. Given the small sample size, the application has only the purpose of illustrating how the two sources of market power can be identified. The results suggest that local market power is a more important explanation for high margins in deposits than collusion between market participants. This inference is to be confirmed by future research.

The present study suggests that difficulties in the creation of a truly integrated European market in banking services may also arise from the degree of local market power enjoyed by incumbents. This structural barrier to entry seems to be a much stronger force than collusive behavior. The proposed model can, therefore, constitute an important piece for evaluation of market integration in European banking. The purpose is to highlight the main features of the structural model, especially as to how the different elements can help to identify the source of banks' market power.

The organization of the paper is as follows. Section 2 presents the structure of the model. Section 3 discusses the data of the study and the econometric methods. Section 4 presents the application to the Portuguese banking sector. Finally, Section 5 concludes.

2. The model

I shall set forth that only pricing decisions are analyzed. Branching decisions as well as the choice of the local markets in which a bank shall operate are taken as given. The fact that banks can arguably be taken as price-takers in one of the markets in which they operate, namely a government securities or a money market, allows us to dichotomize the analysis treating the deposits market and the loans market separately. Taking advantage of this standard theoretical result in banking literature, the analysis will focus on the deposits market.[4]

A feature of the present work is the introduction of explicit multibranch banks and the constraint of an equal pricing rule across branches of the same bank. The structural model of spatial competition yields a precise rule (first-order condition for profit maximization) for the optimal choice of rates by banks. To focus exclusively on spatial competition, a version of the Salop (1979) circular city model is extended to multimarket considerations.[5]

Each local market is represented by a one-dimensional characteristics space

[4] For derivations and a more complete discussion see Hannan (1991).

[5] One similar model, in the approach, can be found in Fuentelsaz and Salas (1992). They also present a model of banking spatial competition where the circle is interpreted as geographic space. Both pricing and branching decisions are considered. Despite its simplicity, the model works remarkably well in the explanation of banks' pricing policies across Spanish regions and across European countries. Our model differs in that the circle length does not stand for geographical space.

(circle) of length one.[6] Bank customers are located continuously, with a uniform distribution of density δ. Densities may differ from market to market. They are the measure of market size in our model. The unit circle describing each local market should be interpreted as a summary description of consumers' preferences over characteristics of banks. Geographic location is one important element in the definition of the characteristics space, but by no means the only one. It justifies, for example, that a deposit featuring the same conditions can be differently located in terms of characteristics across local markets or across branches of a bank in a specified local market. Other characteristics, such as personalized service, interact in some unspecified way to generate the location of each branch in consumers' preferences.

The adoption of a model of horizontal product differentiation, as opposed to one of vertical differentiation, is not obvious. Certain characteristics of products offered by banks clearly lead to horizontal differentiation while others correspond more to vertical differentiation. In the latter category, an example is the (in)existence of lines in branches. In the former type of characteristics, geographic space and complexity and sophistication of services are good examples (complexity of additional services may increase use costs to consumers). A certain level of services may be preferred more by some consumers and less by others. We believe that horizontal differentiation is more important in consumers' decisions in retail banking than vertical differentiation, which justifies the approach followed.

Each customer deposits one unit of money, which has no alternative application. Depositors incur a unit transport cost. The transportation cost reflects the utility cost to depositors of not being served by their most preferred variety of bank. The assumption of inelastic demand is potentially restrictive. However, in the application performed, retail banking for deposits, it is perhaps more reasonable than in other contexts.[7]

A first question to be addressed is how does the pricing policy of a bank change when the same interest rate must be charged in all branches and whether this consideration can explain interest rate differentials across banks. It is shown that different degrees of local market power generate different pricing policies. Thus, empirical evaluation of market power must take this element into account.

2.1. Dispersion of equilibrium interest rates.

An important feature of the proposed model is the ability to generate dispersion of equilibrium interest rates, that is, banks will set different interest rates due to

[6] Addition of the variable ''length of circle'' can be easily done. However, it creates an interpretation problem: explaining changes from market to market in preferences of consumers, which in turn determine the set of possible characteristics. For this reason, the characteristics circle is assumed to be equal in all markets.

[7] The extension to elastic demand schedules can, in principle, be made along well-known lines. See Greenhut et al. (1987).

their differences in location of branches. This property of the model will allow us to distinguish between the two different sources of market power, branches location and collusion, in the empirical evaluation. To simplify the theoretical arguments, we look at a one effect at a time and it is assumed that each bank, except one, has at most one branch. As to the remaining variables, we assume first an equal number of banks in each local market but different transport costs. Second, equal transport costs across markets are considered but the number of banks operating in each market differs. Third, consumers' density differs across markets.

The first result concerns the ability of differences in transport costs across local markets to generate interest rate dispersion. Those three effects work together to make price-cost margins differ across banks. Local market power is greater in a market with higher transport costs, and in the absence of any constraint upon its pricing policies, the multimarket bank charges lower interest rates on deposits. When price discrimination is not possible, the bank adjusts the interest rate in a natural way, to an intermediate value. The other banks will also adjust its equilibrium interest rates. A chain effect on prices is created. In equilibrium, each bank will charge a different interest rate.[8] We have, thus, a first result: *The constraint of no price discrimination across markets generates, in the presence of different transport costs across markets, equilibrium interest rate dispersion*.

This shows the importance of looking not only at the concentration level or the degree of product differentiation in local markets as predictors of market power, but also at the existence of multimarket banks. Equilibrium interest rates are influenced by the degree of product differentiation in other markets where multimarket banks operate. Of course, with more than one multimarket bank, it is possible to design situations where symmetric equilibria arise (for example, two markets and two multimarket banks). The possible cases offer a too-rich set of configurations. No general rule can be stated. Nevertheless, equilibria with interest rate dispersion are expected to be more frequent.

The second effect on equilibrium interest rates of multimarket banks relates to the number of banks in each market. Multimarket banks tend to lessen competition in local markets with many competitors. In markets with just a few competitors multimarket banks increase the degree of local competition. In a sense, multimarket banks ''shift'' competitive pressure from markets with a high number of competitors to markets with low competition. Hence, *the constraint of no price discrimination generates, in the presence of a different number of competitors across markets, equilibrium interest rate dispersion*.

In the standard circular city model the equilibrium price is invariant to demand density. The result can be extended to the presence of a multimarket bank only if all the markets have the same number of branches and the same transport costs.

[8] The structure of first-order conditions of one-market banks is similar to a second-order difference equation. Its resolution implies a different price named by each bank. All proofs are available from the author upon request.

The neutrality results from the fact that equilibrium prices in each market depend only on the number of branches and transport costs. If they are equal across markets, equilibrium prices are identical in all markets. Densities of demand play no role in such a framework. Summarizing, *the constraint of no price discrimination, in the presence of different consumer densities across markets, does not change the Nash equilibrium*.

We now look at a different direction. Besides being present in several markets, a bank can have more than one branch in each local market. To investigate the implications of multibranch banks, a single market is considered. The assumption isolates the effect of multiple branches of a bank on market equilibrium. The crucial feature is the existence, or not, of adjacent branches for a bank. Consider first the situation characterized by each branch having neighbors only from other institutions. Then, *multibranching in the same market does not change the symmetric Nash equilibrium corresponding to the case of one-branch-one-bank as long as branches of the same bank are not adjacent*.

From this it follows that decisions at the bank level or at the branch level yield the same outcome. There is no incentives to centralize or decentralize price decisions, as profits are equal in both circumstances. In the present framework, decentralization means that a bank allows its branches to set the interest rates charged independently and non-cooperatively.

Consider, in turn, the situation where a bank has two branches in adjacent locations. All consumers in reach between the two branches are ''captured'' by the bank. To characterize equilibrium rates and its profits is necessary to know whether the bank prefers to let its branches set prices independently or to centralize the decision. The exercise of market power on ''captured'' consumers suggests intuitively that a centralized decision process is superior, from the point of view of the bank. Decentralization of the pricing decision to the branch level would imply that branches of the same bank compete with each other, thus lowering the banks' aggregate profits. Centralization mitigates price competition among own branches. We can, therefore, state that *if only one bank has two adjacent branches, centralized pricing decisions (prices equal for both branches) yields higher profits than a decentralized process (independent price-setting behavior by each branch).*

Organization costs must be high if the bank is to decentralize, as an optimal decision, price setting to the branch level. A direct consequence of this result is: *under multibranching, a centralized decision process generates equilibrium interest rate dispersion*.

Suppose that the exact location of branches on the circle is determined by consumers' assessments of banks' characteristics. Uncertainty about consumers' preferences (or rivals' characteristics) thus implies uncertainty about exact location of branches. A bank cannot identify who its neighbors are in each and every market. It knows, at best, which banks operate in the same local market and how many branches they have. The exact location in the characteristics circle is unknown. Since symmetry of location in each local market is assumed, the uncertainty concerns only the identity of neighbors.

Introduction of uncertainty about exact locations of branches in consumers' preferences leads to the strict superiority of centralization over decentralization in pricing policies.

It seems reasonable to assume that *a priori* a bank has no information concerning preferences of consumers and, probably, about all relevant attributes of local rivals.[9] Interest rates must be set under some rule for expectations about a neighbor's identity. Assume that a bank assigns the same probability to each of the remaining branches in that local market to be its right or left neighbor in a particular branch. Under these assumptions, *in a spatial market where locations are symmetrically distributed, if a bank has various branches, then centralization is strictly preferred to decentralization, provided there is a positive probability that adjacent branches of the same bank arise*.

One implication of uncertainty about identity of local competitors with multibranch banks is that it gives rise to equilibrium interest rate dispersion across banks, even in a single market context. Of course, the argument easily extends to more than one multibranch bank.

Some other implications to multibranch-multimarket banks can be discussed. A pure multimarket bank suffers a profit reduction under the constraint of no price discrimination across markets. On the other hand, a pure multibranch bank, under the assumption that a positive probability is assigned to the event of having adjacent locations, chooses to commit to a unique interest rate across branches. From this, a bank operating in several markets with more than one branch in each market would like to choose decentralization of decisions to the market level but not to the branch level.

If the bank can only establish decision processes at the branch level or at the central level, due to high organization costs in creating an intermediate layer of power, for example, it faces a trade-off between the gains of discrimination across markets and the gains of price coordination inside the market. Therefore, the observed policy of no discrimination across markets may be profit maximizing, even without appealing to ''business-ethics'' arguments.

In large countries, one may see price discrimination across broad regions, but not in small areas within a region. In any case, one does not see extensive decentralization of price policies to the branch level, especially in deposits. Managers may have some discretionary power to marginally adjust interest rates on deposits, within tight bounds defined at the central office. Special treatment of some customers usually requires clearance at the central office.

The arguments outlined imply vast numbers of possible configurations. The

[9] This is a reasonable assumption if preferences represented by the circle are derived from some ordering over banks' characteristics or from a ranking over some index composed of benefits of characteristics (Caplin and Nalebuff, 1991). The ordering has to satisfy some conditions to be represented by a circle (Horstmann and Slivinski, 1985).

discussion has underscored the fact that the way branches are deployed across markets does matter in explaining banks' pricing policies. It also shows that no general rule can be put forward. Each case must be treated on its own. We now proceed to the specification of the empirical model, introducing explicitly multimarket and multibranch considerations in a structural model of market power measurement.

2.2. The empirical model

Suppose that a typical bank, denoted by i, has n_i branches. Abusing notation, i will denote also the set of branches of bank i. The unit of reference is the branch, indexed by m. The following notation will be used throughout:[10] $t_{k(m)}$ denotes the transport cost in market k where branch m operates; $\delta_{k(m)}$ is the density of consumers (market size); $n_{ik(m)}$ is the number of branches of bank i in market k; $n_{k(m)}$ is the total number of branches in market k and r_i is the interest rate paid on deposits by bank i.

Branches are not restricted to be symmetrically located along the circle. Given a distance $d_m{}^j$ of a branch m to its neighbor j, $j=m+1$, $m-1$, total demand of deposits at branch m, D_m can be written as

$$D_m = \delta_{k(m)}\left(\frac{d_m^{m+1} + d_m^{m-1}}{2} - \frac{r_{m+1} + r_{m-1} - 2r_m}{2t_{k(m)}}\right) \tag{1}$$

Bank funds will earn some interest for the bank, and the relevant opportunity cost is given by the money market (or government securities) interest rate, adjusted for the existence of mandatory reserves. Profit per unit of deposits is thus given by the money market rate (adjusted for mandatory reserves requirements) minus the interest rate on deposits offered by the bank minus the real resources marginal cost of obtaining the deposit. Total expected profit is therefore (allowing for differences in marginal costs, c_i, across banks and assuming risk neutrality)

$$\Pi_i = \sum_{m=1}^{n_i} \delta_{k(m)}\left[\frac{d_m}{2} - \frac{Er_{m+1} + Er_{m-1}}{2t_{k(m)}} + \frac{r_i}{t_{k(m)}}\right](\tilde{r}_i - r_i) \tag{2}$$

where $\tilde{r}_i$ is a reference interest rate for bank i and $d_m = E(d_m{}^{m+1} + d_m{}^{m-1})$. The reference rate is given by

$$\tilde{r}_i = r^s(1-\varphi) + \varphi r_i^0 - c_i \tag{3}$$

where r^s is the money market interest rate, φ is the mandatory level of reserves, $r_i{}^0$ stands for remuneration of reserves and c_i is the (constant) real resources marginal cost for bank i.

The linearity of demand implies that uncertainty about identity of neighbors is reflected only in the expected interest rate of neighbors. There are three possible

[10] The index m will be omitted whenever no confusion arises.

cases: both neighbors of a branch belong to other banks ($m+1 \notin i$, $m-1 \notin i$); both belong to the same bank ($m+1 \in i$, $m-1 \in i$); or only one of them is a branch of another bank ($m+1 \in i$, $m-1 \notin i$; or $m+1 \notin i$, $m-1 \in i$).

The probabilities of occurrence of each case are:

$$\phi_0 = Pr(m-1 \notin i, m+1 \notin i) = \frac{n_k - n_{ik}}{n_k - 1} \times \frac{n_k - n_{ik} - 1}{n_k - 2}$$

$$\phi_1 = Pr(m-1 \notin i, m+1 \in i) = Pr(m+1 \notin i, m-1 \in i) = \frac{n_k - n_{ik}}{n_k - 1} \times \frac{n_{ik} - 1}{n_k - 2}$$

$$\phi_2 = Pr(m+1 \in i, m-1 \in i) = \frac{n_{ik} - 1}{n_k - 1} \times \frac{n_{ik} - 2}{n_k - 2}$$

and $\Sigma_{j=1}^{3} \phi_j = 1$. With these probabilities, expected interest rates of neighbors of each branch can be computed:

$$Er_{m+1} = Er_{m-1} = \sum_{j \neq i} \frac{n_{jk} r_j}{n-1} + \frac{n_{ik} - 1}{n-1} r_i, \tag{4}$$

and inserted into the profit expression.

2.3. Conduct: collusion vs. Nash behavior.

Two benchmark assumptions about conduct are collusive behavior and Nash-Bertrand behavior by banks. The collusive behavior assumption means that interest rates are set to maximize joint profits. Nash behavior means that each bank sets the price to maximize its own profits. Prices set by other banks are taken as given. Accordingly, the objective function of the bank can be written as

$$V = \Pi_i + \sum_{j \neq i} \lambda_{ij} \Pi_j = D_i(\tilde{r}_i - r_i) + \sum_{j \neq i} \lambda_{ij} (\tilde{r}_j - r_j) D_j, \; D_i = \sum_{m \in i} D_m \tag{5}$$

where the parameter λ_{ij} reflects the extent of bank i's internalization of the effect of its price changes on others profits. The critical values for the parameter are $\lambda_{ij} = 1$, where the collusive outcome is duplicated, and $\lambda_{ij} = 0$, which results in the Nash-Bertrand equilibrium.[11]

Pairwise collusion, that is collusion among subsets of banks, can also be considered. Under pairwise collusion, $\lambda_{ij} = \lambda_{ji} = 1$ for some i and j. This allows us to test if pricing strategies of groups of banks show evidence of coordination. Especially interesting is coordination of banks within the same economic group, that is, banks that share the same dominant shareholder(s) or top management.

[11] Note that this formulation is quite different from a conjectural variations model in prices and in general they are not equivalent in a product differentiation model.

The optimal choice of interest rates is determined by the first-order condition for profit maximization, which is given by:

$$\frac{\partial \Pi_i}{\partial r_i} = -D_i + (\tilde{r}_i - r_i)\frac{\partial D_i}{\partial r_i} + \sum_{j \neq i} \lambda_{ij}(\tilde{r}_j - r_j)\frac{\partial D_j}{\partial r_i} = 0 \tag{6}$$

where

$$D_i = \sum_m \delta_{k(m)} d_m - \sum_k \left[n_{ik} \frac{\delta_k}{t_k} \sum_{j \neq i} \left(\frac{n_{jk}}{n_k - 1} r_j \right) \right] + \left(\sum_k \frac{\delta_k}{t_k} \frac{n_k - n_{ik}}{n_k - 1} n_{ik} \right) r_i \tag{7}$$

$$\frac{\partial D_i}{\partial r_i} = \sum_k \frac{\delta_k}{t_k} \frac{n_k - n_{ik}}{n_k - 1} n_{ik} \tag{8}$$

$$\frac{\partial D_j}{\partial r_i} = -\sum_k \frac{n_{ik} n_{jk}}{n_k - 1} \frac{\delta_k}{t_k} \tag{9}$$

Completely free parameters λ_{ij} render the model impossible to identify. So, estimation is performed under the different assumptions on behavior presented above. The resulting models are then compared with each other by means of likelihood ratio tests.

The proposed scheme demands that rival banks are undifferentiated from the point of view of a bank. This rules out the possibility that a bank attaches more importance as a rival to any particular bank.

In the demand equation the parameter $\alpha_i = \sum_{m=1}^{n_i} d_m \delta_{k(m)}$ includes the location information of each branch of bank i. We decompose α_i in a term reflecting a symmetric equilibrium plus a random term capturing location deviations to the symmetric equilibrium. The random element includes the (unknown to the observer) location information of each branch of bank i:

$$\alpha_i = \sum_k \frac{\delta_k n_{ik}}{n_k} + \varepsilon_i$$

Additionally, entry will, on average, reduce the distance between branches. Arbitrarily, this time effect imposes a common mean across banks. Random deviations specific to both the bank and the time period are collected in a pure random effect. These assumptions generate, in a natural way, the stochastic nature of the equations to be estimated.

The empirical application estimates the first-order condition and the demand condition for each bank simultaneously. Joint estimation is necessary in order to provide estimates for all parameters. The unknown parameters of the model are δ_k, t_k and conduct parameters λ_{ij}. Operationally, we take δ_k and t_k^{-1} to be linear functions of market characteristics in a way to be described below.

3. Data and econometric methods

The model is estimated with data from a sample of 15 Portuguese banks, including the main institutions, over a two-year period (1991–1992). The sample covers 92% of the deposits market and about 90% of the branches. The small sample size advises us to interpret with caution the results obtained. The number of observations available constitutes the main problem in the application. The exercise illustrates the potential use of the approach. The application shows in a clear way the advantages of the proposed structural model in distinguishing between the two alternative sources of market power.

The banks included in the sample are *Banco de Fomento e Exterior* (BFE), *Banco Pinto and SottoMayor* (BPSM), *União de Bancos Portugueses* (UBP), *Banco Comercial dos Açores* (BCA), *Banco Comercial Português* (BCP), *Banco Espirito Santo* (BES), *Banco Totta and Açores* (BTA), *Banco Fonsecas and Burnay* (BFB), *Banco Nacional Ultramarino* (BNU), *Crédito Predial Português* (CPP), *Banco de Comércio e Indústria* (BCI), *Banco Comercial de Macau* (BCM), *Banco Borges and Irmão* (BBI), *Banco Portugués do Atlântico* (BPA), and *Caixa Geral de Depósitos* (CGD).

The Portuguese banking sector has recently witnessed the emergence of economic groups. In our sample, we have two groups of state-owned banks (BFE and BBI; CGD and BNU) and two more groups resulting from the on-going privatization program (BPA, BCM and UBP; BTA and CPP). Collusion between groups of banks means coordination between banks of the same economic group.

A local market is defined as a Portuguese local jurisdiction, the *concelho*. This is due to data availability. It is now necessary to specify the variables determining demand intensity and transport costs. Intensity of demand depends, conceivably, on the number of potential depositors and their needs of banking services. Potential depositors are approximated by total population in the market. One measure of the need for banking services commonly used is income per capita (Evanoff, 1988). It is proxied here by income tax payments per capita. The number of firms in the market is also considered, in order to reflect corporate demand for deposits.

With respect to transport costs, everything else held constant, markets with a larger geographical area may imply higher transportation costs to consumers. In order to account for this effect, area of *concelhos*, in km^2, is included as an explanatory variable for transport costs.

Transport costs can differ between rural and urban areas. A dummy variable incorporates this effect in the model. It takes on a value of one if the local market is classified as urban, and zero, otherwise. The following relationships are assumed:

$$\delta_k = \delta_0 + \delta_1 \mathrm{POP}_k + \delta_2 \mathrm{TAX}_k + \delta_3 \mathrm{FIRM}_k \tag{10}$$

and

$$t_k^{-1} = t_0 + t_1 \text{URBAN}_k + t_2 \text{KM}_k^2 \tag{11}$$

where POP_k is population of market k; TAX_k stands for per capita income tax payments; FIRM_k is the number of firms in the market; URBAN_k is a dummy variable (one if urban market, zero otherwise); and, $\text{KM}_k{}^2$ denotes the geographical area of the local market (in squared kilometers).

3.1. Sources of data

Data on the number of branches of a bank operating in each local market is provided by the Portuguese Banks Association publications.

The variables characterizing local markets can be found in *Administração Local em Números, published by Direcção Geral da Administração Autárquica* (1991) (DGAA), a Portuguese government department. These variables are the more demanding statistical information requirements of the model, as they are not published on a regular basis. Data is available for 1991–1992 and does not allow to extend the analysis to a longer time dimension. Interest rates on a bank basis for 1991 and 1992 are computed from published bank accounts.[12] Definition of urban areas is made according to the classification of *Instituto Nacional de Estatística*, the Portuguese Bureau of Statistics. A local market is classified as urban if it has ten thousand or more inhabitants. This is a crude way of assigning *concelhos*.[13]

The real resources marginal cost of deposits is taken from Pinho (1994). For a panel data of banks in the period 1986–1992, estimates from a long-run stochastic cost frontier for real resources employed in the Portuguese banking industry suggests constant marginal costs of about 2.5% for the banks in our sample. The parameter φ is the mandatory (legal) rate of reserves and takes the value 0.17.

3.2. Equations to be estimated

The pair of equations to be estimated is constituted by the deposits demand function and the first-order condition for the interest rate choice:

$$\begin{aligned} D_{ih} = a_h &+ \sum_k \frac{n_{ikh}\delta_{kh}}{n_{kh}} + r_{ih} \sum_k \frac{\delta_{kh}}{t_{kh}} \frac{n_{kh} - n_{ikh}}{n_{kh} - 1} n_{ikh} \\ &- \sum_k \frac{\delta_{kh}}{t_{kh}} n_{ikh} \sum_{j \neq i} \frac{n_{jkh}}{n_{kh} - 1} r_{jh} + \varepsilon_{1it} \\ &- D_{ih} + (r_h^s(1-\varphi) + \varphi r_{ih}^0 - r_{ih} \\ &- c_i) \sum_k \frac{\delta_{kh}}{t_{kh}} \frac{n_{kh} - n_{ikh}}{n_{kh} - 1} n_{ikh} - \sum_{j \neq i} \lambda_{ijh}(r_h^s(1-\varphi) + \varphi r_{jh}^0 - r_{jh} \end{aligned}$$

[12] For the details, see Amador and Brasão (1993).

[13] Alternatively, an older classification is provided by DGAA for 1982. Unfortunately, recent and unequal evolution of Portuguese regions renders it clearly inappropriate.

$$- c_d) \sum_k \frac{n_{ikh} n_{jkh}}{n_{kh} - 1} \frac{\delta_{kh}}{t_{kh}} + b_h = \varepsilon_{2it}$$

$$h = 1991, 1992; \ i, j = 1, ..., 15, \ k = 1, ..., 304.$$

Error terms are included in both equations. The random shock in the demand equation is denoted by ε_{1it} and the error term in the first-order condition is denoted by ε_{2it}. There is a gain in efficiency if estimation is made using a system of seemingly unrelated regressions (Zellner, 1962). The coefficients on the independent variables are restricted to be the same across equations. The SUR technique exploits any correlation that may exist for each firm across time.[14]

The random residual ε_{fih}, $f=1$, 2 is assumed to have zero mean and finite variance and to be uncorrelated with any explanatory variable. The residuals can be correlated, for the same moment in time and for the same bank, across equations. Correlation over time for each bank is also allowed. The residual term can thus be written as $\varepsilon_{fit} = u_{fi} + v_{fit}$, where u_{fi} is a bank-specific random effect and v_{fit} is a pure random term. Maximum likelihood estimates are computed under the assumption of normally distributed disturbances.

The model is estimated with a panel data of 15 Portuguese commercial banks over a two-year period. Regression variables must be computed aggregating the local market variables. Aggregation runs over 304 local markets.

3.3. Conduct parameters

The general formulation for the conduct parameter renders the model impossible to estimate. Three particular schemes are considered in order to reduce the number of parameters to be estimated. The first one, called *market collusion*, imposes $\lambda_{ijh} = \lambda_h{}^M$, $\forall i,j$. That is, banks take into account in their choices some effect upon others in a symmetric way. The parameter can vary over time, reflecting changes in the degree of collusion in the market.

Another scheme makes use of outside information on the system and considers collusion only between banks of the same group: $\lambda_{ijh} = 1$ for i, j in the same economic group, $\lambda_{ijh} = 0$ otherwise. Again, differences across years in the degree of collusion are allowed. The index j covers the two years in the sample.

Finally, Nash behavior ($\lambda_{ijh} = 0$) constitutes the third main behavioral assumption. These three extreme cases are imposed on the model and tested against the more general case of $\lambda_{ijh} = \lambda_h$, as a way of selecting among the three (non-nested) cases. We refrain from the interpretation of an intermediate value for λ_h.

3.4. Estimation strategy

The empirical analysis is intended to shed light on the nature of banks' conduct.

[14] Estimation of fixed effects specific to the firm would consume too many degrees of freedom.

All possible combinations of parameters lead to a fairly large number of models. As a result, the research strategy was the following. In a first step, deposits supply and transport costs variables are omitted and only conduct parameters are estimated. Then, in the second step, previously omitted variables are added one at a time, holding conduct parameters constant. Finally, we test inclusion/exclusion of each variable on the model resulting from the second step.

Fixed time effects are added to both equations. There are three conduct patterns to be evaluated: collusion common to all banks, which will be termed market collusion, collusion including only banks in the same economic group, which will be termed group collusion and Nash-Bertrand behavior. Particular versions of the model are tested against more general nested alternatives using the likelihood ratio test.

4. Empirical findings

Estimates are presented in Table 1, which reports the models that survived the selection process described above. The models retained have only one significant

Table 1
Estimated models

Time-specific effects			
(Deposits demand equation)			
a_{91}	394.504	405.292	405.394
	(3.95)	(4.08)	(4.05)
a_{92}	138.223	152.088	151.497
	(2.19)	(2.50)	(2.46)
(First-order condition)			
b_{91}	101.957	116.347	122.992
	(3.79)	(4.41)	(4.60)
b_{92}	151.687	169.558	173.746
	(4.96)	(5.91)	(6.00)
Demand intensity variables			
Constant (δ_0)	21.457	21.333	21.416
	(10.31)	(10.56)	(10.54)
Transport costs variables			
Constant (t_0)	5.219	11.685	11.312
	(7.20)	(2.87)	(2.71)
URBAN (t_1)		−6.860	−6.504
		(−1.63)	(−1.50)
Conduct Parameters			
Group collusion 1991	0.00	0.00	1.00
Group collusion 1992	0.00	0.00	1.00
Log likelihood Value	−80.9274	−78.7222	−79.6844

Note: *t*-statistics within brackets.

explanatory demand-side variable, URBAN. They are differentiated by the underlying behavior assumption: Nash-Bertrand or group collusion.

The independence of deposits demand intensity from the included regressors is surprising and reinforces the illustrative purposes of the application.

Nevertheless, the results stress the importance of localized competition on deposits in the sense that volume of deposits is associated with the network of branches.

A possible explanation for insignificance of demand variables is statistical. There is a high correlation among explanatory variables after adjusting for the markets a bank operates in. The variation introduced by the aggregation over markets dominates in the transformed variables, making them highly colinear. In addition, the structure imposed by the theoretical model may be too demanding on the data.

Another result of the model is the relevance of transport costs (statistical significance is about 12%), interpreted in a broad sense. Urban markets have higher transport costs than rural markets. This may reflect factors such has the opportunity cost of going to the bank, which we expect to be higher in urban areas. Transport costs are not related to the geographical size of the market. This is explained by the fact that banks tend to cluster in the center of towns. If the relevant market is at the town level, differences in size across administrative jurisdictions should not matter much.

We now turn to conduct analysis. Two different cases cannot be dismissed: collusion at the group level and Nash-Bertrand behavior. Both models are included in a more general model, where the group collusive parameters are estimated, instead of exogenously determined (although one must assume a common value of λ for collusive conduct within every economic group). The natural way of choosing between the two alternatives is to test each against the more general specification. Unfortunately, neither case is rejected, the selection procedure does not give a single choice for the best description of banks' behavior. There is, however, clear rejection of market-wide collusion (industry cartelization). Imposing equal transport costs leads to the selection of Nash-Bertrand behavior across markets.[15] In this sense, we may argue in favor of independent behavior across banks (on average).[16]

The interpretation of the model must be made carefully. It reflects banks decisions as well as their expectations about demand of deposits at the branch level. Modeling of consumer behavior does not go deep into the very fundamentals of choice. Nonetheless, it shows that a clear identification of conduct under the existence of local market power is possible, allowing us to trace the source of observed (high) margins of banks.

[15] The level of significance that allows us not to reject a zero effect is 12%.

[16] Since group-wide collusion and Nash-Bertrand behavior have the same dimensionality, selection tests will tend to choose the model with a higher likelihood value, that is, Nash-Bertrand behavior.

5. Final remarks

The issue of conduct evaluation for multimarket-multibranch firms was addressed in this paper. An application to the banking sector was developed. The banking industry is one of the best examples of industries where local market competition matters. Activities of a bank typically span several branches and markets.

A theoretical model of the multibranch-multimarket competition, based on the circular city model of Salop (1979) was presented and empirically testable restrictions on data were put forward. The model is highly simplified and overlooks several aspects that may be relevant. Some characteristics of the model are noteworthy by their potential restrictiveness. First, there was assumed to be only one banking product. In reality, banks have different types of deposits and credits and their interaction can affect the equilibrium outcome. Extension of the model to incorporate multiproduct considerations is straightforward, but demands unavailable data in the empirical application.

It can be argued that spatial models have too much localized competition. The structure of the model would then be biased against finding evidence of collusive behavior. Also, the implied structure of the model may be too rigid to fit the data. In this respect, a linear ad-hoc deposits demand function was tried. Taking these results together, it is clear that future investigation of deposits determinants and the functional form of the relationship is desired, as results may be sensitive to it.[17] Having put forth the main caveats of the model it should be noted that even very simplistic models can shed some light over oligopolistic interaction in product differentiated industries.

The theoretical framework was applied to data for Portuguese commercial banking. Estimation of the structural model revealed that Nash behavior receives the strongest support from the data (in the set of models considered). Although the evidence in favor of Nash behavior is stronger, given the small sample size, it is not possible to completely discard collusion within the same economic group,[18] although market collusion is always rejected. These results should be confirmed by future research, making use of a longer time period, provided the necessary statistics on Portuguese local jurisdictions are made available.

The small sample size precludes a clear test of the model, as it leads to imprecision of estimates and statistical tests. The empirical results reported are not strong. Further testing of the model should be pursued. For example, we can regard each country as a collection of local markets, suggesting that the empirical

[17] It may seem desirable to allow for a somewhat more flexible deposits demand structure in order to assess the robustness of findings. Estimates are not reported. They are available in the working-paper version. Inferences for market conduct do not change.

[18] In the sense that the statistical superiority of the Nash-Bertrand conduct model may be easily reverted with a more extensive database. The selection tests are clearly on the borderline.

test should be carried out in other EU countries.[19] Despite the difficulties in gathering the appropriate data on a comparable basis, the implications of regional market segmentation to the completion of the European Single Market in commercial banking services deserves our attention.

A main conclusion of the study is that market power measurement and explanation of margins in the banking industry must take into account the local market nature of the activity. Differences in presence across markets can give rise to equilibrium interest rate dispersion, without implying different conduct by banks or different marginal cost structures. This suggests that a deeper understanding of branching strategies and their interactions with price policies is necessary and should motivate further research.

The type of results that can be reported with the proposed model have important implications for evaluation of the likely effects of recent European Union legislation. Opening of national banking markets was deemed to yield non-negligible welfare gains. Existing banking margins were taken as a clear sign that benefits from increased competition in a Single European Market were available. This paper provides a framework to assess this view in a more detailed way that is traditionally done. It is important to identify whether the source of high margins is related more to the degree of local competition or to cartelization of industry. The former means that competition gains may be obtained only if entrants in the market are able to deploy a branch network with relative success. So far, most experiences of banks in the development of branching networks in countries other than the country of origin have failed (most notably in Spain, but also in Portugal).

Increased competition may well take more time to erode existing market power than was anticipated. Only in ‘‘wholesale’’ banking activities is market structure favorable to quickly reveal the benefits from increased competition. However, these markets were already relatively free and a single market has been in place for some time now.

The so-called creation of the Internal Market has led to restructuring of the banking sector in various European countries, with mergers between large banks in several domestic markets. The increased degree of concentration in local markets should be followed closely as such merger activities may act as a significant market-power enhancement tool. At the least, this type of consideration should be included alongside the ‘‘need to achieve European dimension’’ arguments in the assessment of current merger activity in European banking.

Pushing forward the qualitative implications of our analysis, a reassessment of the gains accruing from the creation of a Single European banking market seems highly desirable, incorporating the notion of local market competition. This paper

[19] Finding empirical support for the hypothesis of local market power in a small country like Portugal hints that it may also hold in larger countries, where regional differences are more important (for example, regional banks in Spain and R.B. Scotland in the UK are natural candidates to have strong local market power).

attempts to provide a first step in the right direction, despite the important qualifications to the particular example presented.

Acknowledgements

I benefited from the comments and suggestions of Paulo Pinho, participants at the 1994 EARIE Conference (Crete) and two anonymous referees. Financial support from EC Human Capital and Mobility Fellowship grant ERBCHBGCT920147 and the hospitality of Universitat Autònoma de Barcelona are gratefully acknowledged. The usual disclaimer applies.

References

Amador, J., Brasão A., 1993. Elementos Estatísticos do Sector Bancário Português, (Statistical Elements on Portuguese Commercial Banking). Universidade Nova de Lisboa.

Barros, P., Leite, A., 1994. Competition in Portuguese Commercial Banking. Mimeo, Universidade Nova de Lisboa.

Berg, S.A., Kim, M., 1994. Oligopolistic interdependence and the structure of production in banking: an empirical evaluation. Journal of Money, Credit and Banking 26 (2), 309–322.

Caplin, A., Nalebuff, B., 1991. Aggregation and imperfect competition: on the existence of equilibrium. Econometrica, 51(1), 25–59.

Direcção-Geral da Administração Autárquica, 1991. Administração Local em Números - 1991, (Local Administration in Numbers). Lisboa.

Evanoff, D., 1988. Branch banking and service accessibility. Journal of Money, Credit and Banking 2 (2), 191–202.

Fuentelsaz, L., Salas, V., 1992. Spatial Competition in Retail Banking – Theory and Empirical Evidence from Spain and other European Countries. Typescript, Universitat Autónoma de Barcelona.

Greenhut, M.L., Norman, G., Hung, C.S., 1987. The Economics of Imperfect Competition: A Spatial Approach. Cambridge University Press, Cambridge.

Gual, J., Neven, D., 1993. Banking. European Economy – Reports and Studies 3, 151–182.

Hannan, T.H., Nellie Liang, J., 1993. Infering market power from time-series data – the case of the banking firm. International Journal of Industrial Organization 11, 205–218.

Hannan, T.H., 1991. Foundations of the structure-conduct-performance paradigm in banking. Journal of Money, Credit and Banking 23 (1), 68–84.

Horstmann, I., Slivinski, A., 1985. Location models as models of product choice. Journal of Economic Theory 36, 367–386.

Lloyd-Williams, D.M., Molyneux, P., Thornton, J., 1994. Market structure and performance in Spanish banking. Journal of Banking and Finance 18 (3), 433–443.

Pinho, P., 1994. Essays in Banking. PhD Thesis, City University Business School.

Salop, S., 1979. Monopolistic competition with outside goods. Bell Journal of Economics 10, 141–156.

Shaffer, S., DiSalvo, J., 1994. Conduct in a banking duopoly. Journal of Banking and Finance 18 (6), 1063–1082.

Zellner, A., 1962. An efficient method of estimating seemingly unrelated regressions and tests of aggregation bias. Journal of the American Statistical Association 57, 348–368.