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Demand for Bank Services and Market Power in Brazilian Banking [*]

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Abstract

We use bank-level data to model the demand for bank services in Brazil following the discrete choice literature. A multinomial logit specification is used to study the demand for time deposits, for an aggregate of demand and passbook savings deposits, and for loans. Market for each of these products is defined at the municipality level. In the supply side, we find the absolute price-cost margins consistent with Bertrand competition and with cartel. Our results suggest that even Bertrand competition overestimates the degree of market power in the Brazilian banking industry.

Keywords: demand for bank services, bank competition, Brazilian banking
JEL Classification: G21, L13

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1. Introduction

The degree of competition in the banking industry in Brazil is a subject of some controversy. High bank interest margins coupled with profit indicators for the main banks in the country reinforce the popular view that banks operate under imperfect markets.

The empirical literature that rigorously tested for the presence of market power indeed found some evidence to reject the view that the Brazilian banking sector operates under perfect competition.[1] On the other hand, the hypothesis that Brazilian banks operate under cartel is also rejected. Nakane (2003) surveys the available literature.

However, the relation between the pricing of bank products and the eventual exercise of market power seems to be still largely unknown in the country. The main aim of this paper is to fill this gap and improve upon the available literature.

Another field where the empirical knowledge is almost non-existent is the magnitude of the demand elasticities for the bank products in Brazil. This paper develops a discrete choice model of demand for bank products, and provide preliminary estimates of demand elasticities for some products.

The relevant market for bank products in the geographical dimension is assumed to be local. Each municipality defines a relevant market. By contrast, the relevant market in the previous studies was assumed to be the whole country. Such studies may therefore be biased towards finding more competition than the actual levels. By adopting a more restricted geographical dimension, we intend to decrease such bias.

On the supply side, two models of bank behavior are developed in the paper. The first follows a Bertrand-Nash competition behavior and the second a cartel behavior. Implied price-cost margins are derived for each model. Estimates of these can be obtained by using available data and the estimated demand parameters.

In the present article, we test market power by comparing the observed price-cost margins with the ones predicted by the Bertrand and cartel models. The results show that the Bertrand model is a good description of the service fees charged by Brazilian banks on deposits, but overestimates the market power on the setting of loan and time deposit interest rates.

The article is organized as follows. Section 2 describes the demand model. Section 3 presents the supply models. In section 4, we describe the data and the instruments. Demand estimation results are presented in section 5 and the simulation results in section 6. Finally, section 7 concludes.

2. The demand model

The model described here follows Dick (2002), which modifies the discrete choice framework to fit the demand for banking services. Dick restricted her analysis to the deposit services. In addition to deposits, we also used the model to specify the demand for loans.

The demand model has the following formal structure: Assume the existence of a consumer *i* that chooses the deposit services of a bank *j* in a market *t* ($t = 1,...,T$). Let $j = 0,1,...,J_t$, indicate the banks competing in market *t*, where $j = 0$ represents the "outside" option, i.e. the option for the household not to choose any of the banks. The conditional indirect utility of consumer *i* from choosing bank *j* is:

$$u_{ijt} = p_{jt}^{d}\alpha^{d} - p_{jt}^{sv}\alpha^{sv} + x_{jt}\beta + \xi_{j} + \varepsilon_{ijt} \qquad (1)$$

where p_{jt}^{d} represents the interest rate paid on time deposits, p_{jt}^{sv} is the service fees on banking services, x_{jt} is a K-dimensional row vector of observable product characteristics, ξ_j represents unobserved product characteristics, and ε_{ijt} is mean zero stochastic term with an i.i.d. extreme value type I distribution. The K+2 dimensional vector $\theta_D \equiv (\alpha^{d}, \alpha^{sv}, \beta)$ represents the deposit services demand parameters.

[1] See Nakane (2002), Belaisch (2003), and Petterini and Jorge Neto (2003).

Suppose that each consumer chooses one unit of services from the bank that maximizes her utility. This implicitly defines the set of unobservable variables that results in the choice of services from bank *j*. Formally, let this set be:

$$A_{jt}(x_{.t}, p_{.t}^{d}, p_{.t}^{sv}, \xi_{.t}; \theta_D) = \left\{ (\nu_i, \varepsilon_{it}) \;\; t.q. \;\; u_{ijt} \geq u_{ilt} \;\; \forall l = 0,1,...,J \right\} \tag{2}$$

where $x_{.t} = (x_{1t},...,x_{Jt})'$, $p_{.t}^{d} = (p_{1t}^{d},..., p_{Jt}^{d})'$, $p_{.t}^{sv} = (p_{1t}^{sv},...,p_{Jt}^{sv})'$, $\xi_{.t} = (\xi_{1t},...,\xi_{Jt})'$, and ν_i represents the unobservable characteristics of consumer *i*.

Thus, assuming ties occur with zero probability, the market share of product *j* is given by the probability that $(\nu_i, \varepsilon_{it})$ belongs to the A_{jt} region, for all households. Formally, this market share is given by:

$$s_{jt}(x_{.t}, p_{.t}^{d}, p_{.t}^{sv}, \xi_{.t}; \theta_D) = \int_{A_{jt}} dP^*(\nu, \varepsilon) = \int_{A_{jt}} dP^*(\nu) dP^*(\varepsilon) \tag{3}$$

where *P**(.) represents population distribution functions.

Notice that this model does not include any interaction between the unobservable characteristics of individual *i*, ν_i, and the observable characteristics of product *j*. This means that the model belongs to the class of standard discrete choice models known as multinomial logit models. This allows us to find a closed form solution for (3), given by:

$$s_{jt} = \frac{exp(p_{jt}^{d}\alpha^{d} - p_{jt}^{sv}\alpha^{sv} + x_{jt}\beta + \xi_j)}{1 + \sum_{k=1}^{J} \exp(p_{kt}^{d}\alpha^{d} - p_{kt}^{sv}\alpha^{sv} + x_{kt}\beta + \xi_k)} \tag{4}$$

In spite of its analytic simplicity, the limitations of the logit specification are well known [see, among others, Berry (1994), Berry, Levinsohn and Pakes (1995) and Nevo (2000)]. In particular, the price elasticities generated by the logit model depend only on market shares, generating quite restrictive substitution patterns. Discrete choice models with random coefficients introduce interaction terms between the individual characteristics and observable characteristics of the products, generating more reasonable substitution patterns [see Berry (1994), Berry, Levinsohn and Pakes (1995, 2004) and Nevo (2001)]. The cost of this option is its computational complexity, because, in this last case, expression (3) cannot be analytically solved.

Let $\delta_{jt} \equiv p^{d}_{jt}\alpha^{d} - p^{sv}_{jt}\alpha^{sv} + x_{jt}\beta + \xi_{j}$ be the mean utility of product *j*, which is the same for all consumers, and let $\delta_{t} \equiv (\delta_{1t},...,\delta_{Jt})$. If S_{jt} represents the market share of bank *j* actually observed, then, the following set of equations must hold at the true values of δ:

$$S_{jt} = s_{jt}(\delta), \qquad j = 1,..., J \tag{5}$$

where the term on the right hand side of (5) is given by expression (4), and it represents the market share predicted by the model.

Substituting expression (4) in (5), and normalizing the mean utility of the outside good to zero, we obtain the deposit services demand equation:

$$ln(S_{jt}) - ln(S_{0t}) = p^{d}_{jt}\alpha^{d} - p^{sv}_{jt}\alpha^{sv} + x_{jt}\beta + \xi_{j} \tag{6}$$

Notice that the unobservable characteristics of product *j* will be captured by the regression error in (6). Given the correlation between such components and prices, the econometric estimation must follow instrumental variable techniques.

The specification of the loan demand is entirely similar. It is supposed, in the loan case, that the interest rate collected on loans substitutes the prices that appear in (6).

3. The supply side: two models of bank behavior

Let *j* be a bank that operates at *T* different markets. At each of these markets, this bank deals with the following products: demand deposits (*DD*), saving deposits (*SD*), time deposits (*TD*), loans (*L*), bonds (*B*), and banking services (*SV*).

Each bank follows price competition *a la* Bertrand.[2] The strategic variables for each bank are the following three prices: loan interest rate (p_j^l), time deposits interest rate (p_j^d), and service fee (p_j^{sv}). Suppose that there is no price discrimination among the various markets, so that the price is the same at each market: $p_{jt}^l = p_j^l$, $p_{jt}^d = p_j^d$ e $p_{jt}^{sv} = p_j^{sv}$, $\forall t = 1,...,T$.

In addition to these prices, there are two other prices that are exogenous to the bank: the bond interest rate (r) and the savings interest rate (r^{sd}). We also assume that the interest rate on demand deposits is equal to zero.

Bank j balance sheet constraint is given by:

$$B_j + L_j + \rho DD_j = DD_j + TD_j + SD_j \tag{7}$$

where ρ represents reserve requirements on demand deposits. Assume that there are no reserve requirements on time deposits and on savings or, alternatively, that, if they exist, they are paid at the rate r, which neutralizes their effects on banks. Assume also that banks do not have equity as a funding source, which is not a restrictive assumption for the Brazilian case.

We define and estimate demand models for loans, time deposits and the aggregate of demand and savings deposits ($D_j = DD_j + SD_j$). The following identities are valid for these products:

$$\begin{aligned} L_j &\equiv \sum_{t=1}^{T} L_{jt} \equiv V^L \sum_{t=1}^{T} M_t s_{jt}^L \\ TD_j &\equiv \sum_{t=1}^{T} TD_{jt} \equiv V^{TD} \sum_{t=1}^{T} M_t s_{jt}^{TD} \\ D_j &\equiv \sum_{t=1}^{T} D_{jt} \equiv V^D \sum_{t=1}^{T} M_t s_{jt}^D \end{aligned} \tag{8}$$

[2] We assume the existence of a pure strategy interior equilibrium and strictly positive interest rates at the equilibrium.

where L_{jt} is the loan volume of bank j at market t, TD_{jt} is the time deposit volume of bank j at market t, D_{jt} is the aggregate volume of demand deposits and savings of bank j at market t, V^L is the mean value of the banking sector lending operations, V^{TD} is the mean value of the banking sector time deposits, V^D is the mean value of the banking sector demand and savings deposits, M_t is the size of market t, s^L_{jt} is the market share of bank j in market t in terms of loans, s^{TD}_{jt} is the market share of bank j in market t in terms of time deposits, and s^D_{jt} is the market share of bank j in market t in terms of the aggregate of demand and savings deposits.

The demand models developed in the paper use a logit specification that has the following structure:

$$\begin{aligned}
&ln(s^L_{jt}) - ln(s^L_{0t}) = -\alpha_1 p^l_j + other\ variables \\
&ln(s^{TD}_{jt}) - ln(s^{TD}_{0t}) = \alpha_2 p^d_j - \alpha_3 p^{sv}_j + other\ variables \\
&ln(s^D_{jt}) - ln(s^D_{0t}) = -\alpha_4 p^{sv}_j - \alpha_5 p^d_j + other\ variables
\end{aligned} \tag{9}$$

where s^L_{0t} is the market share of the outside good in market t in terms of loans, s^{TD}_{0t} is the market share of the outside good in market t in terms of time deposits, s^D_{0t} is the market share of the outside good in market t in terms of the aggregate of demand and savings deposits, and α_1 and α_5 are the (positive) price coefficients.

The solution of the bank optimization problem, under Bertrand competition, requires the knowledge of the following partial derivatives:

$$
\begin{aligned}
\frac{\partial s^{L}_{jt}}{\partial p^{l}_{j}} &= -\alpha_1 s^{L}_{jt}(1 - s^{L}_{jt})\\
\frac{\partial s^{TD}_{jt}}{\partial p^{d}_{j}} &= \alpha_2 s^{TD}_{jt}(1 - s^{TD}_{jt})\\
\frac{\partial s^{TD}_{jt}}{\partial p^{sv}_{j}} &= -\alpha_3 s^{TD}_{jt}(1 - s^{TD}_{jt})\\
\frac{\partial s^{D}_{jt}}{\partial p^{sv}_{j}} &= -\alpha_4 s^{D}_{jt}(1 - s^{D}_{jt})\\
\frac{\partial s^{D}_{jt}}{\partial p^{d}_{j}} &= -\alpha_5 s^{D}_{jt}(1 - s^{D}_{jt})
\end{aligned} \tag{10}
$$

The solution of the bank optimization problem, under a cartel structures, will also need the cross partial derivatives. So, for two distinct banks *j* and *k*, we obtain from (9):

$$
\begin{aligned}
\frac{\partial s^{L}_{jt}}{\partial p^{l}_{k}} &= \alpha_1 s^{L}_{jt} s^{L}_{kt}\\
\frac{\partial s^{TD}_{jt}}{\partial p^{d}_{k}} &= -\alpha_2 s^{TD}_{jt} s^{TD}_{kt}\\
\frac{\partial s^{TD}_{jt}}{\partial p^{sv}_{k}} &= \alpha_3 s^{TD}_{jt} s^{TD}_{kt}\\
\frac{\partial s^{D}_{jt}}{\partial p^{sv}_{k}} &= \alpha_4 s^{D}_{jt} s^{D}_{kt}\\
\frac{\partial s^{D}_{jt}}{\partial p^{d}_{k}} &= \alpha_5 s^{D}_{jt} s^{D}_{kt}
\end{aligned} \tag{11}
$$

The profit of bank *j* can be expressed as:

$$
\Pi_j = rB_j + p^{l}_{j} L_j + p^{sv}_{j} SV_j - p^{d}_{j} TD_j - r^{sd} SD_j - C(L_j, TD_j, D_j) \tag{12}
$$

where C (.) represents the operational costs of the bank. Substituting the balance sheet constraint (7) in (12), and assuming that the flow of services SV_j is proportional to the volume of deposits D_j (with the proportionality coefficient normalized to one, without loss of generality), the following expression for bank profits is obtained:

$$\Pi_j = (p_j^l - r)L_j + (r - p_j^d)TD_j + (r + p_j^{sv} - \theta_j)D_j - C(L_j, TD_j, D_j) \tag{13}$$

where:

$$\theta_j \equiv \frac{r\rho DD_j + r^{sd} SD_j}{D_j}$$

We observe that the partial derivatives of θ_j with respect to prices will be omitted in the following first order conditions.

3.1 Bertrand competition

Bank *j* chooses the prices p_j^l, p_j^d and p_j^{sv} so as to maximize its profit function (13). In the first market structure (Bertrand competition), this bank assumes that the prices of its rivals will be kept constant. The first order condition with respect to p_j^l is given by:

$$L_j + \left(p_j^l - r - c_j^L\right)V^L \sum_{t=1}^{T} M_t \frac{\partial s_{jt}^L}{\partial p_j^l} = 0 \tag{14}$$

where $c_j^L \equiv \dfrac{\partial C}{\partial L_j}$ is the marginal cost to provide one unit of loan. Substituting (10) in (14) and rearranging the terms, we obtain:

$$p_j^l - r - c_j^L = \frac{L_j}{\alpha_1 V^L \sum_{t=1}^{T} M_t s_{jt}^L (1 - s_{jt}^L)} \tag{15}$$

Notice that the right side of (15) is observable. This means that expression (15) can be used to derive the absolute price-cost margin of bank *j* related to its loan activities that is compatible with the model developed here. Moreover, if there is information about c_j^L, the left side of (15) is also observable and, as a consequence, this expression can be used to examine the degree of compatibility of the data with the model.

After substituting expression (10), p_j^d first order condition is given by:

$$\left(r - p_j^d - c_j^{TD}\right)\alpha_2 V^{TD}\sum_{t=1}^{T} M_t s_{jt}^{TD}(1 - s_{jt}^{TD}) - \left(r + p_j^{sv} - \theta_j - c_j^D\right)\alpha_5 V^D \sum_{t=1}^{T} M_t s_{jt}^D(1 - s_{jt}^D) = TD_j \tag{16}$$

where $c_j^{TD} \equiv \dfrac{\partial C}{\partial TD_j}$ is the marginal cost to provide one unit of time deposit and $c_j^D \equiv \dfrac{\partial C}{\partial D_j}$ is the marginal cost to provide one unit of demand or savings deposits.

Similarly, the first order condition with respect to p_j^{sv} is given by:

$$\left(r - p_j^d - c_j^{TD}\right)\alpha_3 V^{TD}\sum_{t=1}^{T} M_t s_{jt}^{TD}(1 - s_{jt}^{TD}) + \left(r + p_j^{sv} - \theta_j - c_j^D\right)\alpha_4 V^D \sum_{t=1}^{T} M_t s_{jt}^D(1 - s_{jt}^D) = D_j \tag{17}$$

We can solve (16) and (17), so as to find the absolute price-cost margins for both prices:

$$r - p_j^d - c_j^{TD} = \frac{\alpha_4 TD_j + \alpha_5 D_j}{(\alpha_2\alpha_4 + \alpha_3\alpha_5)V^{TD}\sum_{t=1}^{T} M_t s_{jt}^{TD}(1 - s_{jt}^{TD})} \tag{18}$$

$$r + p_j^{sv} - \theta_j - c_j^D = \frac{\alpha_2 D_j - \alpha_3 TD_j}{(\alpha_2\alpha_4 + \alpha_3\alpha_5)V^D\sum_{t=1}^{T} M_t s_{jt}^D(1 - s_{jt}^D)} \tag{19}$$

Similarly, the right sides of (18) and (19) are observable. As a consequence, we can use these expressions to obtain the absolute price-cost margins predicted by the model for time deposits and bank services or, if we know the marginal costs c_j^{TD} and c_j^{D}, to check the plausibility of the proposed model with respect to the available data.

From (15) and (18) it is possible to obtain the interest rate spread that is compatible with the model. This spread is defined by the difference between the loan interest rate and the time deposit interest rate:

$$p_j^l - p_j^d = c_j^L + c_j^{TD} + \frac{L_j}{\alpha_1 V^L \sum_{t=1}^{T} M_t s_{jt}^L (1 - s_{jt}^L)} + \frac{\alpha_4 TD_j + \alpha_5 D_j}{(\alpha_2\alpha_4 + \alpha_3\alpha_5) V^{TD} \sum_{t=1}^{T} M_t s_{jt}^{TD} (1 - s_{jt}^{TD})} \tag{20}$$

3.2 The cartel solution

The test of market power proposed here compares the Bertrand allocation to the cartel one. To solve the optimization problem under the cartel market structure, assume that the monopolist chooses the prices so as to maximize the sum of the profits of each bank, where the profit of each of these banks is given by an expression such as (13). The first order condition with respect to the loan interest rate of bank *j*, p_j^l, is given by:

$$L_j + \left(p_j^l - r - c_j^L\right) V^L \sum_{t=1}^{T} M_t \frac{\partial s_{jt}^L}{\partial p_j^l} + \sum_{k \neq j}^{J} \left[\left(p_k^l - r - c_k^L\right) V^L \sum_{t=1}^{T} M_t \frac{\partial s_{kt}^L}{\partial p_j^l} \right] = 0 \tag{21}$$

Notice that the first two terms on the left side of (21) are identical to the terms for the Bertrand oligopolist. The third term takes into account the impact of the change of bank *j* prices on the loan demand of other banks.

There are *J* first order conditions that are equivalent to (21). These conditions must be solved simultaneously so as to find the absolute price-cost margins predicted by the cartel model. Substituting the partial derivatives (10)-(11) into (21), it is possible to analytically find these margins. To do so, define the following matrices:

$$\left(p^{l}-r-c^{L}\right)\equiv\begin{bmatrix}p_{1}^{l}-r\text{ - }c_{1}^{L}\\ \vdots\\ p_{J}^{l}-r\text{ - }c_{J}^{L}\end{bmatrix},\ L\equiv\begin{bmatrix}L_{1}\\ \vdots\\ L_{J}\end{bmatrix}\text{, and}$$

$$\Delta_{1}\equiv\begin{bmatrix}\sum_{t=1}^{T}M_{t}s_{1t}^{L}(1-s_{1t}^{L}) & -\sum_{t=1}^{T}M_{t}s_{1t}^{L}s_{2t}^{L} & \cdots & -\sum_{t=1}^{T}M_{t}s_{1t}^{L}s_{Jt}^{L}\\ -\sum_{t=1}^{T}M_{t}s_{2t}^{L}s_{1t}^{L} & \sum_{t=1}^{T}M_{t}s_{2t}^{L}(1-s_{2t}^{L}) & \cdots & -\sum_{t=1}^{T}M_{t}s_{2t}^{L}s_{Jt}^{L}\\ \vdots & \vdots & \cdots & \vdots\\ -\sum_{t=1}^{T}M_{t}s_{Jt}^{L}s_{1t}^{L} & -\sum_{t=1}^{T}M_{t}s_{Jt}^{L}s_{2t}^{L} & \cdots & \sum_{t=1}^{T}M_{t}s_{Jt}^{L}(1-s_{Jt}^{L})\end{bmatrix}$$

The absolute price-cost margins of loans that are consistent with the cartel model are given by:

$$\left(p^{l}-r-c^{L}\right)=\left(\frac{1}{\alpha_{1}V^{L}}\right)\Delta_{1}^{-1}L \tag{22}$$

We can follow a similar procedure for the other two services. At the cartel solution, the first order conditions with respect to time deposits for all J banks can be expressed as:

$$\left(\alpha_{2}V^{TD}\right)\Delta_{2}\left(r-p^{d}-c^{TD}\right)-\left(\alpha_{5}V^{D}\right)\Delta_{3}\left(r+p^{sv}-\Theta-c^{D}\right)=TD \tag{23}$$

where:

$$\left(r-p^{d}-c^{TD}\right)\equiv\begin{bmatrix}r\text{ - }p_{1}^{d}\text{ - }c_{1}^{TD}\\ \vdots\\ r\text{ - }p_{J}^{d}-c_{J}^{TD}\end{bmatrix},\ \left(r+p^{sv}-\Theta-c^{D}\right)\equiv\begin{bmatrix}r+p_{1}^{sv}-\theta_{1}\text{ - }c_{1}^{D}\\ \vdots\\ r+p_{J}^{sv}-\theta_{J}\text{ - }c_{J}^{D}\end{bmatrix},\ TD\equiv\begin{bmatrix}TD_{1}\\ \vdots\\ TD_{J}\end{bmatrix},$$

$$\Delta_{2}\equiv\begin{bmatrix}\sum_{t=1}^{T}M_{t}s_{1t}^{TD}(1-s_{1t}^{TD}) & -\sum_{t=1}^{T}M_{t}s_{1t}^{TD}s_{2t}^{TD} & \cdots & -\sum_{t=1}^{T}M_{t}s_{1t}^{TD}s_{Jt}^{TD}\\ -\sum_{t=1}^{T}M_{t}s_{2t}^{TD}s_{1t}^{TD} & \sum_{t=1}^{T}M_{t}s_{2t}^{TD}(1-s_{2t}^{TD}) & \cdots & -\sum_{t=1}^{T}M_{t}s_{2t}^{TD}s_{Jt}^{TD}\\ \vdots & \vdots & \cdots & \vdots\\ -\sum_{t=1}^{T}M_{t}s_{Jt}^{TD}s_{1t}^{TD} & -\sum_{t=1}^{T}M_{t}s_{Jt}^{TD}s_{2t}^{TD} & \cdots & \sum_{t=1}^{T}M_{t}s_{Jt}^{TD}(1-s_{Jt}^{TD})\end{bmatrix}\text{, and}$$

$$\Delta_3 \equiv \begin{bmatrix} \sum_{t=1}^{T} M_t s_{1t}^D (1 - s_{1t}^D) & -\sum_{t=1}^{T} M_t s_{1t}^D s_{2t}^D & \cdots & -\sum_{t=1}^{T} M_t s_{1t}^D s_{Jt}^D \\ -\sum_{t=1}^{T} M_t s_{2t}^D s_{1t}^D & \sum_{t=1}^{T} M_t s_{2t}^D (1 - s_{2t}^D) & \cdots & -\sum_{t=1}^{T} M_t s_{2t}^D s_{Jt}^D \\ \vdots & \vdots & \cdots & \vdots \\ -\sum_{t=1}^{T} M_t s_{Jt}^D s_{1t}^D & -\sum_{t=1}^{T} M_t s_{Jt}^D s_{2t}^D & \cdots & \sum_{t=1}^{T} M_t s_{Jt}^D (1 - s_{Jt}^D) \end{bmatrix}$$

Similarly, the first order conditions with respect to the prices of services for all *J* banks can be written as:

$$\left(\alpha_3 V^{TD}\right)\Delta_2\left(r - p^d - c^{TD}\right) + \left(\alpha_4 V^D\right)\Delta_3\left(r + p^{sv} - \Theta - c^D\right) = D \tag{24}$$

where:

$$D \equiv \begin{bmatrix} D_1 \\ \vdots \\ D_J \end{bmatrix}$$

Solving (23) and (24) simultaneously, the absolute price-cost margins for time deposits and services can be found to be:

$$\left(r - p^d - c^{TD}\right) = \left(\frac{1}{(\alpha_2\alpha_4 + \alpha_3\alpha_5)V^{TD}}\right)\left[\alpha_4 \Delta_2^{-1} TD + \alpha_5 \Delta_2^{-1} D\right] \tag{25}$$

$$\left(r + p^{sv} - \Theta - c^D\right) = \left(\frac{1}{(\alpha_2\alpha_4 + \alpha_3\alpha_5)V^D}\right)\left[\alpha_2 \Delta_3^{-1} D + \alpha_3 \Delta_3^{-1} TD\right] \tag{26}$$

Finally, from (22) and (25) we have the bank spread that is consistent with the cartel solution:

$$\left(p^l - p^d\right) = c^L + c^{TD} + \left(\frac{1}{\alpha_1 V^L}\right)\Delta_1^{-1}L + \left(\frac{1}{(\alpha_2\alpha_4 + \alpha_3\alpha_5)V^{TD}}\right)\left[\alpha_4\Delta_2^{-1}TD + \alpha_5\Delta_2^{-1}D\right] \quad (27)$$

4. Data

The model is estimated for a panel of banks operating in Brazil in December 2002 and in December 2003. All commercial banks and all universal banks with loan portfolios are included in the sample, for a total of 134 banks.

4.1 Market definition

The market definition will take into account both the product and geographic dimensions. From the product dimension perspective, separate estimations for three classes of products will be presented: the sum of demand and saving deposits, time deposits, and loans. For each product, the geographic dimension will be delineated as a municipality. The definition of municipality follows the one used by IBGE (the official Brazilian institute for geographical statistics). The sample included the 3,252 municipalities where at least one bank was operating on the base date. For the different products we have 3,242 markets for the demand deposits and savings, 2,781 for time deposits, and 3,242 for loans.

4.2 Market shares

To estimate equation (6), we need the market shares of each bank and of the outside good. This paper follows the procedure proposed by Dick (2002), assuming that the consumer discrete choice refers to one unit of "average deposit account". This average account is calculated as the total volume of each kind of deposit divided by the number of banking accounts across all banks in a given year. The division of the volume of a bank's specific deposit by the "average deposit account" gives the number of accounts that is "produced" by a bank in a specific market. The market share for this bank will be the number of accounts it "produces" divided by the size of the potential market. The size of the potential market is defined in terms of the local population of the market, which follows Berry, Levinsohn and Pakes (1995) and Nevo (2001). The market share of the outside good is given by the difference between one and the sum of the shares of each bank operating in this market. The same procedure was adopted to define the "average banking loan" and the market share of the outside good for the loan case.

Data on deposit and loan volumes come from the ESTBAN system of Central Bank of Brazil. This system has information on the main balance sheet accounts for each branch in each municipality. To obtain the deposit volume held by each bank in each municipality, we aggregated the data on branches. The data on deposit and loan volumes correspond to the aggregate of household and enterprise volumes.

The number of accounts for the different kind of deposits is taken from the "Fundo Garantidor de Créditos" (FGC) report, produced by the Central Bank of Brazil. The values of the "average deposit account" for the sum of demand and saving deposits were estimated to be R$ 1,966.47 (December 2002) and R$ 1,819.24 (December 2003). The equivalent values for the time deposits are R$ 37,255.17 (December 2002) and R$ 54,047.71 (December 2003).

The mean value of the loans comes from SCR, a system of credit information from the Central Bank of Brazil. Only loan operations between R$ 5 thousands and R$ 10 millions were considered. There is no information bellow the lower bound, and the choice of the upper bound was an arbitrary decision. The estimated mean value of loans in December 2003 was R$ 21,362.16. We deflated this value by the consumer price index IPCA to calculate the mean value of R$ 19,853.31 for the loans in December 2002.

The data on the municipality population were taken from IBGE. We used the series called "População Residente Total" for the year of 2000.

4.3 Prices

We assume that that $p^d_{jt} = p^d_j$, $p^{sv}_{jt} = p^{sv}_j$, and $p^l_{jt} = p^l_j$, $\forall t$ = 1,...,*T*, because the prices p^d_{jt}, p^{sv}_{jt}, and p^l_{jt} are not observed at the level of each market, but only at the bank level (for the whole country).

The loan price comes from the primary information used to produce the "Press Release: Interest and Banking Spread", from the Central Bank of Brazil. The time deposit price comes from the rates reported to the Central Bank of Brazil by the financial institutions. These prices are daily data on the average preset interest rate charged/paid on/to households and on/to enterprises, which were then weight averaged by the daily inflow volume, compounded and normalized to a month of 21 trading days.

The service fees were derived from the COSIF system of the Central Bank of Brazil. This is an accounting report of the Brazilian financial institutions with monthly balance sheets and income statements. The accounts for December 2002 and December 2003 were used in the study. Service fees were calculated as the ratio of income from services to the volume of deposits. Such price reflects six months of revenues. We therefore divided this price by six to obtain a monthly equivalent measure.

To obtain θ_j that appears in (13), we also need to measure the price of saving deposits. This price is obtained as the ratio of the costs of savings deposits to the volume of savings deposits. As for service fees, this price was divided by six. Finally, the price of bonds is equal to the Selic basic interest rate.

4.4 Observable characteristics

The observed characteristics of a bank include three types of variables, namely: a) variables that are observable at each market, that is for each bank for each municipality; b) variables that are only observable at the country level; and, c) interaction terms between observable bank characteristics and local variables (municipal income per capita).

The observable characteristics of a bank in a market include: a) number of bank branches in the municipality; b) number of Automatic Teller Machines (ATMs) in the municipality; c) branch density in the municipality defined as the ratio of the number of bank branches in the municipality to the area of the municipality; d) ATM density in the municipality defined as the ratio of the number of ATMs in the municipality to the area of the municipality.

The observable bank characteristics of a bank that show no variation across the different markets include: a) number of bank branches in the country; b) number of ATMs in the country; c) number of states where the bank operates; d) bank age; e) number of bank employees; d) average number of bank employees per branch; e) advertisement costs.

Data on the number of branches, number of ATMs, number of employees, bank age, and advertisement costs come from the Central Bank of Brazil. Municipal income is municipal GDP at constant values of 2000 available from SIDRA-IBGE. The same source gives the area for each municipality.

In addition to the bank characteristics, other control variables for the municipalities were also included in the regressions. These additional control variables include the GDP, GDP per capita, area, and the population density for each municipality.

4.5 Instruments

The first set of instruments used in the paper includes bank cost shifters. The following variables are included in this group: a) personnel costs; b) operational costs; c) credit risk, measured as the ratio of (net) provisioning for non-performing loans to the volume of loans; d) liquidity, measured as the ratio of liquid to operational assets; e) ratio of net worth to operational assets; f) ratio of loans to operational assets (this instrument was only used in the demand equations for deposits).

The information for the construction of all the above-mentioned instruments comes from the COSIF system of the Central Bank of Brazil.

In addition to cost shifters, we also employed a set of instruments suggested by Berry, Levinsohn and Pakes (1995), which include the bank characteristics of the rivals in each market (henceforth called BLP instruments). The list of BLP instruments used in the paper include the sum of the following variables for the rivals in each mark: a) number of branches in the municipality; b) number of branches in the country; c) number of ATMs in the municipality; d) number of ATMs in the country; e) density of branches in the municipality; f) density of ATMs in the municipality; g) age; h) advertisements costs.

5. Demand estimation results

We now present the estimates for the demand for bank products. The results are separatelly presented for each of the three bank products considered in the paper, namely: time deposits, demand plus saving deposits, and loans. Four different models were estimated for each product by combining different sets of instruments (cost shifters or cost shifters plus BLP) and the inclusion (or not) of interaction terms between bank characteristics and per capita income.

All estimated regressions include a time dummy (equal to one for 2002) to control for macroeconomic factors. Heteroscedastic robust standard errors are reported. The overidentification test is robust to the presence of heteroscedasticity, following the procedure suggested by Wooldridge (2002, p. 123)[3].

Table 1 shows the price coefficients for the demand for time deposits. Below the value for each estimated coefficient we report the estimated standard error for the coefficient (left) and the associated t statistics (right).

[3] The test p-value is reported between parentheses.

Table 1: Results for Time Deposits Demand

VARIABLE	MODEL 1	MODEL 2	MODEL 3	MODEL 4
Time deposit price	12.9802 0.598 (21.70)	13.00453 0.540 (24.07)	12.93793 0.594 (21.80)	13.0184 0.538 (24.21)
Service fees	-2.21399 0.311 (-7.11)	-2.788356 0.306 (-9.10)	-2.252178 0.312 (-7.22)	-2.793397 0.307 (-9.09)
Income per capita interactions?	No	Yes	No	Yes
Instruments	Cost	Cost	Cost + BLP	Cost + BLP
Overidentification test	406.537 (0.0)	398.737 (0.0)	469.723 (0.0)	593.706 (0.0)
First stage adjusted R2 (time deposit price)	0.8743	0.8799	0.8753	0.8808
First stage adjusted R2 (service fees)	0.4649	0.4779	0.4662	0.4781
First stage F test (time deposit price)	5087.65	3683.12	4177.07	3206.52
First stage F test (service fees)	636.23	461.09	518.55	398.51
Observations	16086	16084	16059	16057

One can observe that, as expected, the price for demand deposits has a positive impact over its own demand while the service fee has a negative effect on the demand for time deposits. All the models share this feature and the coefficients are always highly significant. Moreover, the estimated coefficients do not greatly differ among the different specifications, being reasonably robust.

Table 2 brings the results for the demand for the aggregate of demand and saving deposits.

Table 2: Results for the Demand of the Sum of Demand and Saving Deposits

VARIABLE	MODEL 1	MODEL 2	MODEL 3	MODEL 4
Time deposit price	-1.441257 0.201 (-7.19)	-1.447618 0.203 (-7.14)	-1.227275 0.197 (-6.22)	-1.125488 0.197 (-5.70)
Service fees	-0.6055965 0.105 (-5.78)	-0.8701224 0.109 (-7.99)	-0.609552 0.105 (-5.81)	-0.8721783 0.109 (-8.03)
Income per capita interactions?	No	Yes	No	Yes
Instruments	Cost	Cost	Cost + BLP	Cost + BLP
Overidentification test	1580.20 (0.0)	1330.39 (0.0)	1738.03 (0.0)	1577.85 (0.0)
First stage adjusted R2 (time deposit price)	0.7907	0.7953	0.7920	0.7968
First stage adjusted R2 (service fees)	0.3982	0.4016	0.4005	0.4042
First stage F test (time deposit price)	3020.33	2174.08	2454.29	1876.77
First stage F test (service fees)	529.74	376.40	431.28	325.53
Observations	16785	16783	16748	16746

The estimated price coefficients are, as expected, negative in every specification. They are also highly significant. There is a slight difference among the models, though. The price coefficients for time deposits are higher (in absolute value) when only cost shifters are used as instruments (models 1 and 2). For the coefficients on service fees, the greatest absolute values were found for the models when interactions with income per capita are included (models 2 and 4).

Table 3 reports the results for the demand for loans. For this product, we make the assumption that only the prices of loans affect its demand.

Table 3: Results for Loan Demand

VARIABLE	MODEL 1	MODEL 2	MODEL 3	MODEL 4
Loan price	-0.3170979 0.021 (-15.28)	-0.3968123 0.018 (-21.64)	-0.2473996 0.019 (-12.77)	-0.3257321 0.018 (-18.55)
Income per capita interactions?	No	Yes	No	Yes
Instruments	Cost	Cost	Cost + BLP	Cost + BLP
Overidentification test	113.39 (0.0)	191.63 (0.0)	576.70 (0.0)	600.10 (0.0)
First stage adjusted R2 (loan price)	0.4612	0.4909	0.4688	0.4978
First stage F test (loan price)	786.31	600.29	653.63	530.34
Observations	19267	19265	19228	19226

The price coefficients are negative and highly significant in all the models. Nevertheless, there are some small variations among the models The (absolute) value for the coefficients are higher for the models including only cost shifters as instruments (model 1 against 3, and model 2 against 4) as well as for the models including interactions with income per capita (model 2 against 1, and model 4 against 3).

All the estimated models reject the null hypothesis of the overidentification tests. It is not clear, however, whether this rejection is due to poor instruments or due to the high number of observations in each regression. The statistic for the overindefication test is proportional to the number of observations. The statistical significance for the F test in the first stage regressions suggest that there is some explanatory power for the instruments.

One can obtain the price elasticities for each bank in the sample from the estimated price coefficients[4]. Tables 4 and 5 show the results for 2002 and 2003, respectively. The results are reported for both the median bank as well as for the weighted mean (weighted by the market share of each bank).

[4] It is also possible to compute the cross price elasticities for each pair of banks in the sample. Such elasticities are not reported in the paper, though.

Table 4: Price Elasticity (2002)

PRODUCT	Time Deposit Price Median	Time Deposit Price Mean	Service Fees Median	Service Fees Mean	Loan Price Median	Loan Price Mean
TIME DEPOSITS						
Model 1	23.5196	21.8817	0.5321	0.7833		
Model 2	23.5637	21.9227	0.6701	0.9865		
Model 3	23.4430	21.8105	0.5413	0.7968		
Model 4	23.5888	21.0461	0.6713	0.9882		
DEMAND AND SAVING DEP.						
Model 1	2.1934	2.0096	0.1914	0.2444		
Model 2	2.2030	2.0184	0.2750	0.3512		
Model 3	1.8677	1.7112	0.1926	0.2460		
Model 4	1.7128	1.5693	0.2756	0.3520		
LOANS						
Model 1					1.2209	1.4314
Model 2					1.5278	1.7912
Model 3					0.9525	1.1168
Model 4					1.2541	1.4704

Table 5: Price Elasticity (2003)

PRODUCT	Time Deposit Price Median	Time Deposit Price Mean	Service Fees Median	Service Fees Mean	Loan Price Median	Loan Price Mean
TIME DEPOSITS						
Model 1	15.8692	15.5603	0.6253	0.9073		
Model 2	15.8989	15.5895	0.7875	1.1427		
Model 3	15.8175	15.5096	0.6361	0.9230		
Model 4	15.9159	15.6061	0.7889	1.1448		
DEMAND AND SAVING DEP.						
Model 1	1.6282	1.4520	0.2313	0.2547		
Model 2	1.6354	1.4584	0.3324	0.3659		
Model 3	1.3864	1.2365	0.2328	0.2563		
Model 4	1.2715	1.1339	0.3331	0.3668		
LOANS						
Model 1					1.1225	1.2848
Model 2					1.4047	1.6078
Model 3					0.8758	1.0024
Model 4					1.1530	1.3198

The results show that the own price elasticities are very high for time deposits, being in the range from 21.0 to 23.6 in 2002 and from 15.5 to 16.0 in 2003. The own price elasticities for the loan demand as well as the elasticity for the demand of demand and saving deposits with respect to the price of time deposits are more modest in size. Finally, the demand for both types of deposits were found to be inelastic with respect to service fees[5].

Such estimated values for the price elasticities can be considered as reasonable? The lack of other similar studies for Brazil make it hard to answer this question. Dick (2002) reports some price elasticities for the demand for overall deposits for the U.S. market also using the multinomial logit functional form. She found median price elasticities of 0.644 for service fees and of 5.932 for deposit rates. Dick does not estimate separate demands for different types of deposits. One can then conjecture that the elasticities she found should be in the intermediary range of the elasticities we found for each type of deposits. This is precisely what happens and we, therefore, conclude that the elasticities reported in Tables 4 and 5 are not in conflict with the available literature. In particular, Dick (2002) also found inelastic demands with respect to service fees.

Table 6 presented the signs for the estimated coefficients for the other explanatory variables included in the demand regressions[6]. The meaning of each variable is described in the appendix. The incusion of different sets of instruments do not change the sing of any coefficient. We therefore grouped the results of models 1 and 3, as well as the results of models 2 and 4. When the significance levels change between the grouped models, the table reports the one with the lowest significance.

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[5] Inelastic demands do not imply that the second order conditions for the profit maximization problems are violated. The first order conditions (16) and (17) make clear that both the demand for time deposits as well as the demand for the sum of demand and saving deposits must be taken into account for the determination of service fees. We computed the second order conditions from expressions (14), (16) and (17) and observed that they hold for every observation in the sample (not reported in the paper).

[6] The estimated values for the coefficients are not reported here, but they are available upon request.

Table 6: Results for the Other Explanatory Variables

VARIABLE	TIME DEPOSITS		DEMAND DEP.+SAVINGS		LOANS	
	Mod.1 and 3	Mod.2 and 4	Mod.1 and 3	Mod.2 and 4	Mod.1 and 3	Mod.2 and 4
branchmun	+***	+***	+***	+	+***	-
branchbr	+***	+***	+***	+***	+***	+***
atmmun	-***	+	-	+	-***	+**
atmbr	+***	+*	-***	-***	-***	-***
states	-***	-***	-	+***	-***	-***
densbranch	+***	+***	+***	+***	+***	+***
densatm	+	-	+	-***	-***	-***
advertising	+***	+***	+*	-	-***	-**
age	+***	-	+***	+***	+***	+***
empbranch	+***	+***			-	-***
gdpmun	-***	-***	-***	-***	-*	-
gdpcapita	+***	-***	+***	+***	+***	-
gdpcapitasq	-***	-***	-***	-***	-***	-***
area	-***	-***	-***	-***	-***	-***
density	-***	-***	-***	-***	-***	-***
branchmungdpcap		-*		+**		+**
branchbrgdbcap		-		+***		-***
atmmungdpcap		-*		-		-***
atmbrgdpcap		-		-***		+***
stategdpcap		+***		-***		+**
densbrangdpcap		-		-***		-***
densatmgdpcap		-		+**		+
advergdpcap		-**		+		-
agegdpcap		+***		-		+**
empbrangdpcap		+**				+***

Note: (*) significant at 10%, (**) significant at 5%, (***) significant at 1%. The Appendix presents the meaning of each of these variables.

The results reported in table 6 indicate that the number of bank branches in the municipality and in the country as well as the branch density have positive impacts on the bank demand. Thus, such attributes are valued by the agents. Another result is that bank age has a positive effect on its demand, which may indicate some reputation effect.

With regard to the other bank characteristics, the effects are distinct for the different bank products. Some of the coefficients are not robust to different model specifications whereas some others have signs that are opposite of the expected.

With respect to the municipality characteristics, the results indicate that the demand for bank products are higher for municipalities with greater GDP, GDP per capita, area, and populational density.

The estimated price coefficients reported in tables 1 to 3 will be used in the simulations performed in the next section.

6. Test of market power

In this section we will take the expressions derived in section 4 together with the price coefficients estimated in section 5 to perform a test of market power for Brazilian banking. For each of the estimated models, we computed the absolute price-cost margins consistent with Bertrand and with the cartel models for each bank in the sample. Such margins are calculated form the expressions on the right sides of (15), (18) and (19) for Bertrand, and of (22), (25) and (26) for collusion.

Tables 7 and 8 report the results for both the median bank and for the weighted (by the volume of the respective product) mean. The tables also show the 'observed' price-cost margins, as given by the left sides of the respective expressions mentioned in the previous paragraph. One should notice that the 'observed' values are not affected by the demand coefficients and therefore these values are invariant to the distinct demand models.

However, the 'observed' margins require the availability of the respective marginal costs. Tables 7 and 8 report the observed margins for two estimates for these marginal costs. The first set of results assume that such marginal costs are zero. A second set of results is also reported with estimates of marginal costs being obtained from FIPECAFI (2004).

FIPECAFI (2004) uses resource allocation information from a sample of nine Brazilian commercial banks to decompose operational costs into three different activities: bank credit, portfolio management, and bank services. Deposit raising activities are not separately considered and we therefore have to make some assumption to infer the costs associated to them. We assume that the processes identified in the study as ‘relationship with clients’ and ‘raising of resources’ are entirely related to deposit raising activities. Under such assumptions, we obtain that 20.03% of the interest revenue from loans are allocated to pay for operational costs whereas the shares of fee revenues and time deposit costs allocated to operational costs are 71.7% and 52.88%, respectively.

The first rows of the ‘Observed’ columns in tables 7 and 8 report the price-cost margins with zero marginal costs whereas the second rows report these margins using the FIPECAFI (2004) estimates for marginal costs.

Table 7: Absolute Price-Cost Margins (2002) % p.m.

PRODUCT	Observed		Bertrand		Cartel	
	Median	Mean	Median	Mean	Median	Mean
TIME DEPOSITS	-0.0761	0.0233				
	-0.8857	-1.0377				
Model 1			0.0698	0.2024	0.1034	0.2274
Model 2			0.0675	0.1638	0.0956	0.1842
Model 3			0.0705	0.1879	0.1019	0.2111
Model 4			0.0691	0.1486	0.0952	0.1673
BANKING SERVICES	1.5013	1.4764				
	1.2177	1.1420				
Model 1			1.1749	1.2779	3.0033	2.9329
Model 2			0.8472	0.9051	2.1884	2.1499
Model 3			1.2152	1.3198	3.1088	3.0375
Model 4			0.8980	0.9593	2.3198	2.2791
LOANS	2.1165	2.8452				
	1.3438	1.9266				
Model 1			3.1613	3.2046	3.8225	4.0370
Model 2			2.5262	2.5609	3.0546	3.2260
Model 3			4.0519	4.1075	4.8994	5.1743
Model 4			3.0775	3.1197	3.7212	3.9300

Note: In the column 'Observed', the first row assumes zero marginal costs and the second row uses FIPECAFI (2004) to estimate marginal costs.

Table 8: Absolute Price-Cost Margins (2003) % p.m.

PRODUCT	Observed		Bertrand		Cartel	
	Median	Mean	Median	Mean	Median	Mean
TIME DEPOSITS	0.0818	0.0919				
	-0.5683	-0.5530				
Model 1			0.0665	0.1870	0.08784	0.2027
Model 2			0.0653	0.1526	0.0833	0.1655
Model 3			0.0676	0.1742	0.0878	0.1889
Model 4			0.0673	0.1393	0.0842	0.1513
BANKING SERVICES	1.3466	1.1387				
	1.0683	0.7819				
Model 1			1.1753	1.2707	3.3701	3.2772
Model 2			0.8473	0.8914	2.4717	2.4171
Model 3			1.2156	1.3114	3.4904	3.3957
Model 4			0.8982	0.9447	2.6202	2.5624
LOANS	2.2619	2.8032				
	1.5464	1.9793				
Model 1			3.1617	3.2038	3.7750	3.9750
Model 2			2.5265	2.5602	3.0167	3.1765
Model 3			4.0524	4.1064	4.8385	5.0949
Model 4			3.0778	3.1189	3.6750	3.8697

Note: In the column 'Observed', the first row assumes zero marginal costs and the second row uses FIPECAFI (2004) to estimate marginal costs.

The results for time deposits indicate that even the Bertrand model overestimates the degree of market power. There is also a considerable difference between the median and mean values, with the last ones being much greater than the first. This result indicates that the absolute price-cost margins are greater for banks with larger market shares.

This last finding does not imply, however, that banks have market power with respect to time deposits. The results show that, even under the assumption of zero marginal costs, the ‘observed’ margins are lower than the predicted ones under Bertrand, with the exception of the mean value for 2003. For this last case, the observed price-cost margin (0.082% a.m.) is in excess of the predicted value under Bertrand (0.067% a.m.), but it is still lower than the margin predicted under collusion (0.088% a.m.). When marginal costs to provide time deposits are taken into consideration, all the observed margins become negative, indicating that the median and average banks are not profiting from such products.

For bank services, the observed margins under zero marginal costs are greater than the ones predicted under Bertrand, but they are still significantly lower than the values predicted under cartel. With positive marginal cost the observed margins are within the intervals of the predicted values under Bertrand for the distinct models. We therefore conclude that Bertrand seems to be a reasonable description of the competition pattern for bank services in Brazil.

For the market for bank loans, the results are similar to the ones found for the market for time deposits. That is, even the Bertrand model predicts price-cost margins that overestimate the observed ones. Thus, with the exception of the predicted mean value for model 2, all the other specifications predict price-cost margins under Bertrand that are higher than the observed margins, even when zero marginal costs are assumed.

The overall conclusion of the market power tests is that even the Bertrand model seems to overestimate the degree of market imperfection observed for time deposits and for bank loans. For the first market, the results also indicate the median and mean banks are not operating with economic profits. The Bertrand model seems to be appropriate to describe the market for bank services. Finally, there is no evidence that the collusion model is an accurate description of the behavior of Brazilian banks.

We also compared the predicted and observed price-cost margins for each bank. In particular, we verified to which of the following three intervals the observed margin for the bank belongs: lower than the predicted Bertrand value, between the predicted Bertrand and cartel values, or above the cartel value. Tables 9 to 11 summarize the results for each of the three bank products showing both the relative frequency of observations in each interval as well as the market share of the banks belonging to each interval.

Table 9: Observed vs. Predicted Absolute Price-Cost Margins of Time Deposits

MODELS	Lower than Bertrand		Between Bertrand and Cartel		Greater than Cartel	
	2002	2003	2002	2003	2002	2003
MODEL 1						
% Obs.	97.67	100.00	0.00	0.00	2.33	0.00
Market share (%)	99.85	100.00	0.00	0.00	0.15	0.00
MODEL 2						
% Obs.	97.67	100.00	0.00	0.00	2.33	0.00
Market share (%)	99.85	100.00	0.00	0.00	0.15	0.00
MODEL 3						
% Obs.	97.67	100.00	0.00	0.00	2.33	0.00
Market share (%)	99.85	100.00	0.00	0.00	0.15	0.00
MODEL 4						
% Obs.	97.67	100.00	0.00	0.00	2.33	0.00
Market share (%)	99.85	100.00	0.00	0.00	0.15	0.00

The results for time deposits are homogeneous across the different models and across the two years. Nearly all the observations belong to the interval of values lower than predicted under Bertrand. These results confirm the previous findings that the market power for time deposits is inferior to the one consistent with Bertrand.

Table 10 shows the results for bank services.

Table 10: Observed vs. Predicted Absolute Price-Cost Margins of Banking Services

MODELS	Lower than Bertrand		Between Bertrand and Cartel		Greater than Cartel	
	2002	2003	2002	2003	2002	2003
MODEL 1						
% Obs.	33.33	47.73	66.67	50.00	0.00	2.27
Market share (%)	90.20	97.68	9.80	2.30	0.00	2.30
MODEL 2						
% Obs.	0.00	27.27	93.75	70.45	6.25	2.27
Market share (%)	0.00	91.73	99.70	8.25	0.30	0.02
MODEL 3						
% Obs.	35.42	50.00	64.58	47.73	0.00	2.27
Market share (%)	90.59	97.83	9.41	2.15	0.00	0.02
MODEL 4						
% Obs.	0.00	34.09	95.83	63.64	4.17	2.27
Market share (%)	0.00	92.49	99.70	7.49	0.30	0.024

For bank services, none of the estimated models show a significant number of observations above the values predicted under cartel. For the other two intervals, however, there are significant differences across the models. The models that do not include interactions with income per capita (models 1 and 3) show a large fraction of banks in the intermediate interval. Such banks do not have significant market shares, though. Banks with large market shares belong to the lowest interval.

Models 2 and 4, on the other hand, show significant differences between 2002 and 2003. In the first year, nearly all the banks belonged to the intermediate interval, while in the latter year, at least with respect to market share, the majority of banks were allocated to the interval of values below Bertrand.

We therefore conclude that the Bertrand model still seems to be a good characterization of the market for bank services. Finally, table 11 shows the results for bank loans.

Table 11: Observed vs. Predicted Absolute Price-Cost Margins of Loans

MODELS	Lower than Bertrand		Between Bertrand and Cartel		Greater than Cartel	
	2002	2003	2002	2003	2002	2003
MODEL 1						
% Obs.	85.85	83.02	6.60	7.55	6.60	9.43
Market share (%)	87.80	97.31	3.19	1.41	9.01	1.29
MODEL 2						
% Obs.	75.47	75.47	12.26	6.60	12.26	17.92
Market share (%)	55.40	78.71	33.05	14.18	11.55	7.11
MODEL 3						
% Obs.	96.23	89.62	0.00	2.83	3.77	7.55
Market share (%)	92.31	98.49	0.00	0.82	7.69	0.69
MODEL 4						
% Obs.	85.85	82.08	4.72	7.55	9.43	10.38
Market share (%)	87.79	97.30	2.90	1.36	9.31	1.34

An interesting finding for bank loans is the increase in competition from 2002 to 2003. One can observe such increase through the increased market share of banks in the lower interval between the two years.

The results for bank loans also confirm the previous findings, suggesting that the market structure for this product seems to be more competitive than the one described by Bertrand.

One has to keep in mind that all the reported results strongly rely on the assumption that the demand for bank products is correctly specified. A related issue is the choice of an adequate functional form for the demand model. Could the results be distinct if another functional form were employed?

Results reported by Crooke *et al*. (1999) allow us to make some considerations on these issues. They compare price elasticities (and prices after mergers) associated to four distinct functional forms for the demand for differentiated products. The following functional forms were compared: the Almost Ideal Demand Systems (AIDS), logit, linear, and log-linear (constant elasticity). The results indicate that the price elasticities are lower (and therefore the post merger prices are higher) for the log-linear functional form, followed by AIDS, logit, and the linear forms.

Such results suggest that the logit functional form used in this paper might underestimate market power when compared to a linear demand. For bank products, however, linear demands seem to be rather restrictives. In addition, there is no strong theoretical underpinnings for such functional form.

Perhaps, a more interesting contrast is provided through the comparison of logit and random coefficient models. We have no knowledge of any paper fitting random coefficient demand models for banking. For other markets, Nevo (2001) found that the logit specifications predicts lower price-cost margins than the random coefficient model for breakfast cereals in the U.S. Such results suggest that the logit functional form does not bias the result towards any underestimation of market power.

7. Final remarks

The present paper reported results of a test of market power in the Brazilian banking industry. The first step in the study was the development of a demand for bank products. The second step was the development of bank behavior models consistent with Bertrand competition and with cartel. The third step involved the empirical estimation of demand models for three separate bank products: (a) time deposits; (b) sum of demand and saving deposits; and (c) loans. Last, but not the least, the tests of market power were implemented.

The results for the estimation of demand functions for the different bank products were reasonably robust with the main explanatory variables being significant and with the expected signs. The demand for time deposits respond positively to increases on its own price and negatively to increases on service fees. The aggregate of demand and saving deposits is negatively related to both the price of time deposits and service fees. Demand for bank loans is inversely related to its own price. The implied price elasticities for the different bank products have reasonable values.

The test of market power compares the observed absolute price-cost margin for each bank product with the margins predicted under both Bertrand competition and collusions. The results show that for both time deposits and loans even the Bertrand model overestimated the observed degree of market power. Bertrand competition seems to be a good description of the way the banks set service fees.

Our results are in line with other empirical studies of market power in Brazilian banking. Nakane (2003) surveys the available evidence where the main conclusion is that the Brazilian banking industry is characterized by an imperfect market structure. Moreover, the literature rejects cartel behavior for Brazilian banks. Our contribution to this literature is to basically reproduce the same set of results but cast them under stronger theoretical and empirical foundations.

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APPENDIX: EXPLANATORY VARIABLES

1) Bank Characteristics

branchmun: the sum of the number of branches to the number of auxiliary branches (postos de atendimento bancário) that a bank has in a specific municipality;
branchbr: the number of branches summed to the number of auxiliary branches that a bank has in Brazil;
atmmun: the number of Automatic Teller Machines (ATM) that a bank has in a specific municipality;
atmbr: the number of ATMs that a bank has in Brazil;
states: the number of states where a bank has branches;
densbranch: the density of the sum of the number of branches to the number of auxiliary branches of a particular bank in a specific municipality;
densatm: the density of ATMs of a bank in a specific municipality;
advertising: the advertising expenses of the bank (negative values);
age: the age of the bank (number of days);
empbranch: the number of employees divided by the number of branches of a bank.

2) Municipality Characteristics

gdpmun: the gdp of the municipality;
gdpcapita: the gdp per capita of the municipality;
gdpcapitasq: the square of the gdp per capita of the municipality;
area: the area of the municipality;
density: the population density of the municipality.

3) Interactions

branchmungdpcap: branchmun*gdpcapita;
branchbrgdpcap: branchbr*gdpcapita;
atmmungdpcap: atmmun*gdpcapita;
atmbrgdpcap: atmbr*gdpcapita;
stategdpcap: states*gdpcapita;
densbrangdpcap: densbranch*gdpcapita;
densatmgdpcap: densatm*gdpcapita;
advergdpcap: advertising*gdpcapita;
agegdpcap: age*gdpcapita;
empbrangdpcap: empbranch*gdpcapita.

4) Other control variables

dyear: year dummy (equal to 1 in 2002).

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