Investigaciones Económicas. Volumen XVIII (2) - Mayo 1994, pp. 391-399

MARKET POWER MEASUREMENT- AN APPLICATION TO THE PORTUGUESE CREDIT MARKET

Margarida CATALÃO LOPES*
Banco de Portugal

This paper analyses market power in the Portuguese banking system, specifically in lending operations. We evaluate to what extent the gap between the interest rate on Discount of Commercial Bills and the interest rate on Loans and Advances to «Other Non-Financial Enterprises» (from 91 up to 180 days) can be explained by market power differences. The empirical results do not suggest that stronger market power in the Discount of Commercial Bills segment explains this gap, except via demand elasticity, so it can be ascribed to other factors, especially risk differences between clients who get funding in these markets.

1. Introduction

The purpose of this paper is to evaluate the degree of market power in the Portuguese banking sector, more precisely in lending operations. We wish to measure how the gap between the interest rate on Discount of Commercial Bills (DCB) and the interest rate on Loans and Advances (LA) to «Other Non-Financial Enterprises» and maturing from 91 up to 180 days can be explained by relative differences in market power.

The study considers the sample period from January 1990 to March 1993, after the end of direct monetary control, when the spread began to increase. However, credit ceilings were completely removed as quantitative constraints and as indicative credit growth after April 1991, so only after this date is it possible to speak accurately on market power differences.

We follow Summer's (1981) approach in a similar study, applied to the American cigarette industry. This choice was dictated by the great potentialities of that approach, when one component of the marginal cost is known. To our knowledge, this is the first time this approach is tried for the banking sector. Many other attempts to measure bank behaviour and market

* I am specially grateful to Luís Cabral for his valuable guidance and to António S. Mello, Fernando Branco, Rafael Repullo and two anonymous referees for valuable comments and suggestions. I also wish to thank Carlos Robalo Marques for his important contribution to the econometric application. Any remaining errors are obviously my sole responsibility.

power have made use of the concepts of conjectural variations and price-cost margins, just like we do, but never in this framework[1].

The next section introduces the model applied, presenting the interpretation of the parameters of interest in accordance with a particular oligopoly solution. Data and econometric procedures are presented in the third section. The fourth section comprises the results and their discussion within the applied model. Finally, the principal conclusions are reported.

2. Methodology

Consider a loan market with $j = 1, ..., n$ identical banks facing a linear demand function $p = a - bQ$, where p is the loan interest rate and $Q = \sum_{j=1}^{n} q_j$ is the total amount of loans. Each bank j chooses its supply of loans q_j in order to maximize

$$\pi(q_j) = p(Q)q_j - C(q_j) \qquad [1]$$

where $C(q_j)$ is bank j's total cost function.

If γ denotes the conjectural variation dQ_{-j}/dq_j, where $Q_{-j} = \sum_{i \neq j} q_i$, the first-order condition that characterizes a symmetric equilibrium is given by

$$-b(1+\gamma)q + p = MC \qquad [2]$$

where $MC = C'(q)$. Substituting $q = Q/n$, and using the fact that $p = a - bQ$, we obtain

$$p = \theta_0 + \theta MC \qquad [3]$$

where $\theta_0 = a(1+\gamma)/(n+1+\gamma)$ and $\theta = n/(n+1+\gamma)^2$.

From this equation several interesting hypotheses arise. At one extreme, perfect collusion corresponds to $\gamma = n-1$, so that $\theta = 1/2$. At the other, Bertrand behaviour corresponds to $\gamma = -1$, so that $\theta = 1$. Finally, an oligopolistic Cournot behaviour corresponds to $\gamma = 0$, so that $\theta = n/(n+1)$.

Of special interest in Sumner's approach, which will be followed in our

[1] See, among others, Shaffer (1989) and Berg and Kim (1993).

[2] We are implicitly assuming, as usual in many empirical studies, that loans offered by different banks are perfect substitutes. The consideration of product differentiation would imply the loss of even more degrees of freedom, which was not advisable due to our small sample size. The assumption of linear demand is also common in applied work and has the significative advantage of making θ in equation [3] independent from b. If for example a constant elasticity demand function were to be used, as in Sumner's model, the same linear relationship between price and marginal cost would arise, but depending on the value of the elasticity. The results to be obtained thus depend upon both of these assumptions being true.

paper, is the characteristic that we only need to know one component of the marginal cost, which must be common to all firms. The component considered in the original application to the American cigarette industry was a common tax rate; in our application this component will be the price of financing, since for each credit unit the bank must collect a unit of funds (funding through deposits requires more than one unit, because of the obligation of complying with minimum reserve requirements). So, for instance, one can take as a known component of the marginal cost the interest rate that banks pay in the interbank money market[3].

Using the Lerner's index (which indicates the magnitude of the markup of the price over the marginal cost), as defined by Cowling and Waterson (1976)

$$L=\frac{(1+\gamma)H}{\eta} \qquad [4]$$

where η stands for demand elasticity and H for the Herfindhal measure of market concentration, we can draw inferences about the magnitude of existing market power. The value of H is easily computable and we will obtain, in accordance to our model, an estimate of γ; however, as no estimate for η is available it is not possible to accurately calculate the Lerner's index for each market. Indeed, strategic behaviour is the sole component that will be estimated; based on that estimation and with the available information concerning the relative magnitude of the other two parameters in both markets, conclusions can be drawn regarding comparative market power in that markets.

3. Data and testing procedures

Monthly data for the period January 1990-March 1993 (39 observations) are used to test the relevant null hypotheses in the strategic behaviour of several groups of banks. Giben the evidence that both the dependent and independent variables in [3] are $I(1)$ processes[4], such tests are carried out in a cointegrating framework. The methodology followed is based upon Boswijk's (1993) procedure, which is as follows. An error correction mechanism (ECM) based upon the cointegrating relationship [3] is estimated. The value of θ under the null hypothesis is imposed in the ECM term,

[3] This was the component that allowed the best results to be obtained. Moreover, lending interest rates used in this work have a much higher correlation with the interbank money market rate than with deposit rates, whichever their maturity.

[4] One should bear in mind the size and periodicity of the sample, which weaken the conclusions. Values for the stationarity tests (ADF, complemented with Dickey and Fuller's (1981) ϕ_2 and ϕ_3 tests) will be sent upon request. For variable DCB a $t_{\hat{\alpha}} = -4.05$ (value of the ADF test) was obtained after first differentiating and for variable *LA* a $t_{\hat{\alpha}} = -9.94$ was reached also in first differences, since in accordance with the tests previously performed both variables were not level-stationary.

leaving an extra regressor (MC) free in the regression in order to test such a hypothesis. So, for example, if Bertrand behaviour is to be tested, the estimated model would be

$$\Delta p_t = \text{const} + \beta(p - \text{MC})_{t-1} + \psi \text{MC}_{t-1} + \sum_{j=1}^{p} \alpha_j \Delta p_{t-j} + \sum_{j=1}^{p} \gamma_j \Delta \text{MC}_{t-j} + \varepsilon_t \qquad [5]$$

and H_0: $\psi = 0$ corresponds to H_0: $\theta = 1$[5].

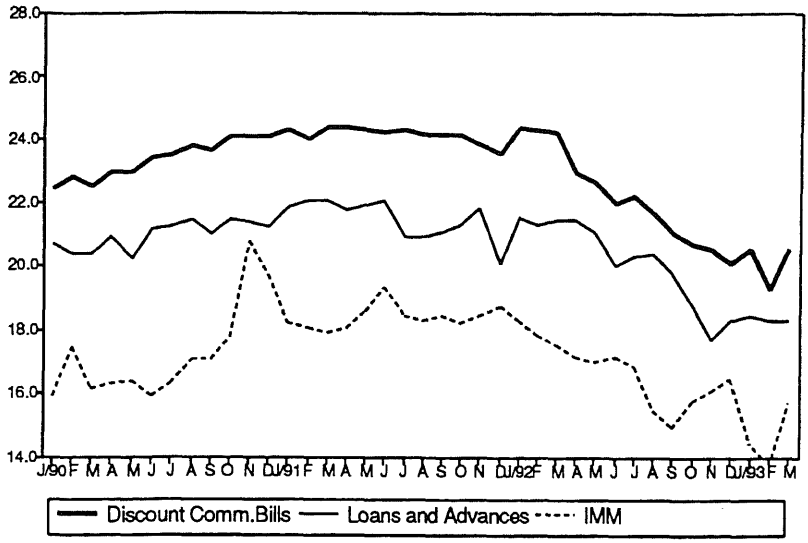
The three-month interbank money market rate is the chosen component of the marginal cost. As well as being applicable to the whole banking system (variables denoted ahead by DCB and LA), the study is also conducted for the strategic behaviour of the following groups of banks: 1) the five biggest banks in the whole system (denoted DCB5M and LA5M)[6]; 2) the remaining thirty one banks (denoted DCBR and LAR)[7]; 3) banks that continuously operated throughout the sample period in both markets (DCB and LA), which also happen to be five (denoted DCB5 and LA5), but with limited coincidence with the other five; 4) banks that continuously operated throughout the sample period in each of the markets (thirteen in the case of DCB and eight in the case of LA, denoted DCB13 and LA8). The interest rate variable for each of these groups was constructed as an amount weighted average of the rates charged by the banks in that group. Banks that constitute the DCB5M have a total market share of approximately 48%; in turn, those of DCB5 weight about 32% of the market and those who are in the DCB13 represent 95% of it. Banks that compose the LA5M variable have a total market share of approximately 56%; those of LA5 weight about 27% and those of LA8 make up approximately 75% of the market. Except for the group of the five biggest banks the spread between the two rates was almost zero at the beginning of the period and widened thereafter. This pattern has been more evident for smaller banks, while for the larger the differential remained fairly stable.

The choice of these configurations of the market was dictated by their relevance. A Stackelberg behaviour between large and small banks, for example, could also have been tested, though this would have implied the loss of more degrees of freedom; however, no evidence was found in the data supporting large banks to be behaving as leaders and small banks as followers (correlations between the interest rate charged by large banks and the interest rate charged by small banks one or more periods ahead are indeed very small).

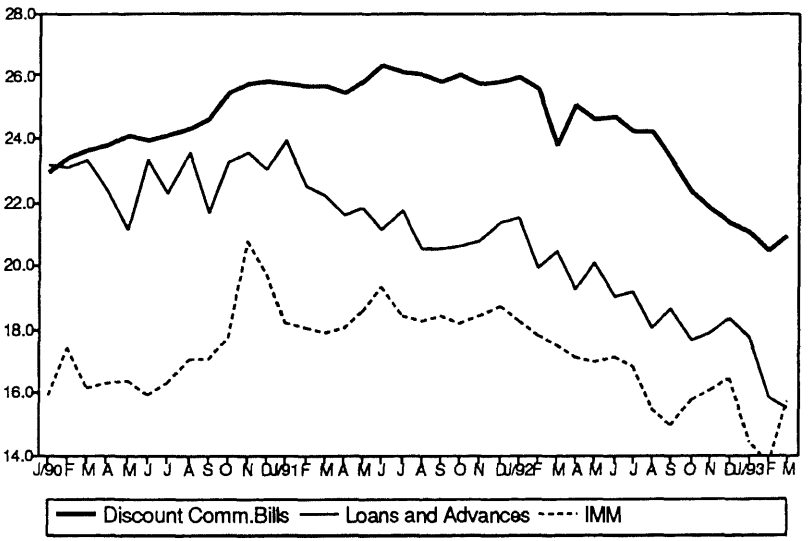
[5] One or more dummy variables were also included in this expression when important economic changes –the introduction of indirect monetary control after some months of a transitory regime or disturbances in the interbank money market– had taken place and results could therefore be distorted.

[6] To choose this group no specific criterion was used: the choice was dictated by several criteria usually employed (assets, credit, deposits, equity, profits), according to which it is possible to group banks almost unambiguously.

[7] Six banks which began activity in 1993 were left out of the sample, and we thus ended up with 36 of the 42 which composed the Portuguese banking system.



Graphic 1
Lending interest rates and IMM rate
(ONFE 91-180 days, 5 Major Banks and 3-month IMM rate)



Graphic 2
Lending interest rates and IMM rate
(ONFE 91-180 days, Remaining System and 3-month IMM rate)

4. Empirical results and analysis

In this section, results are presented and interpreted in the context of the model described in section two. Only for variable LA8 was it not possible to find a dynamic model which made sense in terms of the underlying economic theory, and so tests for this market were not carried out. Tables 1 and 2 contain the value of $\hat{\theta}$ for the group of the five biggest banks and for the remaining 31 institutions, as well as the corresponding $\hat{\gamma}$ and the performed tests for Bertrand, Cournot or collusive behaviour, where «W_2 Bertrand», for example, denotes Boswijk's (1993) W_2 test on the t-ratio of $\hat{\psi}$ in [5] for the dynamic regression testing Bertrand behaviour[8]. Boswijk reports the distribution of this test for 50 observations and values of β of $-0.1, -0.2$ and -0.5. The five per cent critical value for $\beta = 0.5$ (which is the adequate for our results) is 4.384. Since we are considering a model which implicitly attributes the same strategic importance to all firms, the appropriate value for n in the tests of Cournot behaviour is Adelman's numbers equivalent, which has had to be calculated for every market in analysis.

The differences between the estimated θ parameter across groups provide an interesting interpretation, since the lowest value is obtained for the five biggest banks, being thus closer to the collusive solution, and the highest one is obtained for the «fringe» of the remaining banks, being thus closer to competitive behaviour, both in DCB and in LA markets.

TABLE 1
Discount of Commercial Bills

	DCB5M	DCBR
$\hat{\theta}$	0.735	0.924
$\hat{\gamma}$	0.370	−0.589
W_2 Bertrand (H_0: $\theta = 1$)	3.165	0.548
W_2 Cournot (H_0: $\theta = n/(n+1)$)	0.144 ($n = 3.8$)	0.769 ($n = 5.0$)
W_2 collusion (H_0: $\theta = 0.5$)	1.841	7.355

[8] The results for the other groups of banks considered will be sent upon request.

TABLE 2
Loans and Advances

	LA5M	LAR
$\hat{\theta}$	0.529	0.830
$\hat{\gamma}$	0.603	0.208
W_2 Bertrand (H_0: $\theta = 1$)	3.818	0.560
W_2 Cournot (H_0: $\theta = n/(n+1)$)	0.378 ($n = 1.8$)	0.014 ($n = 5.9$)
W_2 collusion (H_0: $\theta = 0.5$)	0.028	3.208

The results of the tests for all the groups of banks considered in the DCB market are favourable to the rejection either of a collusive behaviour (with the exception of the five biggest banks, for which this hypothesis cannot be rejected), or of a Bertrand behaviour[9], indicating a strategic interaction *à la* Cournot, which means, in practice, little sensitivity on the part of the rest of the market to a move of one of its elements and, *ceteris paribus,* an intermediate degree of market power.

As far as the various groups of banks in LA are concerned, evidence favours the acceptance of collusive behaviour, this hypothesis being clearly rejected only for the LA5 variable, and, with the exception of the group of the small banks, it is possible to reject the Bertrand hypothesis for all the others. If we consider the whole system, the strongest hypothesis is the one of collusion and this is also the one with the smallest value of test for big banks (the figure for $\hat{\gamma}$ being also quite near the corresponding value for n-1), though it is equally not possible to reject Cournot behaviour[10]. For small banks, on the contrary, the collusive hypothesis may be rejected at a higher level of significance and there is ambiguity in the distinction between Cournot and Bertrand. Broadly speaking, there is then some evidence of less competitive behaviour in the LA market than in the DCB market, thus favouring, all other things being equal, stronger market power in the first one.

5. Conclusions

This paper provides evidence on how the observed differential between the

[9] The exception now goes to small banks, for which the Bertrand hypothesis is even stronger than the Cournot one. The negative value of $\hat{\gamma}$ also reflects this fact.

[10] The existence of a degree of competitiveness among major banks has not been rejected by our model, both in DCB and in LA.

Discount of Commercial Bills interest rate and the Loans and Advances interest rate for «Other Non-Financial Firms» (with maturity from 91 up to 180 days) in the Portuguese credit market can be explained by market power differences. The study was undertaken for the period after January 1990, when quantitative restrictions on credit were abolished and the differential widened. Besides the whole banking system, several groups of banks (for instance, «big» banks and «small» banks) were also analysed. The method of Sumner (1981), consisting of identifying market power through the existence of a known component of the marginal cost (the interest rate in the interbank money market in this model) is used.

The results reject the collusion hypothesis in the DCB market (except for big banks); in this market the Bertrand behaviour hypothesis may also be rejected (except for small banks), the Cournot hypothesis prevailing. Strategic interaction *à la* Bertrand is also rejected for LA (again with one exception for small banks), and for some markets the collusive hypothesis prevails. Though there is some evidence of less competitive behaviour in LA than in DCB, the null hypothesis that the type of strategic interaction is the same in both markets cannot be rejected. Besides, for the banks which operated throughout the sample period in DCB and LA (DCB5 and LA5 variables), for which we are thus comparing exactly the same sample, the type of strategic behaviour indicated by the tests is the same (Cournot) in both segments.

The conclusions reached concerning market behaviour, combined with the evidence of a clearly higher concentration in LA market than in DCB market and, on the other hand, with a possibly smaller demand elasticity in DCB, which works opposite, do not support the existence of stronger market power in the latter [11], so that the observed differential between the two interest rates can be ascribed to different risk premia.

References

Berg, S. and Kim, M. (1993): «Banks as Multioutput Oligopolies: an Empirical Evaluation of the Retail and Corporate Banking Markets», *mimeo.*

Boswijk, P. (1993): «On the Formulation of Wald Tests on Long-run Parameters», *Oxford Bulletin of Economics and Statistics* 55, pp. 137-144.

Bresnahan, T. F. (1989): «Empirical Studies in Industries with Market Power», in *Handbook of Industrial Organization* (Volume II), Schmalensee, R. and Willig, R. D. (eds.), North-Holland, Amsterdam, pp. 1011-1057.

Bulow, J. I. and Pfleiderer, P. (1983): «A Note on the Effect of Cost Changes on Prices», *Journal of Political Economy* 91, pp. 182-185.

[11] Assuming that the opposite sign effects of demand elasticity and concentration approximately cancel.

Cowling, K. and Waterson, M. (1976): «Price-cost Margins and Market Structure», *Economica* 43, pp. 267-274.
Dickey, D. and Fuller, W. (1981): «Likelihood Ratio Statistics for Autoregressive time Series with a Unit Root», *Econometrica* 49, pp. 1057-1072.
Shaffer, S. (1989): «Competition in the U.S. Banking Industry», *Economics Letters* 29, pp. 321-323.
Sumner, D. A. (1981): «Measurement of Monopoly Behaviour: an Application to the Cigarette Industry», *Journal of Political Economy* 89, pp. 1010-1019.

Resumen

En este artículo se analiza el poder de mercado en el sistema bancario portugués, en particular, en las operaciones activas. Se pretende evaluar en que medida la diferencia entre el tipo de interés del Descuento Comercial y el de Préstamos y Otros Créditos a «Otras Empresas No Financieras» (de 91 a 180 días) se puede explicar por diferencias de poder de mercado. Los resultados empíricos obtenidos no sugieren la utilización de consideraciones sobre el mayor poder de mercado en el Descuento Comercial para explicar el diferencial de tipos de interés, excepto a través de la elasticidad de la demanda. Por tanto, este diferencial estará asociado a otros factores, en particular, a diferencias en el riesgo asociado a los distintos clientes que obtienen fondos en estos mercados.

Recepción del original, agosto de 1993
Versión final, abril de 1994