

AN ASSESSMENT OF COMPETITION IN THE PORTUGUESE BANKING SYSTEM IN THE 1991-2004 PERIOD*

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1. INTRODUCTION

In the course of the 1980s and of the 1990s the Portuguese banking system went through major changes which had an important impact on the degree of competition faced by financial institutions. The first steps towards the sector's liberalisation were taken in the mid-1980s, stress being laid on the opening of markets to private initiative, in the context of a banking sector dominated by public institutions. Still, up to the early 1990s, banks were tightly regulated as regards key aspects of their activity. In fact, the autonomy to define prices and quantities in deposit and loan markets was low, at the same time as the banks' entry (domestic or foreign) into the market and the expansion of the branch network of banks already operating were subject to the discretionary authorisation of authorities.¹ In this setting, the low degree of competition seen during the early 1980s seems to have originated in the very strong administrative restrictions to market functioning rather than in the behaviour of banking institutions. Hence, the carrying out of banking business in a full market environment was only possible as of the early 1990s, with the liberalisation of interest rates applicable to most banking transactions, in parallel with the removal of quantitative credit ceilings. Thus, this paper analyses competitive conditions in the Portuguese banking system in the post-1990 period, including the identification of time series patterns, as well as research on possible behavioural changes associated with participation in the euro area.

Throughout the period under analysis, in addition to increased concentration in the domestic banking system, one should point out the relevance of the privatisation process and of the increased weight of foreign banks, in the wake of the sector's liberalisation. In fact, from 1991 to 1996, the number of public banks operating in Portugal declined from ten to only one. As a consequence, the market share of public banks, measured in terms of total assets, declined in the same period, from close to 60 per cent to around 20 per cent. On the other hand, both the number and the market share of foreign banks increased considerably from 1991 to 2004, the latter having grown from 5 to 20 per cent. In effect, the rise in the market share of foreign banks was greater than the increase in their number, reflecting the acquisition of a major national bank by a foreign institution in 2000. In fact, similarly to most European countries, the organic growth of foreign banks in the Portuguese retail market was not particularly successful in the retail business.

Chart 1 shows the evolution of concentration in the Portuguese banking system, according to 3 and 5-bank concentration indices (C3 and C5 respectively, on the left-hand scale) and to the Herfindahl-Hirschman index (HHI, on the right-hand scale), derived from banks' total assets.² These

* The views expressed in this article are those of the authors and do not necessarily reflect those of the Banco de Portugal.

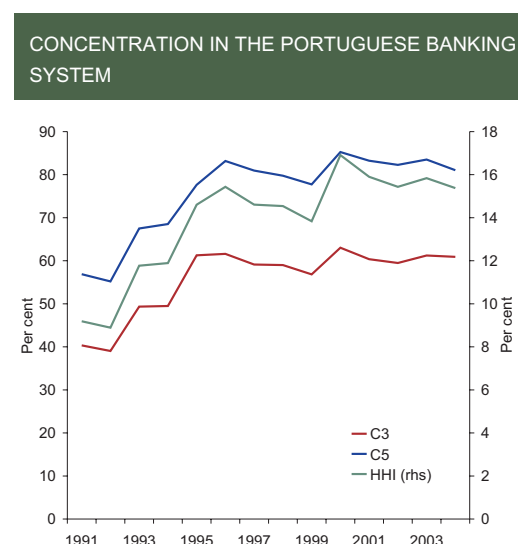
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(1) See Ribeiro (2007) for a brief overview of the Portuguese financial system's liberalisation process.

(2) For the k largest banks of a market with n banks, $C_k = \sum_{i=1}^k s_i$ and $HHI = \sum_{i=1}^n s_i^2$, where s_i is the market share of bank i . The unit of observation considered is the banking group. For more details on this point, refer to Section 3.

three indicators show that concentration has increased throughout the period under analysis, as the deregulation period was followed by a consolidation trend across the market. A more careful analysis of Chart 1 shows that between 1991 and 2004 there were two distinct consolidation waves. Up to 1996, following the privatisation programme, concentration increased almost linearly. Afterwards it stabilised until 2000, when there were deep changes in the shareholding structure of some of the major banking groups.

Chart 1



Source: Authors' calculations.

According to the traditional paradigm establishing a direct relationship between structure, conduct and performance developed in Bain (1951), an increase in concentration is linked to a decrease in competition. However, this result contradicts common wisdom and anecdotal evidence according to which the Portuguese banking system seems to have been characterised by increased competition in this period. This performance – increased competition in a period of increased concentration – is consistent with both Baumol's theory of contestable markets Baumol (1982) and the assumption that concentration may be driven by growth in more efficient institutions (Demestz 1974), and motivates the use of the non-structural test described below.

The approach taken to assess the banking system's degree of competition consists in specifying tests based on reduced-form revenue equations, as originally suggested in Panzar and Rosse (1987). Hence, revenue is explained by a vector of input prices and the sum of the corresponding elasticities is the so-called *H*-statistic, which makes it possible to infer the degree of competition. However, the use of this statistic is not immune to criticism, namely as regards assumptions underlying its use as a measure of competition in banking markets. Therefore, the Panzar-Rosse methodology is a non-structural approach, as opposed to estimable specifications rooted on static oligopoly models, which establish testable relationships between market structure, direct measures of strategic behaviour and competition. Further, this methodology relies on the crucial hypothesis that banks are essentially producers of a single product in the credit market, while all funding sources, including deposits, are considered inputs. Another controversial issue across most empirical studies of this type is the definition of the most appropriate variable to represent banking revenue: interest income or total income, used in levels or scaled by total assets. These issues as well as the possible ways of overcoming them in the empirical specification are discussed in detail in this paper. Special attention is paid to the definition of the inter-

est revenue variable, in order to restrict the analysis to the domestic loan market, which is the bank asset component most likely to exhibit market power. Similarly, the definition of the cost of funding variable takes due care of the differences in the profile of services provided by banks, namely as regards payment and liquidity services. The aim of this procedure was to control for systematic differences in the importance for each bank of the segments of funding markets where market power is more prone to emerge. The banks' funding cost measure is also adjusted to account for the presence of a given institution in the interbank market both as creditor and debtor.

Despite the shortcomings, the simplicity of this methodology helps to explain its frequent use in studies on competition in banking markets. One of the main advantages lies in the fact that to implement this methodology it is not necessary to gather price and quantity data on services provided by banks. This information, needed to estimate structural equations of banks' behaviour, is often not available, and therefore most services are not easy to quantify. Another appealing property of this methodology is the fact that it allows for the inference of the interaction between input price shocks and the revenue function, without requiring the estimation of output demand or cost functions. In addition, there is no need for an a priori definition of the relevant market in a geographic sense, as the input price to revenue relationship captures possible local market product differentiation on average, in the aggregate.

According to the main results obtained, the Portuguese banking sector, and particularly the credit market, experienced weak competition between 1991 and 1996, underwent a period of restructuring until 2000, and from then until 2004 behaved consistently with a high degree of competition. Results further suggest that on occasions both private and domestic banks have competed more aggressively than the banking system as a whole, and no relationship between competitive behaviour and bank size was identified.

The next section briefly summarises the results obtained in empirical applications of the Panzar and Rosse approach to the Portuguese banking market. Section 3 presents the data and the methodology employed. Section 4 discusses the results obtained and Section 5 draws the main conclusions of the analysis.

2. PREVIOUS EMPIRICAL FINDINGS

Most studies applying the Panzar and Rosse methodology reject both the hypothesis of monopoly (or perfect cartel) behaviour and that of perfect competition. In a cross-country analysis for the EU-15 for the period between 1997 and 2003, Casu and Girardone (2006) find a value for the H -statistic between zero and one, thus rejecting both monopoly and perfect competition at EU-15 level, as well as for most countries individually, including Portugal. The article by Koutsomanoli-Fillipaki and Staikouras (2004) also rejects both monopoly and perfect competition, for the period ranging from 1998 to 2002. However, in this study, rather than being estimated individually for Portugal, the H -statistic is estimated for the EU-15 as a whole. Bikker *et al.* (2006) estimate competitive conditions for 101 countries between 1986 and 2005. Since this study intends to make a methodological point, several different specifications are estimated, and the results obtained for Portugal range from monopoly, in their preferred specifications, to perfect competition in the models they consider misspecified. In general, obtained results for Portugal are similar to those estimated for other countries. For a more complete summary of results obtained in recent applications of the Panzar and Rosse methodology, refer to Table 1 in Casu and Girardone (2006) or to Table 1 in Bikker *et al.* (2006).

3. DATA AND METHODOLOGY

The dataset used in this study was obtained from banks' financial statements reported to the Banco de Portugal. The database comprises an unbalanced panel of yearly data for all active banks operating in Portugal from 1991 to 2004. Since detailed consolidated accounting data are available only for the most recent period, data on an individual basis were used instead. However, since interest lies in comparing the behaviour of different economic units rather than legal entities, data for banks belonging to the same economic group were aggregated, and thus the observation unit is the group rather than the bank. Mergers in the database obviously pose a number of difficulties, and there is no way to address this issue that is free from criticism. In this analysis, the choice fell on independently considering the two groups until their merger. Thereafter, only one of the two survives, and a dummy variable was included to control for potential behavioural changes arising from the merger. All money variables used were assessed at constant 1991 prices, and deflated using the GDP deflator.

All banks operating in Portugal are required to report financial statements to the Banco de Portugal. However, there are a large number of small banks that mostly operate in investment banking and are thus likely to behave differently from most commercial or universal banks. Hence, in order to obtain a sample of reasonably homogenous banks, observations for institutions with less than 15 branches or 15 employees were eliminated. Banks that do not take any deposits from customers were also eliminated, and it was checked that positive values for total assets and equity were reported for all observations. The first two years of activity of each bank were also eliminated, as it seems reasonable to assume that during the early years banks may behave somewhat atypically. At the end of this process, the sample included a total of 197 observations corresponding to 25 banking groups. For each year, the final sample includes no less than 92% of loans granted to customers, 94% of customer deposits held and 92% of total assets of the Portuguese banking system.

The definition of banks' outputs and inputs is by no means simple. On the one hand, the "production approach" to bank modelling regards banks as firms producing services which are related to loans and deposit accounts, thus measuring output by the number of deposit accounts serviced and the number of loans originated, and input by labour and physical capital. On the other hand, according to the "intermediation approach" (Sealey and Lindley (1977)), banks' main activity is granting loans and investing in securities and other assets using funds obtained through deposits, wholesale market debt and equity.³ Hence, while both approaches agree in classifying labour and physical capital as inputs, they present a conflicting view as to whether deposits should be classified as an output or as an input. Since economic theory does not give clear guidance as to which alternative best describes the behaviour of banks, it is somewhat reassuring to note that estimated cost functions appear relatively insensitive to the approach followed (Humphrey 1990). In turn, there is empirical evidence suggesting that deposits overall behave primarily as inputs (see for example Gilligan and Smirlock (1984), Hughes and Mester (1993), Shaffer (1994) and Hughes, Mester and Moon (2000)). These results, joined with the fact that there are no available data on the number of deposits collected and of loans granted by each bank, sustain this paper's choice of the intermediation approach, which is crucial for the application of the Panzar and Rosse methodology. Hence, banks are modelled as firms that use labour, physical capital and funds in order to produce loans.

There has been considerable debate in the literature as to whether the dependent variable to be used in the estimation of equations to conduct the Panzar and Rosse test should consider total or interest

(3) See Freixas and Rochet (1998), p. 77-79 for details on the production and intermediation approach.

revenue. On the one hand, the fact that the methodology itself considers a priori loans as banks' main output suggests that interest revenue should be used. On the other hand, the increase in the relative importance of commissions and fees in banks' total revenue should not be neglected. Hence, use was made of the stricter definition of revenue, while including the ratio of other income to interest income as a regressor. Thus, a general model is obtained, encompassing both the specification where the dependent variable is interest income (if the coefficient on this regressor equals zero) and the specification where the dependent variable is total income (if the same coefficient equals minus one).⁴

A third matter of discussion is whether banks' size should be controlled for. Since it seems overly simplistic to assume banks' size is uncorrelated with input prices, the exclusion of a scaling variable is likely to bias the estimates for the elasticities of factor prices, thus introducing a negative bias should there be increasing returns to scale, and a positive bias in the presence of decreasing returns to scale. However, Bikker et al. (2006) point out that the use of a scaling variable through the inclusion of total assets (either as an independent variable or by defining the dependent variable as the ratio of revenue to total assets) effectively turns the revenue equation into another equality, which is quite similar to a price equation. The point is that the sum of output price elasticities with respect to input prices is positive by definition and uninformative on the degree of competition. Hence, including a scaling factor in the estimated equation could introduce a positive bias in the estimate for the H -statistic. The possible presence of "errors-in-variables" due to the approximation of input prices, however, may bias the estimated coefficients downwards, regardless of a scaling factor being used or not.

In the event that banks operating in Portugal in the period under analysis have behaved consistently with long-run equilibrium under perfect competition, the H -statistic should equal one. This is due to the fact that, in a situation where banks have zero economic profit and face an infinitely elastic demand, revenue will necessarily have to follow input price developments so as to guarantee the survival of banks, with free entry determining zero economic profit. In cases of monopoly, perfect cartel or short-run monopolistic competition equilibrium, the statistic of interest should be negative. With regard to monopoly, this result is rather intuitive, since monopolists always operate in the elastic zone of the demand curve. Therefore, an input price increase, which will lead to an output price increase, will cause a reduction in revenue. Finally, in the case of a long-run monopolistic competition model with free entry of firms into the market, the H -statistic is increasing in the perceived demand elasticity converging to 1 as it approaches infinity, thus replicating the result for perfect competition.⁵

The revenue equation was estimated based on the following baseline specification.⁶

$$[1] \quad \ln(\text{Interest Revenue})_{it} = h_1 \ln w_{L_{it}} + h_2 \ln w_{K_{it}} + h_3 \ln w_{F_{it}} + X'_{it} \beta + \delta + \eta_i + \varepsilon_{it}$$

where Panzar and Rosse's H -statistic is obtained by $\sum_{k=1}^3 h_k$, X_{it} is a set of control variables, δ is a constant term, η_i is an unobservable variable that captures idiosyncratic features of each institution that are constant over time (although they may be correlated with some explanatory variables) and ε_{it} is a random shock.

The average price of labour $-w_L-$ is proxied by the ratio of labour costs to the number of employees, whereas the ratio of (tangible and intangible) capital expenditure to (tangible and intangible) fixed as-

(4) This result holds since $\ln TR = \ln(RJ + OR) \approx \ln RJ + (OR / RJ)$, where TR stands for total revenue, IF for interest revenue and OR for revenue obtained through other activities. This approach is used in Bikker et al. (2006).

(5) These results are formally derived in Boucinha and Ribeiro (2008).

(6) The use of the loglinear form is widespread among studies applying the Panzar and Rosse methodology, as it typically improves the regression's goodness of fit and may reduce a possible simultaneity bias (De Bandt and Davies 2000). Furthermore, Molyneux et al. (1996) found that a loglinear revenue equation yielded similar results as a more flexible translog equation.

sets $-w_K$ – proxies the cost of physical capital, and the ratio of interest paid to interest bearing debt $-w_F$ – measures banks' average funding cost.

The dependent variable used in the baseline specification is the natural logarithm of interest revenue obtained from loans granted to domestic customers. The option to focus the analysis only on the portion of interest revenue earned on loans rather than including all interest income is explained by the fact that banks are known to have little market power on the remaining interest earning business, such as interbank and securities activities. As such, interest lies in testing how competitive banks are in customer lending. This is a novelty feature of this study worth emphasising, as to our knowledge all previous studies apply this methodology to all interest revenues.

As to what concerns the control variables included in X_{it} , the ratio of demand deposits to total deposits and that of market liabilities to total liabilities are included to account for banks' funding mix, whereas the ratio of short-term loans to total loans and of interbank assets to customer loans, on the other hand, intend to capture the asset structure. The increasing importance of banks' off-balance-sheet activity is controlled for by the inclusion of the ratio of off-balance-sheet activity to total assets. The ratio of assets to branches intends to capture different branching strategies, measuring systematic differences in banks' branch density.

The share of customer loans that have defaulted during each year is a credit risk measure that attempts to capture the flow rather than the stock of non-performing loans, thus decreasing the *ex-post* character of this variable. In turn, the ratio of equity to assets should proxy banks' risk aversion once credit risk is controlled for.

The ratio of other revenue (composed of net commission and fee income) to interest revenue, as discussed above, intends to capture the increasing role of non-interest revenue in banks' income. The inclusion of asset quartile dummies in the equation is a compromise solution that intends to address the misspecification described in Bikker *et al.* (2006), while at the same time controlling at least partially for the correlation between banks' size and input prices.⁷ Finally, dummy variables identifying when a merger has occurred, or if a bank is foreign or public are also included.⁸

Descriptive statistics of the included variables are presented in Table 1 below.

Equation [1] was first estimated for the whole sample, including domestic and foreign as well as private and State-owned banks for the period ranging from 1991 to 2004. However, as discussed in Section 1, this time period is by no means homogenous, since during the early to mid-1990s the Portuguese banking system underwent a phase of privatisations, consolidation and liberalisation, while preparing for euro area participation. Hence, in order to account for this fact, a sequential test was performed for differences in the *H*-statistic through time, by first estimating equation [1] using data for the first four years in the sample and checking whether the estimate for the fourth year is statistically different from that obtained for the period comprising the first three years. If so, a new period starting on the fourth year would be created; if not, 1994 would be pooled with 1991-1993. This process was repeated until 2004, restricting each period to comprise at least three years of data.⁹

In order to test for differences in the competitive behaviour of different types of banks, equations considering only domestic banks and only private banks were estimated. Even though it would be more informative to allow the estimate of the degree of competition to vary across types of banks, this option is

(7) In the sample used, the simple correlation coefficient between the logarithm of assets and the price of labour, capital and funds is 0.36, -0.07 and -0.23 respectively.

(8) Only domestic public banks are classified as public, since public banks operating abroad are likely to exhibit a different behaviour than that of local public banks. Tables A1 and A2 in the Appendix display which banks are classified as public and as foreign, respectively, for each year.

(9) One reason to maintain this restriction is connected to the small size of the available sample. Furthermore, De Bandt e Davies (2000) advocate the importance of the time series component as they find variable results for cross-section equations even with information for a larger number of banks.

Table 1

DESCRIPTIVE STATISTICS					
Variable	No. Obs.	Mean	Std. Dev.	Min.	Max.
Interest Revenue	197	307.6	340.0	2.5	1445.6
Total Revenue	197	348.7	385.0	2.5	1702.3
Interest Revenue/Assets	197	4.2	2.0	0.4	10.6
Total Revenue/Assets	197	4.7	2.0	0.8	10.9
w_L (thousands of euros)	197	21.2	3.9	7.4	31.9
w_K	197	13.3	5.6	4.0	41.9
w_F	197	6.9	4.5	1.1	27.6
Demand Deposits/Total Deposits	197	35.6	9.5	18.7	65.2
Market Liabilities/Total Liabilities	197	44.1	14.6	13.4	88.7
Short Term Loans/Total Loans	197	46.7	20.8	9.3	93.8
Interbank Assets/Customer Loans	197	45.2	36.5	0.3	169.7
Off Balance Sheet Activity/Assets	197	190.1	2365.9	3.4	33228.2
Assets/Branches	197	27.3	10.9	4.4	58.7
Default Ratio	197	1.5	1.3	0.0	7.6
Equity/Assets	197	6.9	2.7	1.5	29.8
Other Revenue/Total Revenue	197	14.6	12.8	1.0	105.6
ROA	197	4.9	5.7	-47.4	25.8
Assets	197	9295.6	11447.3	70.5	45172.8

Source: Banco de Portugal.

Note: Money variables are valued in 1991 euro million (unless otherwise stated) and ratios are defined in percentage form.

not feasible due to the small number of public and foreign banks in the sample. Hence, although the statistical significance of differences in competitive behaviour across types of banks may not be tested in the approach taken, it nevertheless provides a number of hints in that respect.

As several authors have pointed out – *inter alia* Bikker and Haaf (2002) and Hempel (2002) – small banks may have more market power in local markets, whereas larger banks are generally believed to be more active in markets where they face greater competition. However, this argument may not be relevant for the Portuguese banking industry, considering that the smaller size of the national market leaves less room for the existence of independent local markets and most regions tend to be served by at least one large bank. Nevertheless, the only truly effective way of addressing the misspecification pointed out in Bikker *et al.* (2006) while avoiding the introduction of other sources of bias in the analysis is to assess the competitive behaviour of similarly sized banks, thus avoiding the need to use a scaling variable. Hence, a similar estimation procedure to that in equation [1] is applied to small and large banks separately, where small and large is defined according to whether a bank's total assets are above or below average total assets for each year.¹⁰

The interpretation of the H -statistic depends on whether or not the banking system is in a state of long-run equilibrium. In fact, while the result that the sum of factor price elasticities of a monopolist's revenue must be non-positive holds even in the short run, the validity of the rejection of models of perfect and monopolistic competition depends on the assumption that the banking groups observed are in long-run equilibrium (Panzar and Rosse 1987). In order to investigate whether the system is in long-run equilibrium, as is common practice in several studies applying the Panzar and Rosse methodology,¹¹ one uses the fact that in equilibrium risk-adjusted rates of return should be equalised across banks. Thus, banks' return on assets (ROA) should be uncorrelated with input prices when the market is in equilibrium. A direct test of equilibrium consists in estimating the equation for revenue with ROA as the dependent variable and performing a test to the null hypothesis $H = 0$ (equilibrium) against $H < 0$ (disequilibrium), where H is the sum of factor price elasticities with respect to profitability measures.

(10) Table A3 in the appendix shows which banks are classified as large for each year. In order to test the robustness of estimates, use was also made of an alternative classification which does not allow a given banking group to shift from one class to another, unless the group has purchased/sold a sizeable bank.

(11) See for example Shaffer (1982) and Molyneux *et al.* (1994).

To test for the robustness of results, some alternative specifications were estimated, including the use of total rather than interest income as the dependent variable and using alternative scaling variables, such as the natural logarithm of total assets, scaling income by total assets and not controlling for size differences at all.

4. RESULTS

Table 2 presents estimation results for equation [1] for the Portuguese banking system in the 1991-2004 period, as well as for the auxiliary regression used to perform the long-run equilibrium test in this period. Estimates for elasticities of interest income with respect to each of the three inputs considered prove to be positive. The estimate for the H -statistic, lying at 0.691, changes only marginally when statistically non-significant variables are eliminated from the regression. The monopoly test performed is a one sided test for the null hypothesis $H \leq 0$ versus the alternative $H > 0$. The former is clearly rejected in favour of the latter, thus providing compelling evidence against the hypothesis that the Portuguese banking system has operated as a monopoly or a perfect cartel on average during the period under scrutiny. If, on the other hand, banks were under perfect competition, the H -statistic should equal one. A two-sided test to this hypothesis is thus performed and, as shown in Table 2, the p-value is close to 10%, so that it is not clear whether perfect competition should be rejected or not. Another relevant result reported in Table 2 is that the application of the long-term equilibrium test described in the previous section does not allow for the rejection of the null hypothesis, therefore providing no evidence to reject the assumption that the Portuguese banking industry was in long-run equilibrium during the relevant period. Hence, one may conclude that, on average, in the period rang-

Table 2

ESTIMATION RESULTS				
Variable	Model [1]		Equilibrium Test	
	ln (IR)		ROA	
ln w_L	0.284	0.155	-0.692	1.795
ln w_K	0.230	0.076	-0.492	0.818
ln w_F	0.177	0.105	3.188	1.911
Demand Deposits/Total Deposits	-0.794	0.709	3.837	6.506
Market Liabilities/Total Liabilities	-0.631	0.582	-5.729	6.097
Short Term Loans/Total Loans	-1.025	0.307	6.617	3.675
Interbank Assets/Customer Loans	-0.460	0.099	-3.852	1.199
Off Balance Sheet Activity/Assets	0.004	0.001	-0.015	0.014
Assets/Branches ^(a)	0.022	0.006	0.147	0.070
Default Ratio	1.580	2.328	-193.520	82.798
Equity/Assets	-8.103	2.616	39.284	14.485
Other Revenue/Total Revenue	-1.730	0.416	8.455	6.059
Aqrt(25)	-1.352	0.206	-0.671	1.797
Aqrt(50)	-1.107	0.186	-0.935	1.520
Aqrt(75)	-0.271	0.108	-0.542	0.966
M	0.022	0.064	0.119	0.683
F	0.491	0.172	4.839	2.482
P	-0.821	0.162	-3.424	1.841
δ	14.218	0.721	9.812	8.186
H -Statistic	0.691	0.184		
$p(H \leq 0)$	0.00			
$p(H = 1)$	0.10			
Equilibrium Test (p-value)			0.41	
R^2	0.63		0.00	
Obs.	197		197	
Banks	25		25	

Source: Authors' calculations.

Notes: Heteroskedasticity robust standard errors are presented in italic. (a) The coefficient on this variable and the corresponding standard error are multiplied by 1000.

ing from 1991 to 2004, the behaviour of Portuguese banks cannot be assessed as consistent with alternative forms of monopoly-like conduct (such as perfect cartel or monopolistic competition in a market without the threat of entry), and it is not clear whether it is consistent with perfectly competitive behaviour, or whether it is best described as stemming from a long-run monopolistic competition model with weak market power.

As regards control variables included in the specification, one concludes that the funding mix seems not to have been a relevant determinant of the interest income on granted loans, whereas the coefficient sign on the variable which measures the maturity structure of granted loans suggests that banks for which the weight of short-term loans is more important tend to earn less revenue, which is consistent with the fact that credit risk-adjusted spreads tend to be generally lower on short-term loans. The same reasoning accounts for the fact that banks with a higher ratio of interbank assets to customer loans tend to earn lower interest revenue from customer loans, whereas it seems natural that banks which are more active in the interbank and securities market *vis-à-vis* the customer loan market, for a given value of total assets, earn less revenue from the latter business. Banks with more off-balance-sheet activity seem to earn higher interest revenues, which may be explained by the possibility that this variable is capturing the effect that these banks tend to have a riskier profile.

Banks with relatively less – and possibly larger – branches tend to earn higher interest income, whereas the measures of credit risk and of risk aversion have the expected signs, even if the former is not statistically significant. The coefficient on the variable which controls for the ratio of other revenue to interest income on loans yields a negative sign. However, its value is different from minus one, which means that the estimated equation is not equivalent to one where the dependent variable is total, rather than interest revenue.¹² As expected, the estimated coefficients for the dummy variables identifying the quartile of the asset distribution to which each bank belongs indicate that, all else constant, smaller banks tend to earn less revenue. As to what concerns the remaining control variables, mergers do not seem to have a significant impact on interest revenue earned, whereas, *ceteris paribus*, foreign banks seem to earn more interest revenue, while the opposite result is found for public banks.

Table A.4 in the appendix illustrates, through a series of robustness tests, the impact on results of different choices regarding the dependent variable and the scaling variables used. The reduced sensitivity of results to different alternative specifications suggests that the conclusions of Table 2 are quite robust. Hence, although the authors are available to provide the results of other specification estimations, in order to provide a clear presentation of results, the analysis conducted in the remainder of this paper focuses only on the results of a specification similar to that in [1].

As briefly discussed in the introduction to this paper, the Portuguese banking system underwent significant changes during the sample period. Hence, in order to investigate whether the process of liberalisation and consolidation of the sector had a relevant impact on competitive conditions, the estimated *H*-statistic is allowed to vary over time without any particular functional form being imposed upon it, through the method described in the previous section. As a result, three periods were obtained: a first period of consolidation and adjustment to less restrictive regulations – 1991 to 1996; a second period of post-consolidation adjustment, which includes the beginning of euro area participation – 1997 to 2000; and a final post-liberalisation and post-consolidation period in which the Portuguese banking system is already relatively mature – 2001 to 2004.

The first line of Table 3 shows estimates of the *H*-statistic for Portuguese banks for each of the three periods, as well as for the total sample. During the first period, it is not possible to reject collusive behaviour, and perfect competition is clearly rejected. Furthermore, during this first period of intense con-

(12) See footnote 4.

Table 3

THE EVOLUTION OF THE H-STATISTIC FOR PORTUGUESE BANKS										No. Obs.	No. Banks
	1991-1996			1997-2000			2001-2004		1991-2004		
All Banks	0.07 0.39 0.00 0.20	-0.50* 0.87 0.00 0.00			0.97 0.00 0.90		0.69 0.00 0.10			197	25
Domestic Banks	0.17 0.27 0.00 0.01	1.19 0.00 0.64 0.64			1.37 0.00 0.05		0.98 0.00 0.92			150	21
Private Banks	0.39 0.14 0.09 0.26	-0.13* 0.60 0.03 0.08			0.80 0.00 0.48		0.74 0.00 0.30			162	18

Source: Authors' calculations.

Notes: For each cell, the value in the centre is that of the H -statistic, whereas p -values for the tests $H \leq 0$ (left), $H=1$ (right) and $H_t=H_{t+1}$ (between periods) are presented below. ***, ** and * indicate evidence of disequilibrium at the 1%, 5% and 10% confidence level, respectively.

solidation and deregulation, there is no empirical evidence to reject the hypothesis that the Portuguese banking system was operating under long-run equilibrium. Hence, one concludes that the degree of competition was relatively low during this period. As to what concerns the behaviour of the banking system as a whole in the following period, even if conclusions for the hypothesis tests on the H -statistic are the same, there is evidence that the system was not operating under long-run equilibrium. Therefore, estimated coefficients constitute no evidence of collusive behaviour given that, while the rejection of monopoly remains valid in this context, the non-rejection of $H \leq 0$ no longer implies that the industry has behaved jointly as a monopoly. In the most recent period, there is strong statistical evidence to reject perfect cartel, but perfect competition is not rejected. In addition, the point estimate for the H -statistic in this period is close to one, and the difference between estimates obtained for the intermediate and the most recent period are, both in the magnitude and in the statistical significance, more striking than those found between the first and the second period.

Domestic banks seem to have behaved more competitively throughout the period under analysis. In fact, even if conclusions regarding the first period remain unchanged, between 1997 and 2000 the perfect competition hypothesis for domestic banks cannot be rejected. Results obtained for the most recent period are consistent with domestic banks behaving too aggressively. This might be rationalised under a more complex dynamic oligopoly model, where banks aggressively fight for increased market share in order to capitalise on it with high profits in the future.¹³ Furthermore, there is no empirical evidence that domestic banks did not operate under long-run equilibrium between 1997 and 2000. Restricting the estimate for the H -statistic to be constant from 1991 to 2004, for domestic banks the obtained value is clearly higher than that estimated for the whole banking system, and there is no evidence to reject perfect competition in domestic banks throughout the whole period under analysis. However, the average value of the H -statistic estimated for the whole period under analysis masks important behavioural changes over time.

As regards the behaviour of private banks, for the 1991-2004 period the value obtained for the H -statistic is higher than that for the banking sector as a whole, and the perfect competition hypothesis is not rejected. Still, it is important that developments in this statistic are analysed over time. In fact, although the point estimate obtained for the 1991-1996 period is higher for private banks than for the total banking system, which suggests a more competitive behaviour by the former, the monopolistic behaviour hypothesis still cannot be excluded. As of 1997 the behaviour of private banks follows closely in line with that of the system as a whole. This is by no means a surprise, given that in this period the

(13) This sort of behaviour may stem from the presence of switching or search costs.

privatisation stage was already completed, with only one public banking group remaining in the whole system.

As to what concerns a comparison between the behaviour of differently sized banks, no robust difference was found. In fact, in addition to results not being robust to slight changes in the banks' classification, a formal test to the equality of estimates obtained for small and large banks does not identify statistically relevant differences. Hence, during the analysed period there is no evidence for a hypothesis that is widely stated and tested in empirical literature for other countries, which is that small banks may be able to exert higher market power due to a stronger presence in local markets where competition is less aggressive. This fact should be linked to the smaller size of the national market as compared to those for which the relevant result has been obtained, since in larger countries it is common to find banks which have a strong position in the region where they operate, despite having little weight in the national market as a whole. This result reduces the plausibility of the existence of fully segmented local markets in the Portuguese case.

5. CONCLUSIONS

The main conclusion to retain from this study is that on average, over the period from 1991 to 2004, Portuguese banks do not seem to have operated either under perfect competition or as a perfect cartel. During this period, both private and domestic banks seem to have competed more aggressively on average than the banking system as a whole, and perfect competition may not be rejected for these two types of banks.

An investigation of changes in competition throughout the period suggests that competition was relatively weak between 1991 and 1996, even though results indicate domestic and especially private banks exhibited a slightly sharper competitive behaviour. A period of adjustment to liberalisation, consolidation and openness of the sector followed between 1997 and 2000, although for domestic banking groups the hypothesis of behaviour consistent with perfectly competitive long-run equilibrium cannot be rejected. In the more recent period, ranging from 2001 to 2004, after the liberalisation and openness of the Portuguese banking sector, strong competition was observed, and it is even possible that domestic banks have competed more aggressively than expected in a framework described by a static model with no distortions. Thus, the outlook for participation in the euro area seems to have been one of the factors catalysing an increase in competition in the national banking system.

One should, nonetheless, bear in mind the limitations of the non-structural approach employed, particularly regarding the hypotheses implicitly imposed on the underlying bank behaviour model. Obtained results should therefore be compared with those to be derived in future research from alternative methods, in order to draw more general conclusions on the degree of competition in banking services markets in Portugal.

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APPENDIX

Table A 1

PUBLIC BANKING GROUPS													
1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
BCA BFB BFE BPA CGD CPP UBP	BCA BCM BFE BPA BPSM CGD CPP UBP	BCA BFE BPSM CGD	BCA BFE BPSM CGD	BCA BFE CGD	CGD	CGD	CGD	CGD	CGD	CGD	CGD	CGD	CGD
7/17	8/19	4/15	4/14	3/15	1/15	1/14	1/14	1/14	1/12	1/12	1/12	1/12	1/12

Source: Banco de Portugal

Notes: BPSM was not considered in 1991 due to the unavailability of profit and loss account data. All foreign banks are classified as private.

Table A 2

FOREIGN BANKING GROUPS													
1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
BARCLAYS BBVA CLP	BARCLAYS BBVA CLP	BARCLAYS BBVA CLP	BARCLAYS BBVA CLP	BARCLAYS BBVA CLP SANTANDER	BARCLAYS BBVA CLP SANTANDER	BARCLAYS BBVA CLP SANTANDER	BARCLAYS BBVA SANTANDER	BARCLAYS BBVA SANTANDER	BARCLAYS BBVA SANTANDER	BARCLAYS BBVA SANTANDER	BARCLAYS BBVA SANTANDER	BARCLAYS BBVA BNC SANTANDER	BARCLAYS BBVA BNC SANTANDER
3/17	3/19	3/15	3/14	4/15	4/15	4/14	3/14	3/14	3/12	3/12	3/12	4/12	4/12

Source: Banco de Portugal.

Table A 3

LARGE BANKING GROUPS													
1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
BCP BFE BPA BTA CGD GES	BCP BFE BPA BPI BPSM BTA CGD GES	BCP BFE BPA BTA CGD GES	BCP BPA BTA CGD GES	BCP BPSM CGD GES	BCP BPI BPSM CGD GES	BCP BPI BPSM CGD GES	BCP BPI BPSM CGD GES	BCP BPI BPSM CGD GES	BCP BPI CGD GES SANTANDER	BCP BPI CGD GES SANTANDER	BCP BPI CGD GES SANTANDER	BCP BPI CGD GES SANTANDER	BCP BPI CGD GES SANTANDER
6/17	8/19	6/15	5/14	4/15	5/15	5/14	5/14	5/14	5/12	5/12	5/12	5/12	5/12

Source: Banco de Portugal.

Notes: BPSM was not considered in 1991 due to the unavailability of profit and loss account data. Large banks are defined as those with total assets exceeding average total assets for each year. The remaining banks are classified as small.

Table A 4

ALTERNATIVE DEPENDENT AND SCALING VARIABLES							
Dependent variable	Scaling variable						
	ln (Assets)		Asset quartiles		None		
Ln (<i>Interest Revenue</i>)	0.00	0.70	0.04	0.69	0.10	0.00	0.61
Ln (<i>Total Revenue</i>)	0.00	0.71	0.06	0.71	0.12	0.00	0.60
Ln (<i>Interest Revenue/Assets</i>)						0.00	0.71
Ln (<i>Total Revenue/Assets</i>)						0.00	0.71
Obs.				197			
Banks				25			

Source: Authors' calculations.

Notes: For each cell, the value in the centre is that of the H-statistic, whereas p-values for the test $H \leq 0$ (left) and $H = 1$ (right) are presented below. ***, ** and * indicate evidence of disequilibrium at the 1%, 5% and 10% confidence level, respectively.