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COMISIÓN NACIONAL DE ENERGÍA

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Abstract

The aim of this paper is to assess the level of competition prevailing in the Spanish banking system. The current analysis employs a widely used non-structural methodology put forward by Panzar and Rosse (1987) —the so-called H-statistic— and draws upon a comprehensive panel dataset of Spanish commercial and savings banks covering the period 1986-2005. Standard estimates characterize a hump-shaped profile for the H-statistic throughout the time span under consideration. Nevertheless, a weighted procedure is subsequently performed in order to control for firm size and the number of branches. The estimation outcome reveals a gradual rising path for the H-statistic, thus suggesting a more competitive environment among larger banks. In both settings, a noteworthy increase in the degree of competition is identified at the turn of the eighties, when several liberalization-oriented policy measures came into force. The aforementioned findings discredit the widespread hypothesis which states that concentration impairs competition.

JEL Classification: G21; L13; L10.

Keywords: Banking; Competition; Panzar-Rosse; Market Structure.

1 Introduction

Competition has become a recurrent topic in the banking literature. Specifically, during the last decade a great deal of empirical work has attempted to measure the level of competition prevailing in European banking markets. The beginning of the third stage of the Economic and Monetary Union, in January 1999, and the projected changeover to the euro triggered the interest of researchers in this issue. The initial purpose was to explore the impact of European policy actions aimed to create a level-playing-field in the provision of financial services. The transformation of the European Union's financial landscape was expected to unleash competitive forces in the banking industry, boost the scope of desintermediation and securitisation, foster cross-border capital flows and prompt the restructuring and consolidation processes.

Another stimulus which made researchers draw attention on this issue stems from industrial organization (IO) theory. In particular, the conventional view which holds that increasing concentration may lead to undesirable exercise of market power, i.e. that concentration impairs competition, has been subject to an enormous amount of controversy. The IO theory on competition is usually divided into two major streams, namely the structural and non-structural approaches[1]. The former embraces the structure-conduct-performance (SCP) paradigm and the efficiency hypothesis (EH).

The SCP, originally due to Bain (1951), investigates whether high levels of market concentration result in collusive behavior and other non-competitive practices among larger firms. The simplest procedure to test the SCP paradigm consists in regressing a measure of the firms' profitability on a proxy for market concentration. A positive coefficient is expected to arise in order to validate this hypothesis as it would imply that higher concentration goes hand in hand with higher market power.

On the other hand, the EH, which stems from Demsetz (1973) and Peltzman (1977), states that efficient firms increase in size and, therefore, in market share due to their ability to generate higher profits, leading to higher market concentration. Under the EH there is no direct relationship between competition and concentration, and a highly concentrated sector is the logical outcome of market forces.

The banking literature has now advanced well past this simple approaches. In reaction to the theoretical and empirical shortcomings attributed to the structural stream, namely the recognition of the need to endogenize market structure, three non-structural models of competitive behavior have been developed within the emerging New Empirical Industrial Organization (NEIO) framework. These models, which measure competition and emphasize the analysis of the competitive conduct of firms without using explicit information about the structure of the market, belong to Iwata (1974), Bresnahan (1982) and Lau (1982), and Panzar and Rosse (1987). These models have an important feature in common, they measure competition by estimating deviation from competitive pricing.

The Iwata model consists in the estimation of conjectural variation values for individual firms supplying an homogeneous product in an oligopolistic market.

1. Interested readers should refer to Bikker (2004).

The Bresnahan-Lau model comes down to the estimation of a simultaneous equation system where a parameter representing the degree of market power of firms is included. Both the Iwata and the Bresnahan-Lau models have scarcely been applied for empirical purposes. For instance, the Iwata measure has only been applied once to banking by Shaffer and DiSalvo (1994). Their main drawback relies on their data-intensiveness.

By contrast, the third approach has received widespread acceptance by the academic community. The Panzar-Rosse model builds a competition indicator, the so-called H-statistic, which provides a quantitative assessment of the competitive nature of a market. The H-statistic is calculated from reduced-form revenue equations and measures the elasticity of total revenues with respect to changes in factor input prices. Panzar and Rosse showed that, under certain assumptions, the comparative static properties of this type of equations provide a proxy for the overall level of competition prevailing in the market.

Last, but not least, other reasons underlying the awakening of competition analyses in banking economics have to do with the safety and soundness of financial systems, as an adequate degree of competition and concentration is supposed to safeguard financial stability. Indeed, it has become a matter of prime interest among central bank regulators and supervisors, who are in need of devices for monitoring the evolution of banking competition.

Despite the great number of investigations devoted to the topic, it should be underlined that evidence is still rather mixed. The bulk of empirical studies report the existence of monopolistic competition for every single country under consideration (including Spain), albeit to varying degrees. In this context, the main purpose of this article is to contribute to the ongoing debate over this issue and to cast some light on the Spanish case by means of the Panzar-Rosse approach.

The current paper draws upon a comprehensive bank-level dataset of Spanish depositary institutions covering an extensive twenty-year-long period (from 1986 to 2005). Two different econometric techniques are performed in order to exploit both the cross-sectional and time-series dimensions of the panel data, and, thus, ensure a robust assessment of the overall level of competition prevailing in the Spanish banking industry. Standard estimates reveal a hump-shaped profile for the H-statistic, within the upper monopolistic competition range. Subsequently, the analysis is sharpened with a weighted procedure which accounts for differences in firm size and the number of branches. A reinforced level of increasing competition is the main finding within this setting.

The remainder of this paper is structured as follows. Section 2 discusses several views on the production process of banking firms in order to set the stage for the theoretical framework of the Panzar-Rosse approach, which is described in Section 3. A brief survey of the literature on this particular methodology is presented in Section 4. Section 5 provides an overview of the dataset. The empirical model employed in the analysis is presented in Section 6. Afterwards, estimation results are reported in Section 7. The final section offers a brief summary and outlines some competition policy implications.

2 A Primer in the Theory of Banks' Activities

Before entering the analysis of the methodology put forward by Panzar and Rosse it is worth devoting a couple of pages to review the different approaches of banks' activities which have been developed within the industrial organization framework. Indeed, several assumptions about banks' production activities have to be made in order to transfer the NEIO approaches from classical industries to banking sectors, since the latter are only to a limited extent comparable to other kind of firms.

Even though several attempts have intended to model the role played by banks as economic and production units of the economy, the lack of agreement concerning the appropriate delineation of output and inputs for banking firms has a long history and still remains as a controversial issue that plagues all bank studies. Briefly, the vast literature carried out in this field may be divided, according to Colwell and Davis (1992), into two separate branches: the production approach (PA) and the intermediation approach (IA). Both approaches apply the classical microeconomic theory of the firm, but differ in the specification of banks' activities.

The PA, set forth by Benston (1965) and Bell and Murphy (1968), posits that banks are devoted to the production of services to depositors and borrowers using labor and physical capital as factor inputs. This approach explicitly recognizes the multiproduct nature of banking firms.

A challenging point of view comes from the IA, as it holds that deposits and loans have different characteristics. While the former are presented as divisible, liquid, short-term and riskless assets, the latter are described as being indivisible, illiquid, long-term and risky. Besides, the total amount of loans granted by a certain bank may not equal the total amount of deposits collected, as it can adjust its surplus or deficit of funds at the interbank market. For these reasons, and in order to highlight the transformation activity carried out by banks, the IA posits that banks produce loans using labor, physical capital and financial capital (deposits plus funds borrowed in the financial markets) as inputs.

Several tests addressing whether deposits are best characterized as outputs or inputs have been posed. For instance, Hancock (1991) provides an interesting study based on the 'user cost methodology'. This author regresses banks' profits on the real balances of banks' balance sheet items[2]. Those balance sheet items exhibiting positive coefficients are asummed to correspond to outputs, whereas variables reporting negative coefficients are associated with inputs. Hancock's inquiry reveals that both loans and deposits deserve the consideration of outputs. Thus, her findings are in line with the production approach.

Nonetheless, Hughes and Mester (1993) developed another test consisting in the estimation of a variable cost function with fixed levels of deposits. They find that the derivatives of this function are negative, which they interpret to mean that deposits are inputs, as an increase in the level of one input, ceteris paribus, ought to be linked to a reduction in the amount of money spent on other inputs. In a more recent study,

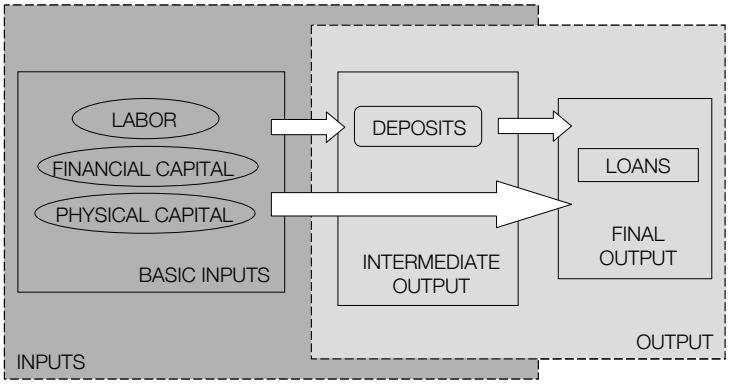
2. It should be noted, as in Freixas and Rochet (1997), that contrary to non-financial firms, whose input and output data are obtained from their profit and loss accounts, the input and output volumes of banks are obtained from their balance sheet statements.

Hughes, Mester and Moon (2001) extend this analysis and draw the conclusion that uninsured and insured deposits alike are to be categorized as inputs[3]. Therefore, their results are consistent with the intermediation approach.

Noteworthingly, a previous study by Sealey and Lindley (1977) offers a reconcilable view of both approaches. These authors, who were among the first to model the technical and economic features of banks' production functions, consider deposits as an intermediate output, supplied by means of several services offered to depositors, and later used in the issuance of loans. Thus, a remarkable feature of banking institutions stems from the fact that a substantial part of their costs relates with the provision of services as partial payment for an input (loanable funds). The cost of 'attracting' this input comprises implicit resource costs, i.e. labor, capital and material inputs involved in this activity.

As a result of the preceeding analysis, the production process of the banking firm is amenable to suit the stylized scheme presented in Figure I. The multistage production process comprehends three basic inputs —labor, financial capital and physical capital— and one intermediate output —deposits— which also exhibits the characteristics of an input as it is deployed to produce the final output —loans—.

Figure I. The multistage production process of the banking firm according to Sealey and Lindley (1977)



It is worth emphasizing that only the 'intermediate' view related above is consistent with both the empirical evidence and the neoclassical theory of the firm underlying the Panzar-Rosse methodology. As the following subsection will review, it was originally designed for quantifying the level of competition in homogenous single-output industries.

3. This view is additionally supported by the rising importance of interbank deposits which certainly do not meet the characteristics of final outputs [Hempell (2002)].

3 Theoretical Framework of The Panzar-Rosse Approach

John C. Panzar and James N. Rosse (P-R hereinafter) developed an empirical test to discriminate between oligopolistic, monopolistically competitive and perfectly competitive markets. Their procedure, which is based on the comparative static properties of reduced-form revenue equations, accomplishes a concise indicator, the so-called H-statistic. Under certain restrictive assumptions, it can be interpreted as a continuous and increasing measure of the overall level of competition prevailing in a particular market.

The methodology put forward by Panzar and Rosse (1987) stems from a general equilibrium market model. It relies heavily on the premise that firms will employ different pricing strategies in response to changes in factor input prices depending on the competitive behavior of market participants. In other words, competition is measured by the extent to which changes in input prices are reflected in firms' equilibrium revenues[4].

Following Bikker and Haaf (2002), let's consider a representative bank *i*. The twofold profit optimization condition applies at the industry and firm levels. At the former level, the zero profit constraint must hold[5]:

$$R_i\left(y_i^*, Z_i^R\right) = C_i\left(y_i^*, W_i, Z_i^C\right) \tag{1}$$

where $R_i(\cdot)$ and $C_i(\cdot)$ refer to the revenue and cost functions of bank *i*, y_i is the output of the firm, W_i is a *K*-dimensional vector of factor input prices of bank *i*, $W_i = \left(w_{1i},...,w_{Ki}\right)$, Z_i^R is a vector of *J* exogenous variables affecting the revenue function $Z_i^R = \left(z_{1i}^R,...,z_{Ji}^R\right)$ and Z_i^C is a vector of *L* exogenous variables that shift the cost function $Z_i^C = \left(z_{1i}^C,...,z_{Li}^C\right)$.

At the individual level, marginal revenues must equal marginal costs:

$$R_i^{'}\left(y_i^*, Z_i^R\right) = C_i^{'}\left(y_i^*, W_i, Z_i^C\right) \tag{2}$$

The measure of competition formulated by P-R, the H-statistic, evaluates the elasticity of total revenues with respect to changes in factor input prices:

$$H = \sum_{k=1}^{K}\left(\frac{\partial R_i^*}{\partial w_{ki}} \cdot \frac{w_{ki}}{R_i^*}\right) \tag{3}$$

4. By the way, Panzar and Rosse developed this methodology in 1977 during the course of an empirical study of the American daily newspaper industry. Ever since, their methodology has been applied to several sectors ranging from banking systems to airline industries.

5. Variables marked with an asterisk represent equilibrium values.

The empirical application of the P-R approach usually assumes log-linearity in the specifications of the marginal revenue and cost functions[6]:

$$Ln\left(R_i^{'}\right)=a_0+a_1Ln\left(y_i\right)+\sum_{j=1}^{J}d_jLn\left(z_{ji}^{R}\right) \tag{4}$$

$$Ln\left(C_i^{'}\right)=c_0+c_1Ln\left(y_i\right)+\sum_{k=1}^{K}b_kLn\left(w_{ki}\right)+\sum_{l=1}^{L}v_jLn\left(z_{li}^{C}\right) \tag{5}$$

For a profit-maximizing bank the equilibrium output results from (2):

$$a_0+a_1Ln\left(y_i^{*}\right)+\sum_{j=1}^{J}d_jLn\left(z_{ji}^{R}\right)=c_0+c_1Ln\left(y_i^{*}\right)+\sum_{k=1}^{K}b_kLn\left(w_{ki}\right)+\sum_{l=1}^{L}v_lLn\left(z_{li}^{C}\right) \tag{6}$$

Rearranging terms:

$$Ln\left(y_i^{*}\right)=\frac{1}{\left(a_1-c_1\right)}\cdot\left(c_0-a_0+\sum_{k=1}^{K}b_kLn\left(w_{ki}\right)+\sum_{l=1}^{L}v_lLn\left(z_{li}^{C}\right)-\sum_{j=1}^{J}d_jLn\left(z_{ji}^{R}\right)\right) \tag{7}$$

The reduced-form equation for revenues of the representative bank is given by the product of the equilibrium output of bank *i* and the common price level:

$$Ln\left(R_i^{*}\right)=Ln\left(p^{*}y_i^{*}\right) \tag{8}$$

The price level is provided by the inverse demand equation, which also reads in logarithms:

$$Ln\left(p\right)=\mu+\lambda Ln(Y) \tag{9}$$

where

$$Y=\sum_{i=1}^{I}y_i \tag{10}$$

is the aggregate output of the industry.

After a bit of algebra, the reduced-form revenue equation is achieved:

$$Ln\left(R_i^{*}\right)=\alpha+\sum_{k=1}^{K}\beta_kLn\left(w_{ki}\right)+\sum_{q=1}^{Q}\delta_qLn\left(z_{qi}\right) \tag{11}$$

where Z_i is a vector of *Q* bank-specific variables, without explicit reference to their origin from the cost or revenue functions[7], $Z_i=\left(z_{1i},...,z_{Qi}\right)$.

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6. *Ln* denotes the natural logarithm. For estimation purposes, the log-specification is intended to avoid heteroskedasticity.

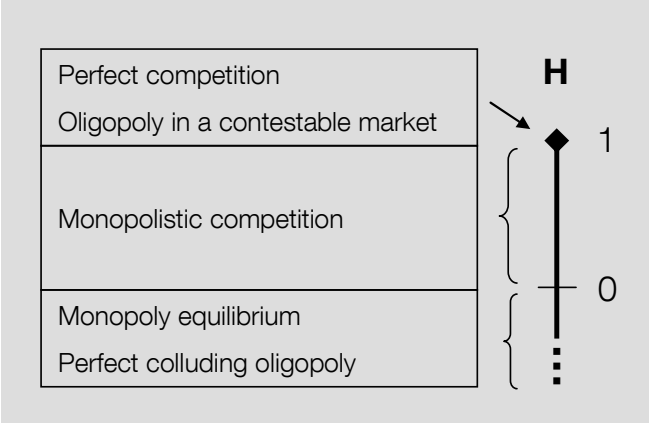
Hence, the H-statistic is calculated as follows:

$$H = \sum_{k=1}^{K} \beta_k \tag{12}$$

The H-statistic abridges in a single figure the overall level of competition prevailing in the market under consideration. According to P-R, the H-statistic ranges from minus infinity to unity (Figure II). A negative H arises when the competitive structure is a monopoly or a perfect colluding oligopoly. In both cases, an increase in input prices will translate into higher marginal costs, a reduction of equilibrium output and, subsequently, a fall in total revenues[8]. If H lies between zero and unity, the market structure is characterized by monopolistic competition. Under perfect competition the H-statistic equals to unity. In this particular situation, a proportional increase in factor input prices induces an equiproportional change in revenues without distorting the optimal output of any individual firm.

Contestable markets would also generate an H-statistic equal to unity. The contestability theory, first stated by Baumol, Panzar and Willig (1982), enables the existence of competition in highly concentrated scenarios[9] under very restrictive circumstances, basically free entry and exit of market participants, i.e. neither economic nor legal entry barriers, completely costless exit, and highly price-elastic demands for industry's output. On account of these features, the threat of potential new market participants forces larger firms to price their output in a competitive manner.

Figure II. Interpretation of the H-statistic



Since P-R is a static approach, a critical feature of the empirical implementation is that the test must be undertaken on observations that are in long-run equilibrium. In previous studies, testing for long-run equilibrium involves the computation of the H-statistic in a reduced-form equation of profitability, using a measure such as ROE or ROA in place of revenues as dependent variable. The resulting H is supposed to be significantly equal to zero in equilibrium, and significantly negative in case of disequilibrium. This empirical test has traditionally been justified on the grounds that competitive markets will equalize

7. In practice, both functions are affected by a common set of variables. It is hard to make a distinction between them.
8. One limitation of the approach that should be noted concerns the increasing relationship between H and competition, which may not hold in certain other oligopoly equilibria. In fact, as De Bandt and Davis (2000) point out, P-R is somehow a joint test of underlying theory and competitive behavior.
9. Conversely, less concentrated environments could engender collusive practices.

risk-adjusted rates of return across firms such that, in equilibrium, rates of return should not be correlated statistically with factor input prices. However, the fact that we observe market entry and exit might question the existence of an overall equilibrium in the market under investigation[10].

Another crucial assumption, on which the previous section elaborates, is that the P-R test only applies for single-output firms. Consequently, banks must be treated as producers of intermediation services by means of factor inputs such as labor, physical capital and financial capital. In other words, the entire scope of activities is needed in order to estimate the level of competition within the sector. However, even if the previous assumption is ignored, the analysis of separate segments of the market is hampered by accounting standards, since data are not detailed enough to estimate the appropriate reduced-form revenue equations. At last, other requirements inherent to the P-R approach relate to the cost structure, which must be homogeneous, and the price elasticity of demand, which must be greater than unity.

Some authors claim that one of the advantages of the P-R model, as well as other non-structural models, is that there is no need to specify a relevant market, since the behavior of individual firms provides an indication of their market power[11]. This rationale could be misleading as the selection of firms included in the sample is implicitly revealing a geographical market. Conventionally, existing studies —and the current analysis is no exception— locate the relevant market within national boundaries[12].

Overall, the P-R model is regarded as a valuable tool for assessing market conditions. Since banks' revenues are more likely to be observable than output prices and quantities or actual costs, data availability becomes much less of a constraint and helps to explain why this model has been more successfully applied than the Iwata or the Bresnahan-Lau models. Indeed, such information is recorded in public accounting statements and readily available through several data sources.

10. The assumption of long-run equilibrium should be considered as the most problematic within this approach. Indeed, a number of authors impose that banks have reached this steady state.

11. The relevant market is theoretically defined by the largest set of suppliers of a particular product or service, including actual and potential competitors [Bikker (2004)].

12. In the Spanish case, it appears to be a sensible assumption due to the widespread establishment of large and medium-sized banks throughout the territory, and the scarce presence of foreign credit institutions [Gutiérrez de Rozas (2006)].

4 Literature Review

This subsection is intended to provide a brief summary of the articles that have applied the P-R methodology to Spain, either in cross-country studies or Spain-only studies (see Table I). As mentioned in the introduction, recent changes in the European banking industry have fueled a large literature on banking competition and concentration.

The first study of European markets[13] is due to Lloyd-Williams, Molyneux and Thornton (1994), who carried out the P-R methodology on a sample of French, German, Italian, Spanish and UK banks for the period 1986-1989. Their results point towards an intermediate level of monopolistic competition in the Spanish case.

A few years later, Bikker and Groeneveld (2000) focused on a sample of European countries between 1989 and 1996. They hardly found evidence of increasing competition during this period. A novelty put forward by these authors is the attachment of different weights to banks included in the sample. These weights are computed as the share of individual banks in the total volume of assets of the banking system. In this case, H-statistics are higher than those resulting from the unweighted model.

In the same vein, Bikker and Haaf (2002) extend the analysis to 23 OECD countries over the period 1988-1998. For every single country, including Spain, results describe a monopolistic competition environment. They posit the distinction between several bank sizes, in order to capture different geographical markets. In particular, large, medium-sized and small banks are supposed to operate in an international, national and regional dimension, respectively. Competition appears to be stronger for large banks and weaker for small banks. These results are fully consistent with those obtained in the contemporary work by De Bandt and Davis (2000).

Both Bikker and Groeneveld (1998) and Bikker and Haaf (2002) account for possible gradual changes in the market structure by introducing a logistic time curve model into the original P-R setting. Once, the competitive behavior of the banking industry is identified, their analyses focus on the relationship between competition and market structure. Their purpose is to check the validity of the SCP paradigm. Results support the conventional view that concentration impairs competition[14].

Another influential study belongs to Claessens and Laeven (2004), who exploit the broadest sample, by far, ever employed in a multi-country analysis of banking competition. They compute the H-statistic for fifty developed and developing countries for the period 1994-2001. According to their results, monopolistic competition is the best description of the markets under consideration. Subsequently, they draw attention on the

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13. It should be outlined that the earliest analyses applying the P-R approach to banking sectors were conducted by Nathan and Neave (1989), who applied it to the Canadian financial system, and Lloyd-Williams, Molyneux and Thornton (1991), who focused on the Japanese case. Northcott (2004) and Staikouras et al. (2006) provide excellent and up-to-date surveys of worldwide studies devoted to this topic.

14. However, most cross-country studies circumvent a key characteristic of several banking industries. When focusing on the relationship between competition and concentration, Herfindahl-Hirschman indexes are calculated on a national basis, even though such geographical scope may not be indicative of the actual level of concentration prevailing in regional or local markets. The German case is frequently used to highlight this feature. Germany exhibits an atomized financial market with highly concentrated local markets (at a *Länder* level) but a scarcely concentrated national market [Deutsche Bundesbank (2005)]. For Spain, there is no evidence of such disparities [Cebrián (1997)].

factors underlying competition by regressing the estimated H-statistics on a number of country-specific characteristics. These refer to the presence of foreign banks, activity restrictions, entry regime, market structure, competition from the non-bank sector, general macroeconomic conditions and overall development of the country. They do not come across a straightforward relationship between competition and concentration, but find that fewer entry and activity restrictions (i.e. higher contestability) result in more competition.

Weill (2004) measures banking competition for a sample of twelve EU countries over the period 1994-1999. Annual Tobit-based estimates of the H-statistic depict a decreasing pattern of monopolistic competition in Spain. In the second stage of the analysis, this author explores the relationship between competition and efficiency. Efficiency scores, estimated using a stochastic frontier approach, are regressed on the H-statistic and a set of explanatory variables including macrofactors, an intermediation ratio and geographical dummies. His results show a negative relationship between competition and efficiency.

An interesting comparison between the Spanish and UK banking systems is conducted by Utrero-González (2004). Elaborating on the work by Bikker and Haaf (2002), the purpose of the analysis is to identify competitive divergences due to the introduction of the euro. Estimation results describe an overall scenario of monopolistic competition, in line with previous studies. The main innovation of the paper is the distinction between commercial banks and non-profit institutions. The former are reported to operate under conditions of quasi-perfect competition, whereas the latter seem to operate in a less competitive environment.

More recently, Casu and Girardone (2006) focus on a sample containing the former EU-15 member countries. They extend the standard specification to account for bank efficiency, calculated by means of a non-parametric DEA (Data Envelopment Analysis) approach. They regress the H-statistic against several structural indicators and estimated efficiency levels. The degree of concentration does not appear to be related to the level of competition.

In an extensive paper, Staikouras et al. (2006) carry out the first multi-country analysis for the EU following enlargement to 25 Member States, covering the 1998-2002 time-span. They find evidence of monopolistic competition with larger banks behaving more competitively than smaller banks, and new members showing higher levels of competition than former members. Complementarily, these authors try an atypical dependent variable in the reduced-form revenue equation, namely organic income, which is defined as interest revenue plus fee and commission income.

The first Spain-only study was undertaken by Maudos and Pérez (2003), who focused on the period 1992-1999. Using a sample of commercial and savings banks, their investigation leads to conclude that competition decreases during the period under consideration (the full-sample estimation of the H-statistic is 0.71). They buttress their findings with the calculation of Lerner indexes, used to proxy the level of market power exerted by banks.

Last of all, Garrido (2004) assesses the degree of competition among Spanish banks between 1994 and 2000 employing a wide variety of econometric techniques. In spite of the instability of least squares estimates for separate years, results are in keeping with monopolistic competition. Furthermore, during the last period under study the level of

competition decreased, confirming conclusions reached by other authors. Following Maudos and Pérez (2003) and Bikker and Haaf (2002), the level of competition is also measured separately for commercial and savings banks, on the one hand, and for large, medium-sized and small banks, on the other.

Summing up, this compilation of articles seems to provide ample evidence supporting the hypothesis that monopolistic competition, albeit to varying degrees, is the prevailing environment among Spanish banks. In fact, monopolistic competition is quite a recurrent finding owing to the wide range of values the H-statistic can take within this scenario (between zero and unity). This context enhances the importance of several methodological issues concerning the empirical implementation of the P-R approach such as, inter alia, data, estimation techniques and sample period under consideration.

Regarding data availability for banking studies, a few caveats are in order. The aforementioned studies display two common features (see Table I). First, they all draw upon samples obtained from commercial databases such as Bankscope (Bureau van Dijk) and Fitch-IBCA Ltd, a London-based rating agency[15]. Since commercial data sources are biased in favor of larger firms, the actual level of competition might be underestimated. Second, these studies concentrate on five to eight year-long samples. Such coverage may turn out to be unsatisfactory to disentangle the fundamentals underlying banks' behavior.

Two remarkable innovations of the current study are the use of a comprehensive data source, and the consideration of a longer period of time. Obviously, the purpose is to provide a reliable background for an accurate implementation of the P-R approach. The next section summarizes the main characteristics of the data employed in the analysis.

15. With the exception of Maudos and Pérez (2003), who build a panel dataset with information gathered from annual reports by AEB *(Asociación Española de Banca)* and CECA *(Confederación Española de Cajas de Ahorros).*

5 Data

The main database employed in this study is the information contained in balance sheets, income statements as well as complementary files, reported by depositary institutions to the Spanish supervisory authority *(Banco de España)* over the period beginning in 1986 and ending in 2005.

In compliance with accounting standards, Spanish banks are compelled to enclose regular information about their activity and business structure. In particular, banks report detailed information concerning the volume and composition of assets held in terms of cash and balances, loans, debt securities, financial instruments, tangible/intangible assets, as well as deposits, debt certificates and other financial instruments on the liabilities side. With respect to the income statement (or profit and loss account), it embodies an appealing number of entries related to interest income and expenses, fees and commissions, gains and losses on financial assets and liabilities, as well as personnel, administrative and other operating expenses. Regarding complementary files, these documents provide valuable information about human resources and structural capacity of banking firms, in terms of staff composition and number of branches, respectively.

Even though, Spanish data are available back in time for several years, due to differing reporting schemes between commercial *('bancos')* and savings banks *('cajas de ahorros')* 1986 was chosen to be the earliest observation date in the analysis[16]. The balance sheets and income statements are reported on a monthly and quarterly basis, respectively. For the sake of comparability, end-of-year aggregate figures from the balance sheet (December) and the income statement (fourth quarter) have been taken so as to transform accounting information into yearly data.

No cooperative banks *('cooperativas de crédito')* are included in the sample due to the lack of relevant data for the purpose of this study. In addition, Spanish cooperative banks represent a small share of the financial market. Branches of foreign banks with limited presence in the country are also excluded, specially in retail banking, to keep the units of analysis as much homogeneous as possible. The total number of banks with usable information starts with 184 in 1986 (of which 112 are commercial banks and 72 savings banks) and ends with 122 in 2005 (76 and 46, respectively). The consolidation process among Spanish banks explains the bulk of variation in the number of firms. Besides, just a handful of firms are recorded to have started or ceased operating during the period under consideration.

It should be stressed that the population of commercial and savings banks considered in the paper represents the vast majority of the banking system (between 84 and 92% of aggregate assets corresponding to the credit institutions sector). Therefore, the sample shall be regarded as fairly representative and comprehensive (Table II). As far as this author is concerned, this is the most exhaustive data sample ever employed in the implementation of the P-R methodology for the Spanish banking industry.

16. Ever since, all variables can be straightforwardly defined.

First adjustments to these data were undertaken in a general consistency check, excluding all observations where banks reported missing values. In a next step, the data were adjusted for outliers. For each factor input price[17], observations lying outside the 1-99th percentile range were deleted from the sample. An additional number of observations were dropped due to reporting errors in some regressing variables. Taken together, these adjustments amount to a reduction of the original raw data by 289 out of 3,232 observations (around 8.9%). Despite the above modifications, the absence of a selecting bias resulting from the partial omission of small depositary institutions, as in commercial databases, is a big advantage this study benefits of.

The dataset has also taken into account mergers and acquisitions (M&A, hereinafter). In contrast with previous studies which circumvent this issue, each transaction is considered to engender an entirely new institution, implying a separate registration in the dataset. The purpose is to avoid structural breaks in the data, otherwise great deviations in the estimation results are expected to arise, as the majority of M&A involved medium-sized and large banks.

Needless to say, the resulting panel is unbalanced since not all banks submitted information throughout the entire time span. The choice for an unbalanced dataset entails the advantage of permitting a greater number of observations to enter the estimations, however, at the cost of including firms which presumably do not behave as they would typically do in market equilibrium, because they are new entrants[18], exiting or merged banks.

Before embarking upon the assessment of the level of competition prevailing in the Spanish banking industry, a brief description of the market structure is in order. Several commonly used indicators of concentration, namely CR1, CR3, CR5, CR10, as well as the Herfindahl-Hirschman index (HHI) and the numbers-equivalent (NE) are reported in Table III. CRn is the percentage market share of the n largest depositary institutions, ranked according to assets, in the sum of the assets of all banks in a particular observation date. The HHI is calculated as the sum of the squares of all depositary institutions' market shares, according to total assets. The NE translates the measure of concentration, as reported by the HHI, into the number of equally-sized firms constituting the same level of concentration.

For illustrative purposes, Figure III depicts the CR5 and the level of market share instability, measured by the instability index (II), over the period under consideration. The instability index was devised by Hymer and Pashigan (1962) and it is formally defined as:

$$II_t = \sum_{i=1}^{N} \left[\left| s_{i,t} - s_{i,t-1} \right| \right] \tag{13}$$

where $s_{i,t}$ is the share of firm i at time t. The larger is the value of II, the more unstable is the industry. Abrupt rises have traditionally been related to the presence of fierce competition, regardless the degree of clustering[19]. According to the five-firm concentration we can distinguish two stages, namely 1986-2000, characterized by a moderate pattern of increasing

17. As the next section will review, three input prices are considered, namely price of labor (PL), price of loanable funds (PLF) and price of capital expenditure (PCE).

18. In particular, new entrants are supposed to behave more agressively (i.e. more competitively) in order to gain market share and fulfil their short-term objectives.

19. Empirically, the index is not very sensitive to the exclusion of small companies. However, it should be recognized that the treatment of M&A may overstate the actual level of instability. Anyway, since this criterium has been maintained throughout the sample, the II should be regarded as a meaningful and consistent measure in relative terms.

consolidation, and 2001-2005, which exhibits a slightly decreasing path. By contrast, attending to the degree of instability up to four different stages can be recorded: 1987-1993 is a phase dominated by sudden changes, which slows down during 1994-1998. A peak of instability is reached between 1999 and 2000[20] whereas a remarkable level of stability is achieved during 2001-2005. Overall, the aforementioned patterns of concentration and varying levels of market instability throughout the twenty-year-long sample period under consideration provide a suitable background for the empirical analysis of banking competition.

20. A couple of M&A deals involving the two largest commercial banks took place in this period.

6 The Empirical Model

Several specifications have been presented in the burgeoning literature devoted to the P-R methodology. For empirical purposes, the following operationalization of equation (11) is used[21]:

$$Ln(NITA_{it}) = \alpha_t + \beta_{1t} Ln(PL_{it}) + \beta_{2t} Ln(PLF_{it}) + \beta_{3t} Ln(PCE_{it}) + \delta_{1t} Ln(EQTA_{it}) + \\ + \delta_{2t} Ln(LOATA_{it}) + \delta_{3t} Ln(LFTA_{it}) + \delta_{4t} Ln(LDTLD_{it}) + u_{it} \quad (14)$$

The dependent variable, NITA, is the ratio of Net Income to Total Assets. The set of explanatory variables embraces three factor input prices, namely PL (Price of Labor), PLF (Price of Loanable Funds) and PCE (Price of Capital Expenditure), as well as four bank-specific variables: EQTA (EQuity to Total Assets), LOATA (LOAns to Total Assets), LFTA (Loanable Funds to Total Assets) and the scale factor LDTLD, which represents the individual market share according to loans and deposits. Finally, u_{it} is the disturbance term.

The H-statistic at time t is given by the following expression:

$$H_t = \beta_{1t} + \beta_{2t} + \beta_{3t} \quad (15)$$

At this stage of the analysis, it is worth elaborating on the choice of the aforementioned set of variables[22], since former studies have employed a wide range of explanatory indicators. Whereas traditional approaches in the literature have used either gross interest or total income as dependent variable, the current exercise draws attention on net total income alone. This concept comprises interest income, net brokerage fees and commissions and net gains on financial assets and liabilities. The decision to consider total revenue, rather than only interest revenue, relies mainly on the fact that non-interest income has increased dramatically in recent years. This choice is supported, among others by Casu and Girardone (2006), who argue that in a more competitive environment, the distinction between interest and non-interest income becomes less relevant, as banks struggle for profits in both fronts[23]. By the same token, the existence of accounting differences across years[24] is an additional argument in favor of a broader view of bank revenues [Staikouras et al. (2006)].

A number of authors employ unscaled revenues. The main drawback of this procedure is the strong correlation (close to unity) between the dependent variable and the scale factor, which would deliver non-significant coefficients for other explanatory variables. In order to abstract from size effects and, thus, avoid distorted estimations, the dependent variable is expressed as a ratio to total assets.

On the other hand, there seems to be common agreement on the inputs used by banking firms, namely labor, loanable funds (comprising demand deposits and term deposits)

21. Subscripts *i* and *t* refer to bank *i* and year *t*.

22. Annex I contains a detailed description of each variable.

23. De Bandt and Davis (2000), using OECD data, estimated that non-interest income accounted for 20 to 40% of total net income for a selected group of European banks between 1992 and 1996. These figures resulted from both an increasing trend of the non-interest income –which stems from the reinforcement of non-core business areas such as asset management, mutual funds and insurance– and the reduction of interest income.

24. For instance, three major changes in financial reporting standards happened in Spain during the time span under consideration, namely in 1986, 1992 and 2005.

and physical capital (fixed capital plus materials), which is in line with the production process held by Sealey and Lindley (1977). A separate price is assigned to each.

Factor input prices are commonly proxied by ratios of expenses to respective volumes. Concerning the price of labor, existing studies tend to use personnel expenses divided by total assets, due to the scarce availability of employment data in commercial databases. By contrast, in this study, PL is measured by the ratio of personnel expenses to total number of employees. It should be highlighted that the latter definition aims to provide a cleaner and more accurate measure of unit labor costs[25].

The price of loanable funds, PLF, is obtained by dividing the sum of interest expenses by the amount of loanable funds (which comprise deposits, tradable securities and subordinated instruments) outstanding at the end of each year. This formulation provides a broader measure of funding costs, in contrast with previous studies which usually restrict to the interest paid per deposit unit. On the other hand, the price or unit cost of physical capital (PCE) is conventionally calculated as the ratio of capital expenses (i.e. operating expenses, taxes and amortization) to the stock of fixed assets.

Overall, the dependent variable and these three factor input prices show a strong variability. Figure IV(a) displays a dispersion graph corresponding to NITA which is characterized by a decreasing cyclical pattern. PL experiments a steady growth rate with increasing volatility, which may reflect changes in the staff composition[26] —Figure IV(b)—. Noticeably, PLF shows a similar profile to NITA. In contrast with PL, the dispersion of PLF (measured by the distance between the first and the third quartile) has experienced a progressive reduction —Figure IV(c)—. Conversely, the price of capital expenditure —Figure IV(d)— shows, in the last few observation dates, a particularly striking spread.

Input prices are followed by a set of bank-specific factors which, basically, are intended to catch differences in risk, business mix and size. Specifically, these control variables account for risk propensity (captured by EQTA), variations in the relative weight of the loan portfolio (which are mirrored in LOATA) and importance of deposits in the balance sheet (LFTA). LDTLD is included to consider the possible impact of scale economies. Last, TASS (Total ASSets) and BRANCH (number of BRANCHes), are other variables designed to control for the firm size[27].

Summary statistics of the aforementioned variables are presented in Table IV. Regarding the set of bank-specific variables, mean values for LFTA remain fairly stable throughout the sample period (around 87%), whereas LDTLD experiments a continuous growth, ranging from 0.6 to 1%. Remarkably, average figures for EQTA and LOATA are quite similar to those reported by Staikouras et al. (2006). However, it should be highlighted that the mean volumes of total assets (TASS) are somewhat lower, which seemingly reveals that their sample is biased towards larger banks. On average terms, the number of branches increases dramatically during the time span under consideration.

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25. The former is actually a relative weight of personnel expenses in the balance sheet.

26. Since the entire spectrum of employees is comprised in the computation of the labor price, rises in PL could spring from a higher proportion of highly qualified workers.

27. As the next section will review, TASS and BRANCH are only used in the weighted version of the model.

Finally, Table V contains the correlation matrix of all the variables involved in the empirical analysis. As expected, the dependent variable exhibits a weak correlation with the scale variables. Noticeably, low values are reported for PL and PCE in the first column (NITA). These figures suggest the finding of close-to-zero and non-significant elasticities in the next step of the analysis, which is devoted to the estimation of the econometric model presented above.

7 Estimation Results

The reduced-form revenue function stated in equation (14) is linear in its unknown parameters and, therefore, amenable to estimation by standard methods. In order to exploit both the cross-sectional and the time-series dimensions of the panel dataset, two different least squares regression procedures have been performed. In particular, subsample and full-sample estimates for the period 1986-2005 have been obtained by means of pooled generalized least squares (PGLS) and pooled weighted least squares (PWLS).

Ordinary least squares is the simplest and most common estimation procedure employed in the P-R literature. However, in order to offset the potential existence of heteroskedasticity in the data, generalized least squares was considered a more appropriate method to start with[28]. As in many other studies, the current dataset is not large enough to attain robust annual estimates for the eight parameters in the model. Accordingly, the sample period is divided in four lustrums: 1986-1990, 1991-1995, 1996-2000 and 2001-2005.

Table VI displays PGLS regression results. The dependent variable, NITA, appears to be positevely related to the price of loanable funds (PLF). By contrast, the price of labor (PL) and the price of capital expenditure (PCE) are negatively associated with the net income variable, albeit to to a very limited extent. Regarding the coefficients of the remaining explanatory variables, a negative sign for EQTA was expected to arise because lower capital ratios are supposed to lead to higher bank revenues. However, estimation results show positive values for this variable. Presumably, an explanatory hypothesis may state that reinforced capital buffers encourage risk-taking. Hence, banks could be improving their earning capacity through riskier loan portfolios. The reported positive coefficients for LOATA seem plausible because more loans reflect more potential income. Last, evidence for LFTA and the scale variable LDTLD is blurred by their non-significance.

Figure V(a) plots the H-statistics corresponding to the PGLS estimation outcome. The first stage exhibits the lowest level (0.55), but rises substantially during the second stage (0.70) and reaches it maximum during the third phase (0.79). Noteworthingly, the H-statistic falls to an intermediate position (0.55) during the last stage. This result is concurrent with the decline in the degree of concentration of the industry —Figure III—. In accordance with these results, monopolistic competition (MC) is the proper assessment for the Spanish banking market, since both the null hypotheses of H equal to zero (oligopoly) and H equal to one (perfect competition) are rejected, at the 90% confidence level, in each of the four subsamples under consideration. The full-period estimate of the H-statistic stands at 0.78.

Several striking features of the estimation outcome should be highlighted. First, the marked rise of the H-statistic between the first and second subsample periods is likely to be explained by a handful of contemporary policy initiatives which, both at the European and national levels, aimed to create a unified market for banking services. In particular, at the

28. By the way, several tests have previously been performed cross-sectionally in order to check out the validity of the long-run equilibrium assumption. The dependent variable in equation (14) was ordinarily replaced by a proxy for the return on equity (ROE), which was specifically designed for this purpose. For every single year, but two, the null hypothesis cannot be rejected at the 95% confidence level. These equilibrium test results are available upon request to the author.

national level, legal restrictions on the geographical scope of savings banks were removed in 1989. This development triggered the consolidation and outward expansion processes among savings banks[29], enhancing the level of integration of the Spanish banking market[30]. Besides, at the European level, remaining constraints on the number of branches of foreign banks in member countries were abrogated as a result of the Second Banking Co-ordination Directive[31] (enacted in 1992).

Second, among the constituent parts of the H-statistic only the price of loanable funds contributes significantly to the explanation of the net income of banks. By contrast, both the price of labor and the price of capital expenditure provide a deceiving outcome due to their scarce correlation with the dependent variable.

Third, the dispersion of the price of loanable funds fell during the last years of the sample —Figure IV(c)—. This fall is even more dramatic if we attend to the distance between 1-99th percentiles[32]. The fact that this reduction is not entirely mirrored in the volatility of the dependent variable —Figure IV(a)— is responsible for shrinking the elasticity of this input and, hence, the value of the H-statistic corresponding to the fourth stage[33].

Last but not least, the overall level of competition during the nineties is, in comparison with former studies, relatively high and stable. Table IX gathers P-R results for the Spanish banking industry (ES), as well as for Germany (DE), France (FR), Italy (IT), United Kingdom (UK) and the United States (US). In most cases, an intermediate level of monopolistic competition, with H-statistics varying from 0.3 to 0.6, is recorded for Spain. Remarkably, Germany does also exhibit a similar range of values, whereas the US appears to have slightly less competitive banks. Without exception, the PGLS estimates obtained in this study stand well above the figures reported in the literature.

A number of authors discriminate between small, medium-sized and large banks[34]. However, such distinction is not made in this analysis since, basically, all banks are presumed to offer an homogeneous variety of financial products. An alternative approach, set forth by Bikker and Groeneveld (2000), consists in estimating a model where banks are weighted according to their size in terms of total assets. This approach is intuitively justified by the fact that larger firms may be able to influence the pricing strategy of smaller market participants[35]. Likewise, it seems sensible that in order to obtain a more representative and realistic picture of the actual level of competition, those banks with a larger number of customers

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29. Up to that date, savings banks were confined to the regional markets they belonged to.

30. Accordingly, the distinction between commercial and savings banks, which other authors posit, becomes presumably irrelevant. Nevertheless, the main feature that remains to distinguish savings banks from other type of financial institutions is their organizational form. Savings banks, which typically began as mutual funds, operate with a significant level of state involvement. Despite being a challenging issue, whether its particular governance regime can affect or not their competitive behavior is hardly analyzable under the P-R approach and is well beyond the scope of this paper.

31. Salas-Fumás and Saurina (2003) and Fernández de Guevara, Maudos and Pérez (2005) provide concise overviews of the liberalization-oriented policy measures which came into force during this period at the national and European levels, respectively.

32. For the sake of presentation, Figure IV only depicts the first and third quartile range. Otherwise, the strong upward biases these variables show would seriously distort the graphs.

33. This convergence in the price of loanable funds brings up an insight due to Shaffer (2004) which states that if price-taking firms buy homogeneous inputs in a common set of markets, the data will lack any variation on account of the so-called 'absolute version of the law of one price'. Ultimately, no regressions can be run on such a sample.

34. For instance, Bikker and Haaf (2002) split up their worldwide sample according to the following criterium: the smallest 50% firms constitute the small-bank sample, the largest 10% form the large-bank sample, and the remainder 40% make up the medium-sized sample.

35. A detailed analysis of the price setting behavior of Spanish banks is provided in Martín-Oliver, Salas-Fumás and Saurina (2007).

(proxied by the total amount of assets) and an extensive nationwide presence (gauged by the number of branches) ought to have a greater impact on the estimation outcome[36].

Tables VII and VIII collect PWLS regression results. Employing TASS and BRANCH as weighting variables, this estimation procedure[37] turns out to improve the significance of the explanatory variables (p-values are surpassingly lower). Besides, the elasticity of PLF and, therefore, the H-statistic are somewhat higher than in the standard model. The evolution of the H-statistic describes a different pattern from the unweighted setup. The H-statistic does now evidence a remarkable staggered increase —Figures V(b) and V(c)—.

The entire time span PWLS estimates (0.95 and 1.00) may induce to think of the existence of a more competitive environment among larger banks. This conjecture is in keeping with Bikker and Groeneveld (2000), who point out that larger banks are relatively more active in international wholesale markets, where competition is regarded to be more fierce. By contrast, retail and corporate finance markets, where small and medium-sized banks operate, are assumed to be less competitive.

An alternative explanation would consider instead that large banks are closer to long-run equilibrium than smaller banks, which presumably embrace new arrivees [Shaffer (2004)]. If that is the case, a greater value of the H-statistic does not reliably imply that the former behave more competitively. However, since the long-run equilibrium condition has been successfully verified for the entire sample of banks, this criticism does not apply. Moreover, this encouraging finding, which deserves to be regarded as the foremost contribution of the analysis, discredits the widespread hypothesis which states that large banks are prone to perform non-competitively, as it would have led to a lower value of the P-R indicator.

36. Besides, weighting can also be justified on econometric grounds. From an 'asymptotic point of view', large banks are expected to behave more 'normal' than smaller ones. Bikker and Groeneveld (2000) corroborate this argument with the empirical finding of smaller disturbance terms for larger firms. Thus, weighted estimation appears to be more efficient.

37. PWLS estimates have been computed by means of Stata's *iweight* (importance weight) option, which enables to weight the set of observations according to any variable specifically designed for this purpose. In the current analysis two scale factors –TASS and BRANCH– are used separately to carry out PWLS results. A shortcoming which goes hand in hand with this procedure is related with the possible existence of heteroskedasticity in the data. Obviously, with weighting procedures –and this one is no exception– there is no chance of using White's variance and covariance matrix. However, the log-specification of equation (14) is intended to undermine this circumstance.

8 Concluding Remarks

Banks play a prominent role in the allocation of economic resources. Furthermore, they exert a fundamental influence on asset transformation, provision of liquidity insurance, access to payment services, and thereby, are a key to economic growth and development. In this context, the need for reliable analytical instruments devoted to the measurement of the level of competition prevailing in banking markets appears to be broadly justified.

Nevertheless, the interest of researchers in this issue was not elicited until the recent trend towards consolidation in the European banking industry. Ever since, the analysis of competition has turned into a burgeoning field in banking economics. Despite the great number of investigations which have focused on the Spanish case, mainly in multi-country studies, evidence on the actual level of competition is rather mixed and still subject to debate.

In order to shed light on this topic, the current study attempts to carry out an exhaustive analysis of the Spanish banking industry. In particular, it extends previous studies to several respects. First, a substantially longer period of time, covering two decades (1986-2005), is under consideration. Second, a comprehensive panel dataset of commercial and savings banks has been constructed using the information these institutions report to the Spanish supervisory authority *(Banco de España).*

The empirical analysis is grounded on a widespread non-structural approach due to Panzar and Rosse (1987). Overall, the estimation outcome leads to conclude that the prevailing level of competition is quite higher than reported in the literature, and in the particular case of large banks it is really close to perfect competition. Second, there is no apparent relationship between competition and market structure —in terms of concentration and instability—.

The robustness of the results presented herein is challenged by a recent paper due to Fernández de Guevara and Maudos (2006). These authors analyze the role of size, efficiency, specialization and concentration, among other factors, in the explanation of market power. Using as laboratory the Spanish banking system in a fairly similar sample period (1986-2002), they estimate Lerner indexes to proxy the degree of market power. The two major results of this piece of work have to do with an increasing pattern of market power starting in the mid-1990s and the lack of significance of the level of concentration in the explanation of this trend. Whether the former finding can be reconciled or not with the evolution of competition described in the current analysis is quite a complex issue. Nevertheless, it deserves a brief comment on an intuitive difference between the terms 'competition' and 'market power', since they are often used interchangeably. Market power is, basically, an individual phenomenon which results from the behavioral pricing strategy of a particular firm. By contrast, competition should be regarded as a collective phenomenon stemming from the aggregate interaction of the set of market participants. Therefore, the empirical relationship between them is not as straightforward as it may seem at first glance[38].

38. Indeed, the Lerner index is an indicator of market power, not competition. It is based on prices and marginal costs, and provides a separate figure for each of the firms in the industry. Conversely, the H-statistic is just an indicator of competition, not market power. Based on the price elasticities of factor input prices in a reduced-form revenue equation, it provides a single figure for the whole industry.

Noteworthingly, the lack of significance of market concentration is concurrent with the results achieved in this article. In a sense, as Claessens and Laeven (2004) claim, this finding is consistent with the contestability theory. If carefully explored, the validity of the contestability theory may deliver far-reaching policy implications. Up to date, worldwide competition authorities draw upon merger guidelines based on indirect yardsticks such as the Herfindahl-Hirschman index. These heuristic procedures are in keeping with out of fashion structural approaches, within the classical IO theory, which posit that concentration impairs competition. The fact that concentration ratios may not provide an appropriate criterium to evaluate the actual impact of a certain deal, should be a matter of great concern[39].

Moreover, competition policies should be subject to deep revision. A step in the right direction would involve the use of NEIO indicators such as the H-statistic reviewed in this article, which stands out for several advantages regarding data availability, the simplicity of the estimation procedure and its clear interpretation. An additional argument which backs up the P-R methodology as a valuable tool for competition monitoring relies on its flexibility to account for characteristics specific to each sector. To date, few studies have outlined this issue.

Finally, it is worth highlighting that the financial sector is only comparable to a limited extent to other type of industries. As a matter of fact, there are conflicting views on the desirable degree of competition in banking[40]. From a theoretical perspective, intense competition is assumed to lower intermediation expenses and contribute to the improvement of efficiency, at the cost of shortening the average duration of lending relationships and eroding banks' profitability. Therefore, both the solvency and the ability of financial institutions to withstand liquidity shocks could be seriously undermined. Remarkably, this trade-off context enhances the role played by banking regulators, inasmuch as certain prudential tools may turn out to provide a necessary buffer against adverse developments.

In order to sharpen our understanding of financial stability, forthcoming research efforts ought to direct attention towards the common fundamentals underlying competition and market structure in banking industries. At present, there is a deal of work that needs to be done.

39. In fact, perfect competition could emerge in highly concentrated scenarios, and vice versa.

40. For a detailed discussion on the optimal level of competition in the banking sector, see Cetorelli (2001) and Vives (2001).

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APPENDIX

Annex I. Definition of Variables

1. Dependent Variable

- NITA: Ratio of Net Income to Total Assets (%).

Net Income = Interest and Similar Income + Variable portfolio Income + Fee and Commission Income + Gains on Financial Assets and liabilities - Brokerage Fee and Commission Expenses - Losses on Financial Assets and Liabilities.

2. Explanatory Variables

2.1 Factor Input Prices

- PL: Price of Labor (Ratio of Personnel Expenses to Staff Number) (thousands of Euros/employee).

- PLF: Price of Loanable Funds (Ratio of Interest Expenses to Loanable Funds) (%).

  Interest Expenses (IE) = IE from *Banco de España* + IE from Credit Institutions + IE from the Spanish General Government + IE from Other Resident Sectors + IE from Non-resident Creditors + IE from Loans and Other Tradable Securities.

  Loanable Funds (LF) = Deposits from *Banco de España* + Deposits from Credit Institutions + Deposits from the Spanish General Government + Deposits from Other Resident Sectors + Deposits from Other Non-resident Creditors + Loans and Other Tradables Securities + Subordinated Instruments.

- PCE: Price of Capital Expenditure (Ratio of Capital Expenditure to Fixed Assets) (%).

  Capital Expenditure = Operating Expenses + Contributions and Taxes + Fixed Assets Amortization and Provisions.

2.2 Bank Specific Variables

2.2.1 RISK VARIABLE

- EQAS: Ratio of Equity to Total Assets (%).

  Equity = - Issued Capital - Unregularized Loss + Special Funds + Capital or Endowment Fund + Reserves + Net Profit (Loss).

2.2.2 BUSINESS-MIX VARIABLES

- LOATA: Ratio of Loans to Other Resident Sectors to Total Assets (%).

- LFTA: Ratio of Loanable Funds to Total Assets (%).

2.2.3 SCALE VARIABLES

- LDTLD: Individual Volume of Loans and Deposits to Aggregate Volume of Loans and Deposits (to Other Resident Sectors) (%).

- TASS: Total Assets (hundreds of millions of Euros).
- BRANCH: Number of branches.

Table I. Available Panzar-Rosse Studies for the Spanish Banking Industry

Authors	Countries considered	No. of Spanish banks	Period	Source
Cross-country studies including Spain				
Molyneux et al. (1994)	DE, ES, FR, IT, UK	116	1986-1989	IBCA
Bikker and Groeneveld (2000)	15 EU countries	80	1989-1996	Fitch-IBCA
Bikker and Haaf (2002)	23 OECD countries	154	1990-1998	Fitch-IBCA
Weill (2004)	12 EU countries	152	1994-1999	Bankscope
Claessens and Laeven (2004)	50 countries	157	1994-2001	Bankscope
Utrero-González (2004)	ES, UK	204	1996-2002	Bankscope
Casu and Girardone (2006)	15 EU countries	100	1997-2003	Bankscope
Staikouras et al. (2006)	DE, ES, FR, IT, UK	108	1998-2002	Bankscope, Fitch-IBCA
Spain-only studies				
Maudos and Pérez (2003)	ES	155	1992-1999	AEB, CECA
Garrido (2004)	ES	117	1994-2000	Bankscope

Table II. Number of Banks in the Sample

Year	No. of banks	No. of observations per bank type		Comprehensiveness*
		Commercial banks	Savings banks	
1986	184	112	72	84.0
1987	186	114	72	84.9
1988	191	115	76	87.6
1989	191	116	75	88.2
1990	186	121	65	81.5
1991	178	123	55	85.3
1992	177	124	53	81.9
1993	176	125	51	86.1
1994	174	123	51	91.1
1995	172	122	50	90.7
1996	169	119	50	90.8
1997	166	116	50	91.5
1998	157	107	50	93.8
1999	149	100	49	93.1
2000	137	90	47	92.9
2001	136	90	46	92.3
2002	132	86	46	92.2
2003	126	80	46	92.3
2004	123	77	46	92.3
2005	122	76	46	92.4
1986-2005	3,232	2,136	1,096	90.6

Note: Comprehensiveness refers to the percentage of assets corresponding to Spanish depositary institutions which is accounted for by the banks included in the sample.

Table III. Market Structure Indicators based on Banks' Total Assets

Year	CR1	CR3	CR5	CR10	HHI	NE	II
1986	7.5	21.3	33.5	48.5	310	32	-
1987	7.6	20.8	32.4	47.7	298	34	8.0
1988	10.8	23.7	33.2	48.0	327	31	45.3
1989	10.1	22.5	33.0	46.9	312	32	9.3
1990	10.4	25.8	35.7	47.6	344	29	38.3
1991	9.7	24.6	36.0	51.4	359	28	36.5
1992	10.1	25.4	37.2	49.8	365	27	21.1
1993	11.8	29.0	41.4	53.5	434	23	34.9
1994	9.9	26.4	38.7	54.2	398	25	17.7
1995	9.5	25.8	38.5	54.4	393	25	10.5
1996	10.3	27.5	39.5	54.5	412	24	9.7
1997	10.8	28.3	39.8	54.6	420	24	9.4
1998	10.6	27.7	41.9	57.5	446	22	18.5
1999	16.7	35.9	48.2	60.4	608	16	42.6
2000	19.0	43.1	53.8	63.9	801	12	48.7
2001	17.5	41.1	51.4	62.2	733	14	7.7
2002	16.2	39.7	50.1	61.4	676	15	9.7
2003	15.6	39.1	49.4	61.9	661	15	7.2
2004	15.3	37.4	47.8	62.4	624	16	8.5
2005	15.1	36.5	47.1	62.8	607	16	7.4

Note: CRn, HHI, NE and II stand for Concentration Ratio of the n largest firms, Herfindahl-Hirschman Index, Numbers-Equivalent and Instability Index, respectively. CRn is the percentage market share of the n largest banks, ranked according total assets, in the sum of the assets of all banks in each observation date. HHI is the sum of the squares of all banks' percentage market shares, according to total assets, and ranges from 0 to 10,000. The NE is the number of equally-sized firms constituting the same level of concentration as reported by the HHI. The II measures the aggregate difference in the banks' percentage market shares between two consecutive years.

Table IV. Descriptive Statistics

Mean	NITA	PL	PLF	PCE	EQTA	LOATA	LFTA	LDTLD	TASS	BRANCH
1986	10.5	25.4	7.1	55.4	7.8	36.2	88.0	0.58	12.9	143.6
1987	10.9	27.2	7.4	70.9	8.5	38.3	87.3	0.57	13.6	139.7
1988	10.6	33.1	6.9	74.8	9.6	41.2	86.4	0.55	16.3	156.3
1989	10.8	34.2	7.6	86.5	10.1	39.9	86.0	0.55	19.3	164.0
1990	11.6	35.0	8.7	96.1	10.6	38.6	85.2	0.56	20.5	156.6
1991	11.8	36.5	8.7	91.9	11.0	40.5	85.2	0.59	25.2	169.2
1992	11.3	38.3	8.3	111.1	10.4	40.3	86.2	0.59	27.4	169.4
1993	11.4	41.7	8.2	118.4	10.0	37.0	86.9	0.62	35.8	179.2
1994	9.0	42.7	6.1	121.9	10.2	36.6	86.8	0.61	38.5	192.2
1995	9.6	45.9	6.9	125.1	9.8	37.8	86.9	0.60	40.2	197.4
1996	9.0	48.7	6.2	118.8	9.5	37.7	87.2	0.64	46.6	210.8
1997	7.7	50.5	4.6	141.8	9.8	40.4	87.4	0.64	50.2	216.8
1998	6.5	51.5	3.6	132.8	9.4	44.9	87.4	0.70	60.1	244.9
1999	5.5	54.5	2.5	125.5	9.1	49.7	87.2	0.74	69.1	260.5
2000	5.9	54.2	3.3	158.9	9.9	51.7	86.0	0.78	81.2	273.3
2001	6.2	55.7	3.6	167.9	10.2	53.5	86.1	0.81	90.7	280.3
2002	5.4	58.6	2.7	196.0	9.9	56.0	86.5	0.84	98.9	287.7
2003	4.9	60.9	2.0	242.7	9.6	59.1	86.9	0.91	122.0	317.0
2004	4.5	63.0	1.8	206.4	9.7	61.1	87.1	0.97	143.9	348.7
2005	4.3	63.9	1.9	244.0	6.3	66.8	90.1	1.00	183.6	371.5

Note: NITA: Net Income to Total Assets; PL: Price of Labor; PLF: Price of Loanable Funds; PCE: Price of Capital Expenditure; EQTA: Equity to Total Assets; LOATA: Loans to Total Assets; LFTA: Loanable Funds to Total Assets; LDTLD: Loans and Deposits To aggregate Loans and Deposits; TASS: Total ASSets; BRANCH: Number of Branches.

Table V. Correlation Matrix

1986-2005	NITA	PL	PLF	PCE	EQTA	LOATA	LFTA	LDTLD	TASS	BRANCH
NITA	1.00									
PL	-0.37	1.00								
PLF	0.80	-0.20	1.00							
PCE	-0.12	0.45	0.00	1.00						
EQTA	0.16	0.00	0.08	-0.09	1.00					
LOATA	-0.18	-0.06	-0.33	-0.13	-0.05	1.00				
LFTA	-0.17	-0.10	-0.12	0.01	-0.87	0.15	1.00			
LDTLD	-0.10	-0.02	-0.13	-0.16	-0.03	0.03	0.01	1.00		
TASS	-0.19	0.10	-0.17	-0.08	-0.04	0.03	0.00	0.83	1.00	
BRANCH	-0.13	-0.03	-0.18	-0.18	-0.04	0.07	0.02	0.95	0.81	1.00

Note: NITA: Net Income to Total Assets; PL: Price of Labor; PLF: Price of Loanable Funds; PCE: Price of Capital Expenditure; EQTA: Equity to Total Assets; LOATA: Loans to Total Assets; LFTA: Loanable Funds to Total Assets; LDTLD: Loans and Deposits To aggregate Loans and Deposits; TASS: Total Assets; BRANCH: Number of Branches.

Table VI. Pooled Generalized Least Squares (PGLS) Estimation Results

Dependent variable: Ln(NITA)

coefficient p-value		1986-1990	1991-1995	1996-2000	2001-2005	1986-2005
Ln(PL)		**-0.001**	**-0.015**	**-0.010**	**-0.009**	**-0.016**
		0.582	0.000	0.003	0.002	0.000
Ln(PLF)		**0.555**	**0.717**	**0.796**	**0.555**	**0.795**
		0.000	0.000	0.000	0.000	0.000
Ln(PCE)		**-0.006**	**-0.002**	**-0.002**	**0.002**	**-0.002**
		0.000	0.073	0.444	0.102	0.003
Ln(EQTA)		**0.146**	**0.006**	**0.088**	**0.090**	**0.060**
		0.001	0.905	0.080	0.002	0.014
Ln(LOATA)		**0.041**	**0.045**	**0.024**	**0.006**	**0.017**
		0.000	0.000	0.001	0.400	0.000
Ln(LFTA)		**0.168**	**-0.041**	**-0.009**	**0.046**	**0.009**
		0.012	0.592	0.908	0.245	0.831
Ln(LDTLD)		**0.058**	**0.021**	**-0.014**	**-0.040**	**-0.009**
		0.008	0.361	0.523	0.029	0.448
cons		**-0.061**	**0.116**	**0.064**	**0.034**	**0.083**
		0.166	0.032	0.268	0.214	0.002
No. of obs.		853	824	718	548	2943
R-squared		0.57	0.57	0.44	0.32	0.73
H-statistic		**0.548**^{MC}	**0.700**^{MC}	**0.786**^{MC}	**0.546**^{MC}	**0.777**^{MC}
H_0: H=0	F-stat	448.45	533.99	223.88	28.14	2924.13
	p-value	0.000	0.000	0.000	0.000	0.000
H_0: H=1	F-stat	306.30	98.46	16.91	19.12	241.05
	p-value	0.000	0.000	0.000	0.000	0.000

Note: Superscript MC (Monopolistic Competition) indicates that H=0 and H=1 are rejected at the 5% significance level.

Table VII. Pooled Weighted Least Squares (PWLS) Estimation Results

Dependent variable: Ln(NITA)
Weighting variable: TASS

coefficient p-value		1986-1990	1991-1995	1996-2000	2001-2005	1986-2005
Ln(PL)		**0.000**	**-0.013**	**-0.016**	**-0.010**	**-0.018**
		0.120	0.000	0.000	0.000	0.000
Ln(PLF)		**0.528**	**0.800**	**0.977**	**1.040**	**0.968**
		0.000	0.000	0.000	0.000	0.000
Ln(PCE)		**-0.002**	**0.004**	**0.001**	**0.003**	**0.002**
		0.000	0.000	0.001	0.000	0.000
Ln(EQTA)		**0.201**	**0.101**	**0.113**	**0.064**	**0.110**
		0.000	0.000	0.000	0.000	0.000
Ln(LOATA)		**0.051**	**0.040**	**0.033**	**0.025**	**0.018**
		0.000	0.000	0.000	0.000	0.000
Ln(LFTA)		**0.178**	**-0.006**	**0.042**	**-0.006**	**0.041**
		0.000	0.348	0.000	0.001	0.000
Ln(LDTLD)		**0.005**	**0.008**	**-0.041**	**-0.024**	**-0.023**
		0.032	0.000	0.000	0.000	0.000
cons		**-0.076**	**0.073**	**0.042**	**0.048**	**0.056**
		0.000	0.000	0.000	0.000	0.000
No. of obs.		14122	27437	43413	68424	153397
R-squared		0.56	0.67	0.62	0.57	0.88
H-statistic		**0.526**[MC]	**0.790**[MC]	**0.962**[MC]	**1.034**[MC]	**0.952**[MC]
H_0: H=0	F-stat	14305.73	31798.97	54399.76	55024.11	350000
	p-value	0.000	0.000	0.000	0.000	0.000
H_0: H=1	F-stat	11683.48	2238.56	83.45	58.85	869.7
	p-value	0.000	0.000	0.000	0.000	0.000

Note: Superscript MC (Monopolistic Competition) indicates that H=0 and H=1 are rejected at the 5% significance level.

Table VIII. Pooled Weighted Least Squares (PWLS) Estimation Results

Dependent variable: Ln(NITA)
Weighting variable: BRANCH

coefficient p-value		1986-1990	1991-1995	1996-2000	2001-2005	1986-2005
Ln(PL)		**-0.001**	**-0.010**	**-0.018**	**-0.022**	**-0.018**
		0.000	0.000	0.000	0.000	0.000
Ln(PLF)		**0.545**	**0.807**	**1.014**	**1.053**	**1.013**
		0.000	0.000	0.000	0.000	0.000
Ln(PCE)		**0.008**	**0.016**	**0.002**	**0.010**	**0.005**
		0.000	0.000	0.000	0.000	0.000
Ln(EQTA)		**0.260**	**0.225**	**0.216**	**0.059**	**0.213**
		0.000	0.000	0.000	0.000	0.000
Ln(LOATA)		**0.054**	**0.062**	**0.042**	**0.028**	**0.024**
		0.000	0.000	0.000	0.000	0.000
Ln(LFTA)		**0.244**	**0.170**	**0.175**	**-0.008**	**0.157**
		0.000	0.000	0.000	0.000	0.000
Ln(LDTLD)		**-0.019**	**0.019**	**0.000**	**0.006**	**-0.017**
		0.000	0.000	0.551	0.000	0.000
cons		**-0.125**	**-0.072**	**-0.046**	**0.093**	**-0.031**
		0.000	0.000	0.000	0.000	0.000
No. of obs.		129787	149206	171882	174190	625065
R-squared		0.59	0.76	0.82	0.72	0.92
H-statistic		**0.552**^{MC}	**0.812**^{MC}	**0.998**^{PC}	**1.042**^{MC}	**1.001**^{PC}
H_0: H=0	F-stat	120000	220000	500000	200000	2000000
	p-value	0.000	0.000	0.000	0.000	0.000
H_0: H=1	F-stat	77035.18	11797.27	3.03	322.37	1.77
	p-value	0.000	0.000	0.082	0.000	0.183

Note: Superscript MC (Monopolistic Competition) indicates that H=0 and H=1 are rejected at the 5% significance level. Superscript PC (Perfect Competition) indicates that H=0 is rejected but H=1 is not rejected at the 5% significance level.

Table IX. Panzar-Rosse Model Results in Other Studies

Authors	H-statistics						Period	This study		
	ES	DE	FR	IT	UK	US		ES		
Cross-country studies								**PGLS**	**PWLS^{TASS}**	**PWLS^{BRANCH}**
Molyneux et al. (1994)	0.47	0.13	0.73	-0.61	0.62	-	1986-1989	0.53	0.51	0.55
Bikker and Groeneveld (2000)	0.58	0.85	0.91	0.91	0.72	-	1989-1996	0.67	0.75	0.78
De Bandt and Davis (2000)	-	0.27	0.19	0.51	-	0.55	1992-1996	0.72	0.81	0.81
Bikker and Haaf (2002)	0.59	0.62	0.70	0.82	0.63	0.55	1990-1998	0.74	0.87	0.92
Weill (2004)	0.53	0.58	0.58	0.62	0.57	-	1994-1999	0.78	0.96	0.97
Claessens and Laeven (2004)	0.53	0.58	0.69	0.60	0.74	0.41	1994-2001	0.78	0.96	0.99
Utrero-González (2004)	0.29	-	-	-	0.49	-	1996-2002	0.76	0.96	0.99
Casu and Girardone (2006)	0.31	0.36	0.17	0.41	0.32	-	1997-2003	0.65	0.96	0.97
Staikouras et al. (2006)	0.52	0.50	0.79	0.67	0.67	-	1998-2002	0.59	0.74	0.72
Spain-only studies								**PGLS**	**PWLS^{TASS}**	**PWLS^{BRANCH}**
Maudos and Pérez (2003)	0.71	-	-	-	-	-	1992-1999	0.81	0.95	0.97
Garrido (2004)	0.57	-	-	-	-	-	1994-2000	0.79	0.97	0.99
This study							***1986-2005***	***0.78***	***0.95***	***1.00***

Note: For the sake of comparability, reported H-statistics for other studies are, whenever available, full-sample least squares estimates. PGLS stands for Pooled Generalized Least Squares. PWLS^{TASS} and PWLS^{BRANCH} stand for Pooled Weighted Least Squares with TASS (Total Assets) and BRANCH (Number of Branches) as weighting variables, respectively.

Figure III. Market Structure and Consolidation in the Spanish Banking Industry

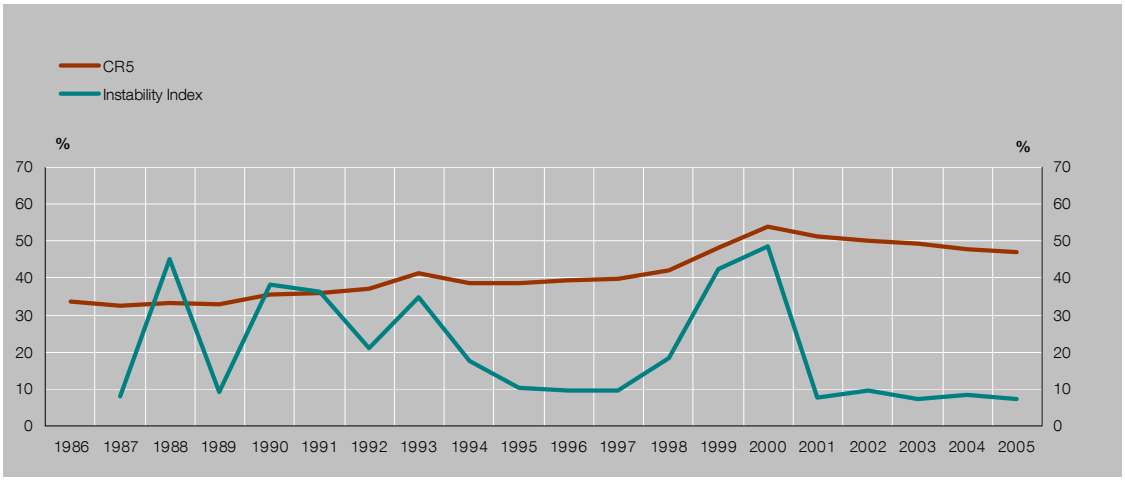
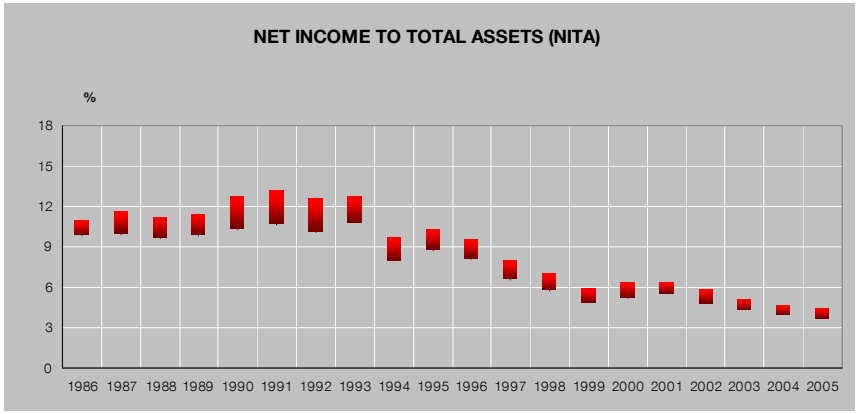
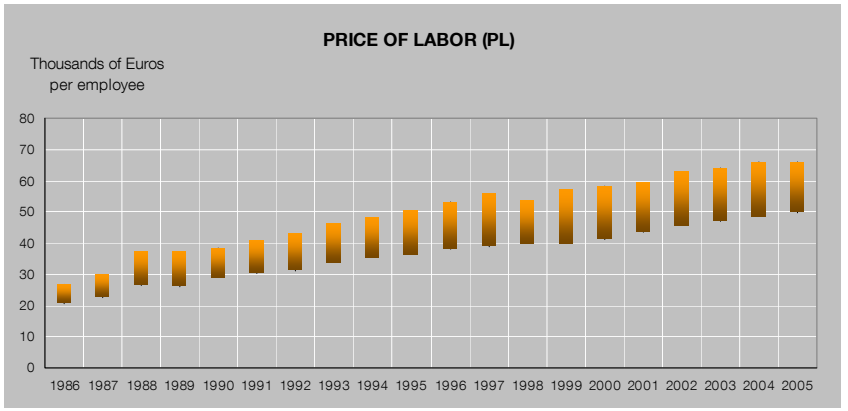


Figure IV. Dispersion Graphs

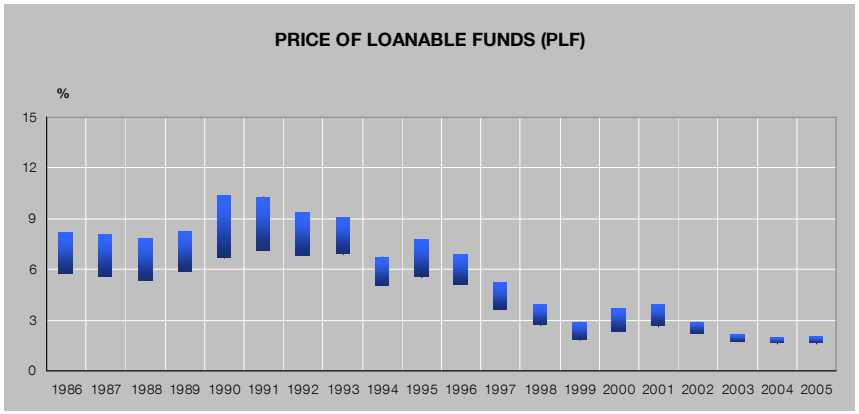
(a)



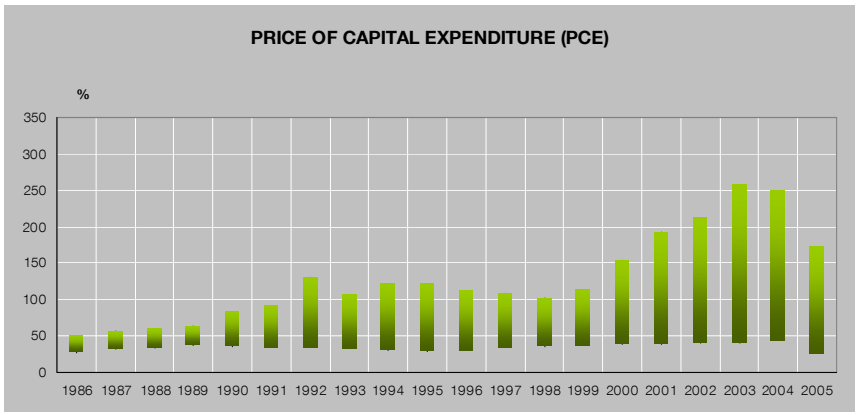
(b)



(c)



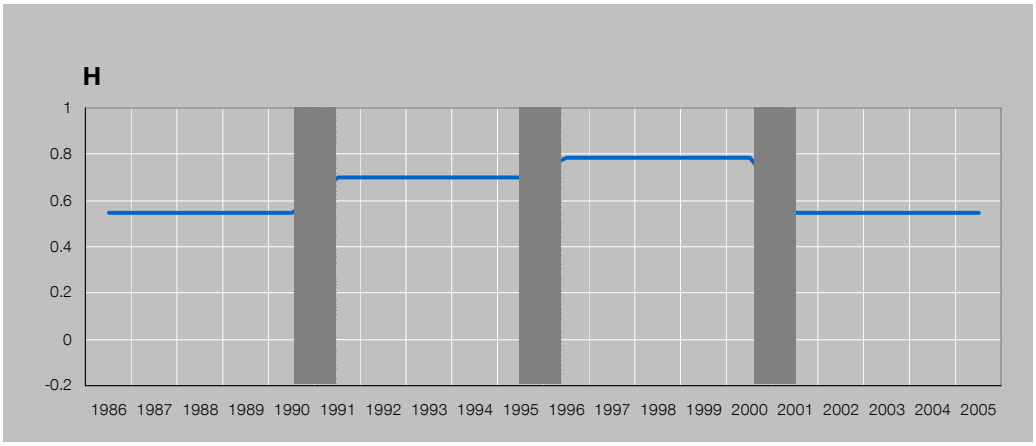
(d)



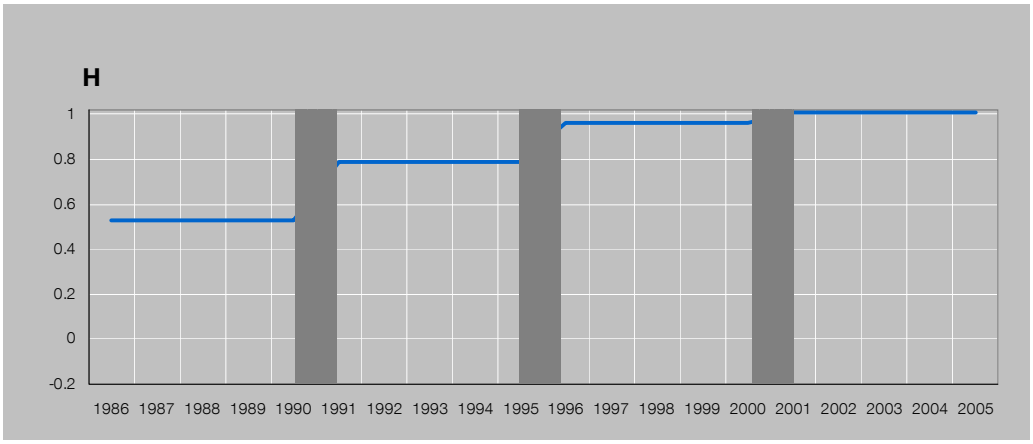
Note: For each year, the bottom of the box represents the first quartile and the top represents the third quartile.

Figure V. Estimation Results

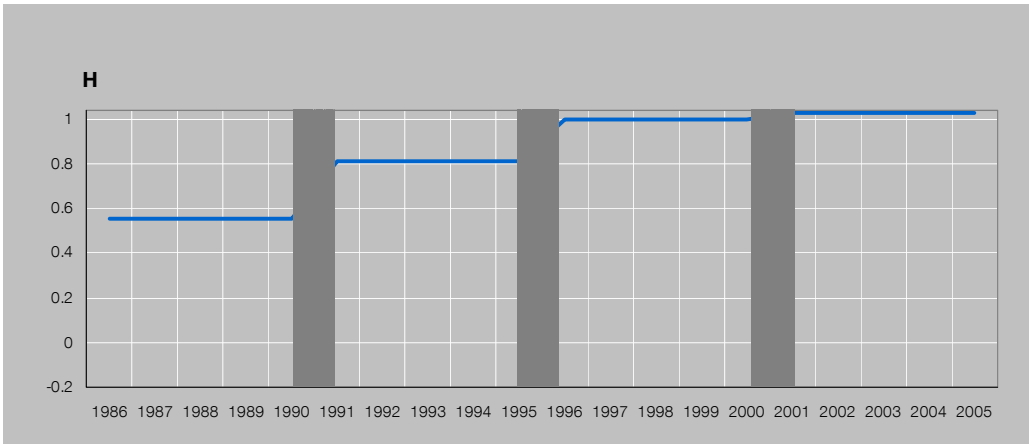
(a) Pooled Generalized Least Squares (PGLS) Estimates



(b) Pooled Weighted Least Squares (PWLS) Estimates according to total assets



(c) Pooled Weighted Least Squares (PWLS) Estimates according to the number of branches



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