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Mónica Melle [*]

Universidad Complutense de Madrid

[*] Universidad Complutense de Madrid
Facultad de CC. Económicas y Empresariales
Departamento de Economía y Administración Financiera de la Empresa
Despacho 107. Pabellón 4º
Campus de Somosaguas
28223 Pozuelo de Alarcón (Madrid)

Teléfono: +34 91 394 2560 / 2531
Fax: +34 91 394 2531
E-mail: mmellehe@ccee.ucm.es

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Abstract.

This paper analyzes the effect of product-market competition on managerial incentives. It examines the role of this external factor in stimulating firms to improve their efficiency. We analyse the potentially reduction in cost efficiency brought about by the lack of market discipline in concentrated markets. The belief that competition improves company performance is widespread, and it plays a role in motivating organisational efficiency and growth. The incentives to improve efficiency are greater in markets where firm behaviour is more competitive. The paper focuses on a panel of Spanish commercial banks over the years 1991 to 2001, using their published accounts. We take care of the crucial problem of potential endogeneity of explanatory variables by using GMM estimators proposed by Arellano and Bond (1991). Our results show that competition at firm and industrial levels in loan and deposit markets, has a positive and significant impact on performance. But the increase of loan and deposit markets competitions at geographical level are not significant as control mechanisms to motivate organisational efficiency and growth in banks. However, Spanish saving banks may face local loan markets competition. Finally, there is some evidence to suggest that deposit-market competition at industrial and geographical levels can be substituted by loan-market competition at the same levels.

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1. Introduction

The objective of the firm consists of maximising its market value, so economists like to think. In practice, however, some firms do not pursue this objective, because the agency problems generated by the separation of ownership and control emerge. The problems of asymmetric information and moral hazard, and the lacks of monitoring mechanisms could lead to managers' opportunist behaviours. In this context, the managers pursue their own interests which are not aligning with the shareholders' objectives, and therefore, they expropriate rents to the shareholders, decreasing the firm results, and harming the other stakeholders of the firm.

The internal mechanisms of corporate governance may not always be effective to align managers' goals with the owners' goals. As a consequence, some other external mechanisms based on the markets are necessary. In fact, there are some external factors which might systematically induce different performances between companies. Taking the constraints of technology into account, some firms are very efficient whereas others are not. The product market competition (Hart, 1983) and the financial market pressure (Jensen, 1989) are two external factors that are important in aligning managers' goals with the aim of efficient production, and so, in generating improved productivity performance in companies.

Traditionally, research and public policy concerns about concentration in product markets have focused on social loss associated with the exercise of market power at high levels of concentration (Berger and Hannan, 1998). The higher prices in concentrated markets bring out a restriction of output relative to the competitive level and thereby misallocate resources. The possibility of another loss associated with the exercise of market power has also long been recognized, but not so often measured or focused upon for policy purposes. As suggested by the quote from Hicks (1935: 8): "The best of all monopoly profits is a *quiet life*", the reduction in competitive pressure in concentrated markets may result in lessened effort by managers to maximize

operating efficiency. Thus, product-market competition reduces managerial slack. Hart (1983) attempts to formalize this proposition by modelling the effect of competition on the agency problem between a firm's owners and managers.

In this paper we examine the possibility that the state of competition within the market affect the incentives for firms to improve their efficiency. The paper focuses on the corporate governance in Spanish banking industry, examining the role of loan-market competition and deposit-market competition in the bank performance. Commercial banking is an industry in which all firms have access to virtually the same technology and produce relatively homogeneous products in geographically limited markets with different market structures. Bank prices are virtually unregulated, and banks can and do charge different prices for their deposit and loan products in different local markets.

In addition to the general interest in this topic, the agency problem inherent to the relationship between shareholders and managers is more acute in banks, due to the deposit insurance schemes, which could incentive managers to assume high risk. The industry is consolidating rapidly, a trend that is expected to continue under recent deregulation. Banks are also different from other companies because they are looking after other people's money, and they are exposed to special risks. Due to the financial intermediation carried out by the banks, the regulatory authorities and other stakeholders different from the shareholders, are interested in the corporate performance of the banks (Stoney and Winstanley, 2001). Moreover, if the 'quiet effect' and other efficiency-reducing effects of concentration are substantial, they might be considered in the merger approval process, along with traditional concerns about the welfare loss due to mispricing and the safety and soundness of the consolidated firm. Furthermore, the corporate governance of a bank affects, or could affect, to the sound of financial system as a whole, due to the systemic risk.

This work is based on the hypothesis that the external control mechanisms to discipline managers, such as market competition, are indeed necessary to supplement and improve the effectiveness of the internal control mechanisms, such as incentives schemes or board of directors, for example. In this sense, the EMU and the New Basel Capital

Accord point out the importance of the market control to define the strategies and the operative policies by the European banks. The increasing competition, the technological advances and the new role of the supervision by the European System of Central Banks, transfer, even more, the control from the banking managers to the stakeholders (lenders and debtholders), the shareholders and the product market. The increasing importance of the 'marketisation' of EU banking intensifies the influence of the external market on banks' internal resource allocation decisions (Gardener *et al.,* 2001). Moreover, Pillar 3 of the New Basel Capital Accord recognises that market discipline has the potential to reinforce capital regulation and other supervisory efforts to promote safety and soundness in banks and financial systems. Following the New Accord, market discipline imposes strong incentives for banks to conduct their business in a safe, sound and efficient manner (Basel Committee on Banking Supervision, 2001).

We find evidence that suggests that Spanish banks in more competitive loan markets exhibit high efficiency. In addition to this, Spanish banks in more concentrated deposit markets (thus, less competitive) exhibit low efficiency. There is some evidence to suggest that deposit market competition can substitute for loan market competition as different mechanisms for limiting managerial slack, and vice-versa. Thus, the impact of loan market competition on productivity performance is lower when banks are under the pressure of the deposits market competition. This result is robust to the use of multiple estimation techniques, and multiple characterisations of the output and concentration variables.

In the remainder of the paper, we first discuss the theoretical background and the existing evidence on the role of this external factor, such as product market competition, in increasing firm performance. Then we present an empirical investigation based on a large sample of Spanish banks for 1990-2001. We pursue also the issue of the comparison and integration of whether competition in loan markets and competition in deposit market as a 'discipline device'. Finally, we summarise some general conclusions.

2. The theoretical background and empirical evidence

There are two ways in which competition may impinge on the behaviour of firms (Vickers, 1995; Nickell, 1996). The first and most direct, effect is described by Vickers as 'discovery and selection': in a model of entry into a homogeneous good market with Nash-Cournot competition, the post-entry equilibrium reveals the ranking of the entrant in terms of relative costs. A low cost entrant will generate a substantial 'disturbance' to the market equilibrium, and may drive out some high cost incumbent(s). At the very least, the distribution of market shares and the profitability of firms will be affected as output shifts from high cost firms to low cost firms.

The second effect of competition is to sharpen incentives to managers. One strand in the literature appeals to explicit incentives scheme, where an increase in the number of players in the market enhances the possibilities of comparisons between the performance of managers (Holmstrom, 1982; Nalebuff and Stiglitz, 1983). A second strand (Hart, 1983; Scharfstein, 1988; Nickell, 1996) focuses on implicit incentives. The idea is that the market is unable to observe either the effort or the ability of the manager: it can only observe output which is additionally affected by productivity shocks. If however, there are a number of firms, and productivity shocks are correlated across firms more than the underlying managerial ability, then the performance over time can be used to distinguish superior managerial ability. A third approach, due to Willig (1987), outlines the conditions under which competition in product markets makes profits more sensitive to the efforts of managers. The owners then have an incentive to relate managerial remuneration to profits, so as to keep managerial effort high.

The models, which we discuss, are based on the determination of managerial effort. In particular, they analyse an external factor which influences managerial effort that then affects efficiency. Competition is a source of discipline; that is, that it reduces the amount of slack in the system due to individuals' not minimizing costs or being on their production possibility frontiers. In fact, Leibenstein (1966) has argued that such X-inefficiency, which takes the form of managerial slack, is much more important in

practice than more conventional sorts of inefficiency due to prices' not equalling marginal costs. Because of the separation between ownership and control in firms, managers have the opportunity to pursue goals of their own, such as growth maximization or effort minimization, which are in conflict with market value maximization, the goals of owners.

The product market competition may affect performance and foster efficiency by improving managerial incentives. The main argument for the influence of competition on company performance is that the existence of monopoly rents gives managers the potential to capture some of them in the form of slack. The reasons to justify that are mainly three:

1) It is easier for the owners or the market to monitor managers in a competitive environment. This is because there are greater opportunities for comparison which can lead to sharper incentives. Intertemporal models using market-based rewards based on the analysis of Holmström (1982) generate a positive impact of competition on managerial effort. Nalebuff and Stiglitz (1983) also show in a setting with cost functions which are stochastic but identical across firms that perfect competition reveals full information to the owners about the realisation of common cost shocks. In this case, relative performance can induce optimal managerial performance.

2) The costs and benefits of a reduction in costs or an innovation vary with the extent of competition. There is a degree of ambiguity. While demand elasticities tend to be higher under competition, thereby increasing the relative rewards from a costs reduction, the scale of operations is bigger for a monopolist tending to increase his absolute reward from a similar cost reduction (Willig, 1987). This ambiguity is also present since Schumpeter competition has been viewed as an impediment to innovation and growth. If market power is considered as a prerequisite for innovation, competition, through such Schumpeterian channel, may have a negative impact on firm performance (Aghion and Howitt, 1996).

3) Under reasonable assumptions, more competition will raise the probability of bankruptcy at any given level of managerial effort. Increasing the probability of bankruptcy, competition incites managers to greater effort and costs reduction necessary to avoid bankruptcy. So competition provides better incentives to work harder to avoid this outcome (Schmidt, 1997).

Turning to the existing empirical literature, Stigler (1958), Holmström (1982), Hart (1983), Nalebuff and Stiglitz (1983), Shleifer and Vishny (1986), Hermalin (1992), Nickell (1996), Schmidt (1997), and Aghion and Howitt (1996) all view competition in product markets as a powerful force for solving the agency problem between owners and managers. Caves and Barton (1990), Geroski (1990), Green and Mayes (1991), Blundell *et al*. (1995), Nickell (1996), Nickell *et al*. (1997), Oulton (1998), Gort and Sung (1999), Disney *et al*. (2000), Grosfeld and Tressel (2001), Januszewski *et al*. (2001), and Bottaso and Sembenelli (2001), all find evidence that increased product market competition is associated with higher firm productivity or higher productivity growth. Some of the findings of these works are such as: increases in market concentration tend to be associated with reductions in technical efficiency, the intensity of domestic competition drives forward productivity and helps an industry achieve international dominance, industry concentration dampens innovative activity, and the productivity growth in companies is positively correlated with the number of their competitors and negatively correlated with the average level of rents which they generate.

Over the past two decades, substantial research has gone into evaluating the efficiencies of financial institutions. Berger and Humphrey (1997) survey 130 recent studies that apply frontier efficiency analysis to financial institutions in 21 countries. Commercial banks have witnessed sweeping changes in the regulatory environment, huge growth in off-balance sheet risk management financial instruments, the introduction of e-commerce and online banking, and significant financial industry consolidation. All of these forces have made the Spanish banking industry highly competitive.

In competitive industries, production units can be separated by some standard into those that perform relatively well and those that perform relatively poorly. Financial

economists have done this "separation" by applying frontier efficiency analyses. The information obtained from such studies can be used for improving the managerial effort: managerial performance can be improved by identifying "best" and "worst" practices associated with high and low efficiency, respectively (Berger and Humphrey, 1997).

The banking industry competition refers mainly to (i) the loan market competition, and (ii) the deposit market competition. Berger and Hannan (1998) focussed on a reduction in cost efficiency brought about by the lack of market discipline in concentrated markets, employing data from commercial banking industry, which produces very homogeneous products in multiple markets with differing degrees of market concentration. They found evidence that suggests that banks in more concentrated markets exhibit poorer cost efficiency than do other banks, all else equal.

To sum up, empirical evidence concerning the relationship between product market competition and 'good' corporate governance is still scarce, but shows that competition can act to discipline managers and improve company performance. Previous studies of financial institution efficiency have examined efficiency and performance from several different perspectives. These include the effects of mergers and acquisitions (Berger *et al*., 1999, and Resti, 1998), institution failure (Barr *et al*., 1993; and Cebenoyan *et al*., 1993), and deregulation (Humphrey and Pulley, 1997; DeYoung, 1998), among many others. Frontier efficiency models are employed by these researchers primarily because they result in an objectively determined quantified measure of relative performance that removes the effects of many exogenous factors. This permits the researcher to focus on quantified measures of costs, inputs, outputs, revenues, profits, etc. to impute efficiency relative to best practice institutions. However, to our knowledge, there is no evidence that examines the effect of product market competition on corporate governance in banks, analysing whether loan market competition can be substituted by deposit market competition as an external control mechanism to discipline managers.

3. An empirical investigation based on the Spanish banking industry

Our empirical investigation is based on an unbalanced panel of Spanish banks from 1991 to 2001. In this section, we present the empirical framework, the data and measurement issues, and the results of our empirical application. Its aim consists, first, of testing the effects of loan market competition and deposit market competition on managerial efforts to improve bank performance in a substantial number of Spanish banks. And second, we examine whether competition in both markets reinforces each other (are complementary) as external mechanisms to discipline managers or if one can be rather considered as a substitute to another.

3.1. The empirical model

To explore the efficiency of the banks in our sample we adapt the stochastic frontier production function model of Aigner *et al.* (1977):

$$y_{it} = f(x_{it}) + v_{it} - u_{it} \qquad (1)$$

where i is the bank subscript, t is the time subscript, y_{it} is the natural log output of bank i in year t, $f(x_{it})$ is a conventional production function, v_{it} are production shocks (reflects all factors that affect productivity level) with distribution $N(0, \sigma_v^2)$ (all other productivity shocks are not correlated among banks and is assumed to be serially uncorrelated), and u_{it} are firm specific inefficiencies, on which more will said bellow (reflects factors that influence productivity growth and do not depend on the level of production factors and are affected by the competence and behaviour of management). The equation (1) considers a bank run by a manager whose management decisions are summarised in the variable of 'efforts' u_{it}. We assume that this effort affects the overall efficiency of the bank.

Following Nickell (1996), $f(x_{it})$ is specified as a constant-returns Cobb-Douglas function with lagged adjustment of output to inputs[1]:

[1] Research on bank production functions and scale economies have yielded results consistent with the underlying assumptions of the model. Mullineaux (1978) reports results consistent with Cobb-Douglas

$$f(x_{it}) = \alpha_i + \beta_t + \lambda \cdot y_{it-1} + (1-\lambda) \cdot \alpha_i \cdot l_{it} + (1-\lambda) \cdot (1-\alpha_i) \cdot k_{it} + \sigma_1 \cdot h_t \qquad (2)$$

where n_{it} and k_{it} are labour and capital in natural logs. The null hypothesis is that there are constant returns to scale in production (i.e. $\alpha_i + (1-\alpha_i) = 1$). The λ coefficient reflects lags in adjustment of output to inputs. h_t is an indicator of cyclical conditions that affect the banking industry in each year. The coefficients β_t are time specific efficiency effects, picking up shifts in the production frontier over time. The change in β_t between periods is a measure of the rate of technical change. α_i is a bank-specific time invariant efficiency effect: in a cross section of banks the α_i pick up the efficiencies of firms. The possible reasons for differing α_i across banks are various. The most obvious variation is likely to be the differing quality of management due to innate abilities and business experience. But banks may also differ in access to high technologies and inherited capital stock and technologies.

In addition to α_i, equation (1) includes bank-specific but time variant inefficiency effects, u_{it}, which are assumed to be distributed either as truncated normal or half normal distributions, or as an exponential distribution. The u_{it} reflect the shortfall of the banks relative to their own 'best practice' in each period, where best practice for the bank is determined by the time invariant α_i efficiency coefficient. Changes in the u_{it} indicate the extent to which the bank makes an effort in a particular period to improve its relative efficiency, or alternatively allows its efficiency drift.

The inclusion of two bank specific effects, α_i and u_{it}, is a departure from the existing literature on frontier production functions with panel data. Including α_i and u_{it} has the advantage of an obvious economic interpretation, distinguishing long run average efficiency for the bank (arising from quality of management, technologies available to the bank) from short run efficiency (arising from the efforts of management to use the given resources of the bank productively). The latter varies over time, as the management raises its effort in response to performance and competitive pressure.

The empirical equation is obtained by substituting (2) into (1):

production in banks, and studies of bank scale economies generally report constant returns or only very small scale economies, and then only in the case of the smaller size classes. See, for example, Bell and

$$y_{it} = (\alpha_i + \beta_t + \lambda \cdot y_{it-1} + (1-\lambda)\cdot\alpha_i \cdot l_{it} + (1-\lambda)\cdot(1-\alpha_i)\cdot k_{it} + \sigma_1 \cdot h_t) + v_{it} - u_{it} \qquad (3)$$

As in Nickell (1996), Nickell *et al*. (1997), and Grosfeld and Tressel (2001), we estimate directly the production function, which allows to identify the factors explaining the output of the bank. According to the theoretical and empirical literature described in the previous section, the degree of competition in both markets –loan and deposit markets– may affect the efficiency of the bank when managers do not have profit-maximising behaviour: the bank manager chooses the effort under the constraints and the incentive mechanisms provided by the competitive environment.

The equilibrium effort level of the bank i in t u_{it}^{*} depends on the degree of competition in the loan market in t-1, LC_{t-1}, on the degree of competition in the deposit market in t-1, DC_{t-1}, and on the interaction term:

$$u_{it}^{*} = u^{*}(LC_{t-1}, DC_{t-1}, LC_{t-1} \cdot DC_{t-1}) \qquad (4)$$

The interaction terms between loan market competition and deposit market competition allow to discuss the potential complementary or substitutability between competition in both markets.

The econometric specification of the time and firm specific effects needs careful consideration. For estimation, one time period dummy (β_0) and one firm dummy (α_j) have be dropped: the sum of these two elements is estimated as the constant in the equation. The problems of simultaneity between outputs and inputs, and of correlation between the lagged dependent variable and the error term, are addressed by extensive instrumenting of the regressors. The parameters of this model are estimated treating lagged output and factor inputs as endogenous to control for the potential endogeneity bias. In general, lagged values up to t-3 were used. In the production function we also consider a lagged effect on output including the lagged dependent variable which allows for endogenous persistence.

Murphy (1968).

We will use the generalized method of moment technique (GMM) developed by Arellano and Bond (1991). It is a standard technique for estimating dynamic panel data models, which treats lagged output and factor inputs as endogenous because of their potential correlation with lagged shocks, v_{it-1}.

The model is also estimated as a productivity growth model. It seems plausible that managers devote their efforts to both activities: improve the level of productivity and the rate of growth of productivity, and so we may suppose that all models refer both to productivity levels and to growth rates as their final outcomes. Then the model can be written as

$$\Delta y_{it} = \Delta b_t + \boldsymbol{l}_1 \cdot \Delta y_{it-1} + \boldsymbol{l}_2 \cdot \Delta l_{it} + \boldsymbol{l}_3 \cdot \Delta k_{it} + s_1 \cdot \Delta h_{it} + \\ + \Delta u^*_{it} + \Delta v_{it} \qquad (5)$$

Because of the use of fixed-effects panel data framework, the attempt to isolate the impact of product-markets competition on the level of productivity is essentially a search for a time-series effect. Indeed, it is clear from equation (5) that we are concerned with the impact of changes in both levels of competition, in loan and deposit markets [$\Delta u^*_{it} = -(u_{it} - u_{it-1})$], on changes in the productivity [Δy_{it}]. But equation [6] involves looking at the cross-section correlation between both markets competition [$\boldsymbol{g}_i(e^*)_{it}$] and productivity growth [Δy_{it}]. So we estimate the impact of competition in both markets on the ***rate of growth*** of productivity, as well as of the ***level*** of productivity. The main reasons that motivate this choice are: first, the impact on the level of productivity should in principle require a longer time period to materialise; and second, we assess whether and how productivity growth is affected as competitive pressures increase or decrease.

3.2. Data and variables

We use year-end data for 83 Spanish commercial banks from 1991 to 2001. This sample represents practically the whole Spanish resident banking industry (see Table 1), and includes all Spanish savings banks (there were 50 savings banks in 1991 and 46 in

2001) and the largest Spanish banks (30 banks in 1991 and 33 in 2001)[2] -this sample is detailed in Appendix I-. Due to the merger and acquisition processes, the sample is an unbalanced panel that includes between 79 and 86 banks depending on the year. On average, there are 9 years of consecutive observations per bank.

Table 1: Sample of Spanish banks. December 2001 *(Euro Miles)*

	Loans	Deposits	TOTAL ASSETS
Sample (Total Banks and Savings Banks)	568,767,042	625,582,139	1,021,862,011
Total Spanish credit institutions	624,854,000	643,166,000	1,265,524,000
Percentage of the sample over the total sector	91,02 %	97,27 %	80,75 %

Source: CECA (Confederación Española de Cajas de Ahorros), *AEB (Asociación Española de Banca),* and Bank of Spain (*Banco de España*).

Our analysis of product-market competition and its impact on efficiency of the banks is based on several sources of data. The public financial statements (balance sheets and profit and loss account) and the number of employees come from the yearbooks of both the Spanish Savings Banks Federation (*Confederación Española de Cajas de Ahorros, CECA*) and the Spanish Banks Association (*Asociación Española de Banca, AEB*). Finally the National Statistics, such as Gross Domestic Product (GDP), GDP deflator index and price general index (PGI) came from the Statistical National Institute (*Instituto Nacional de Estadística, INE*) and the Bank of Spain (*Banco de España*).

The variables we use in our econometric analysis are mainly based on Nickell (1996) and Nickell *et al*. (1997) in order to allow direct comparison with their different results, but we use also some common measurements for banks. All variables used in this study are appropriately deflated and measured in prices of 1995 (using the GDP deflator). Table 2 provides a description of the variables used in our models:

i) The **output of bank** (y_{it} is the natural log output of bank *i* in year *t*):
How to value bank output has been a topic of much discussion in the financial literature because banks do not explicitly charge for all the financial services that they provide,

[2] The sample is filtered by eliminating those banks whose data are not available for more than three years

relying instead on net receipts of interest for much of their revenue. Interest payments are generally treated as a distribution of income by businesses to investors who have provided them with funds, not as a payment for services. Applied to banks, depositors purchase these implicit services with imputed interest income that eliminates the gap between the total interest received by banks and the total interest paid by banks. The view that all the implicit services of banks go to depositors is based on the notion that depositors are the ultimate lenders and that the net interest belongs to them. This view, however, does not adequately account for the implicit services of commercial banks to borrowers in their role as financial intermediaries. In that role, banks transform deposits into earning assets by providing many financial services. In particular, banks provide services related to the provision of credit that overcome problems of asymmetric information and transfer risk to the bank. Banks devote staff time and other resources both to activities that serve depositors, such as clearing checks, and to activities that serve borrowers, such as making loan-underwriting decisions. Historically, banks were virtually the only source of credit to many households and businesses, and burgeoning needs for credit services were a major impetus for growth of this industry. Accordingly, a measure of bank output should reflect borrower services along with depositor services (Fixler *et al*., 2003).

After reviewing the main literature on bank output (Hannan and Mavinga, 1980; Mullineaux, 1978; Barr *et al.* 1993; Berger and Humphrey, 1997; Berger and Hannan, 1998; DeYoung, 1998; Pérez and Quesada, 1991; Barr *et al*., 2002; Fixler *et al*., 2003), we use four alternative variables to measure the desired outcomes of a bank: interest income, gross income, adjusted net income and earning assets.

(1) The **interest income** of a bank is an independent measure of performance that only recognizes the interest rate paid by borrowers to the bank. Barr *et al*. (2002) found strong and consistent relationship between efficiency and interest income. This bank output variable does not harm banks that use their resources for increasing their deposits and those that use their resources for providing many financial services using a large number of branches closer to the customers. Other version of

in the period 1991-2001.

this variable consists on adding the **non-interest income** due to the implicit services of banks to customers. Then we obtain the total financial income of a bank, that is the sum of interest and non-interest incomes of a bank (denoted by total financial income).

(2) The **gross income**, measured by the interest income minus the interest expenses plus the non-interest income. The gross output of a bank consists of explicit sales of services, which are booked as fee income, and implicit sales of services, which are currently measured by bank's net interest income.

By treating bank's net interest income as imputed sales of services, we recognize that adjustments to interest rates are substitutes for explicit fees to cover the cost of providing services to bank customers. If the reference rate represents the rate that banks earn on their investments after deducting expenses of providing services to borrowers, banks could, in principle, charge depositors explicitly for services and pay them the reference rate of interest. Similarly, banks could charge borrowers explicitly for services that they receive and reduce the rate of interest on loans to the reference rate.

(3) The **adjusted net income** is calculated by the gross income minus the operating expenses.

Given the difficulties in defining output of commercial banks, the profit function appears particularly useful for analysis of this industry (Mullineaux, 1978). In this case, the dependent variable is bank profits, measured as operating revenue minus operating expenses net of occupancy costs.

(4) The **earning assets** of the bank are the total loans less the loans past due 90 days or more and the loans in nonaccrual status, plus the total securities, the interest-bearing balances, the federal funds sold and the securities purchased under agreements to resell, and the assets held in trading accounts.

Banks allocate resources and control internal processes by effectively managing their employees, facilities, expenses, and sources and uses of funds while working to maximize earnings assets and total income. Banks with too much input or too little output relative to some subset of their peers are productively inefficient to some extent.

ii) The **two bank inputs**, which represent resources required to operate a bank, are defined by the following variables:

a) The **labour input**, l_{it}, measured by two alternative variables:
   - The total number of employees of the commercial bank in each year.
   - The salary expense of the bank. Barr *et al*. (2002) found that the most efficient institutions incur significantly lower salary expenses than the least efficient institutions.

b) The **physical capital** of the bank is measured by its capital stock, k_{it}, defined as its premises and fixed assets. The most efficient banks have also significantly lower fixed asset levels than do the least efficient banks (Barr *et al*., 2002). These results are consistent with the expectation that the minimization of fixed (non-earning) assets is among the characteristics that distinguish more efficient institutions.

iii) To control for **business cyclical effects** we use the annual variation of the Gross Domestic Product (GDP) as a proxy variable of business cycle, denoted by h_t.

iv) Finally, we use three **measures of competition**:

The empirical difficulty is that competition in the behavioural sense cannot be directly measured. We use some measure of concentration (market shares) as a proxy variable basing on the relationship between market share and the degree of competition in the market. This relationship is highly non-linear. An increase in cooperation or a decrease in the number of rivals does make market share less responsive to firms' costs, at the same time increasing the non-linearity of the relationship. Dominant firms may behave less competitively than smaller firms may. In which case more efficient (and hence dominant) firms will have smaller market shares, and less efficient (and hence smaller) firms will have larger market shares, than would be the case where their competitive

stance was identical. These arguments suggest that it is appropriate to specify a non-linear relationship in the empirical work which follows. A log-linear relationship gives acceptable empirical results.

However, there are a number of problems associated with the use of market share as a measure of market power (an inverse measure of competition):

a) Collusion depends not only on the size of the various banks involved relative to the market but also on other factors that are hard to control, such as asymmetries in costs and the ability of banks to "hide" their price changes, for example (Nickell, 1996).
b) Potential as well as actual competition influences market power.
c) The measure of market share does not fully reflect foreign competitors.
d) We consider that banks and savings banks compete in the same market. However both credit institutions develop different strategies and, for example, regarding to the deposit market, Spanish saving banks receive more financial resources through investments funds than banks do.

As a consequence, market share has little value as a cross-section measure of market power. However, if it is used as a time-series measure of market power, the problems above are less serious. The omitted and unobservable factors are likely to be relatively stable over time, which implies that one might expect there to be some correlation between measure of market share and changes in a true measure of market power. Thus it is worth using change in market share as an inverse measure of **changes** in the extent of competition. Furthermore, to eliminate reverse causality (high productivity growth leading to improvements in market share) we shall lag the independent variable two years (using $\Delta mksh_{it-2}$), following the work of Nickell (1996).

Definitively, we suggest the following variables to proxy market competition:

(1) **As firm level measures**, the market share at the bank level, $mksh_{it}$. We consider both firm market shares in both loan and deposit markets. Loan market share, denoted by $LoanMkSh_{it}$, is measured by the reported value of total loans of a bank

divided by the total loans of the banking industry. Deposit market share, denoted by $DepositMkSh_{it}$, is measured by the reported value of total deposits of a bank divided by the total deposits of the banking industry.

(2) **As industry level competition**, we use two measures of concentration: (i) the Herfindahl indices of bank concentration calculated for both markets -loan and deposit markets (*LHHI* and *DHHI*)[3]-, and (ii) the number of competitors (denoted by *COMPET*).

(3) The real competition level of many Spanish commercial banks is a **geographical level competition**. Markets relevant to banking services tend to be local in nature, thus allowing cross sectional analysis of market conditions, which vary considerably within this industry. In fact, many banks operate mainly in regional or local markets. Thus, in addition to the domestic level competition, we include two variables that proxy the real competition of a bank in the region where it operates: (i) the loan market share of a bank in the region where it is more introduced (that is, where it has the highest number of branches) (denoted by $GEOLMkSh_{it}$ and measured by the *ratio* between the reported value of total loans of a bank and the total loans of the banking industry in the region where the bank is more implanted), and (ii) the deposit market share of a bank in the region where it is more introduced) (denoted by $GEODMkSh_{it}$ and measured by the *ratio* between the reported value of total deposits of a bank and the total deposits of the banking industry in the region where the bank is more implanted). For banks operating in more than one local market, each bank's $GEOLMkSh_{it}$ and $GEODMkSh_{it}$ are calculated as a weighted average across its markets in each year, with the proportion of the bank's branches in each market serving as the weights.

[3] The Herfindahl index for loan market (*LHHI*) is calculated as the sum of squared loan market shares of all banks operating in this market, and the Herfindahl index for deposit market (*DHHI*) is calculated as the sum of squared deposit market shares of all banks operating in the deposit market.

Table 2: Definition of the variables

Variables	Definition
Bank-Specific variables:	
Output (y_{it})	(1) $ININCOME_{it}$: Natural log Interest income.
	(2) $GINCOME_{it}$: Natural log Gross income. **Gross income** = Interest income – Interest expenses + Non-interest income
	(3) $ANINCOME_{it}$: Natural log Adjusted net income. **Adjusted net income** = Gross income –Operating expenses
	(4) $EARNASSET_{it}$: Natural log Earning assets. **Earning assets** = Total loans + Total securities + Interest-bearing balances + Federal funds sold and the securities purchased under agreements to resell + Assets held in trading accounts.
Labour (l)	EMP_{it} Natural log Number of employees. It reflects total employment of the bank i in the year t.
	$SALARY_{it}$ Natural log salary expense of the bank i in the year t.
Capital (k)	CAP_{it} Natural log net capital stock (revalued by using the GDP deflator index). It reflects the fixed assets of the bank i in the year t.
Business cycle (h):	$GDPt$ *The annual variation of the Gross Domestic Product (GDP)*
Product market competition:	
a) Bank level competition:	
Market share at the bank level ($mksh_{it}$)	
- Loan market:	$LOANMKSH_{it}$ Loans of the bank i in year t to total loans of the banking industry in this year t.
- Deposit market:	$DEPOSITMKSH_{it}$ Deposits of the bank i in year t to total deposits of the banking industry in this year t.

Variables	Definition
b) Industrial level competition:	
Industry concentration: Herfindahl indices of bank concentration	
- Loan market:	$LHHI_t$ The Herfindahl index is calculated as the sum of the squares of the loan market shares of the banks operating in the loan market.
- Deposit market:	$DHHI_t$ The Herfindahl index is calculated as the sum of the squares of the deposit market shares of the banks operating in the deposit market.
Number of competitors:	$COMPET_t$ Number of Spanish commercial banks and savings banks operating in the industry in year *t*.
c) Geographical level competition:	
Market share at the geographical level	
- Loan market:	$GEOLMKSH_{it}$ Loans of the bank *i* in year *t* to total loans of the banking industry in the region where the bank is more implanted in this year *t*.
- Deposit market:	$GEODMKSH_{it}$ Deposits of the bank *i* in year *t* to total deposits of the banking industry in the region where the bank is more implanted in this year *t*.

In Table 3, we present descriptive statistics on output, labour, capital, product-market competition variables. We divide the sample in two sub-samples: banks and savings banks, in order to look some differences between both aggregates.

Table 3: Descriptive Statistics

Variables	Spanish Banks			Spanish Savings Banks			Total		
	Mean	Median	St.Dev	Mean	Median	St.Dev	Mean	Median	St.Dev
Output:									
$ININCOME_{it}$	10.1691	10.1569	1.7263	10.3241	10.3665	1.2005	10.2604	10.2965	1.4417
$GINCOME_{it}$	10.080	9.7612	1.1525	9.8590	9.7543	0.6671	9.9695	9.7577	0.9098
$ANINCOME_{it}$	10.6846	10.4937	1.0588	10.4476	10.3391	0.5746	10.5661	10.4164	0.8167
$EARNASSET_{it}$	12.4861	12.3718	1.5652	12.6892	12.7153	1.3299	12.6079	12.6208	1.4314
Inputs:									
EMP_{it}	6.9465	6.9328	0.1213	6.9145	6.9048	0.1039	6.9305	6.9188	0.1126
$SALARY_{it}$	8.6688	8.7941	1.6897	8.74997	8.7978	1.1839	8.7169	8.7963	1.4126
CAP_{it}	9.3998	9.0615	0.8975	9.4981	9.4033	0.6421	9.4489	9.2324	0.7698
Bank level competition:									
$LOANMKSH_{it}$	0.0161	0.0149	0.0065	0.0084	0.0093	0.0028	0.0123	0.0121	0.0046
$DEPOSITMKSH_{it}$	0.0137	0.00349	0.027	0.0104	0.00567	0.0164	0.0118	0.00522	0.0215
Industrial level competition:									
$LHHI_t$	0.03889	0.03648	0.00826	0.01561	0.01595	0.00147	0.05449	0.05129	0.00837
$DHHI_t$	0.03245	0.02863	0.00809	0.01869	0.01857	0.00171	0.05113	0.04857	0.00698
Geographical competition:									
$GEOLMKSH_{it}$	0.09745	0.05549	0.12320	0.13293	0.10679	0.12294	0.11846	0.06537	0.12428
$GEODMKSH_{it}$	0.11128	0.05505	0.14995	0.16216	0.11950	0.14868	0.14140	0.07518	0.15128

Source: Own estimations based on data bases from *CECA (Confederación Española de Cajas de Ahorros)* and from *AEB (Asociación Española de Banca)*.

3.3. Results

We begin our empirical analysis with some preliminary evidence on a simple measure of bank efficiency. We estimate a standard two-factor Cobb-Douglas production function with interest income, gross income, adjusted net income and earning assets as

the dependent variable. In order to analyse the impact of competition in the loan and deposit markets on the rate of growth of productivity we estimate also the production function with the variation of interest income, gross income, adjusted net income and earning assets as the dependent variable.

We interpret the residuals from this static regression as a measure of relative bank efficiency (denoted by u_{it}, time variant efficiency). Table 4 reports the results from several specifications. In the regressions showed on panel A, the estimates of unrestricted coefficients do not allow us to reject the hypothesis of constant returns to scale with respect to labour and capital inputs.

The results presented on panel B of Table 4 show that the estimates of the regressions of the change of productivity. The two input variables are statistically significant when we use the variation of Log interest income or the variation of Log gross income, as dependent variables.

Table 4: Cobb-Douglas production function estimates without time dynamics. Dependent variable: Natural log output of bank (y_{it})

Panel A $f(x_{it}) = a_i + b_t + \lambda \cdot y_{it-1} + (1-\lambda)\cdot\alpha_i \cdot l_{it} + (1-\lambda)\cdot(1-\alpha_i)\cdot k_{it} + u_{it}$

Sample (adjusted): 1991-2001	y_{it}: Log interest income			y_{it}: Log Gross income			y_{it}: Log Net interest income			y_{it}: Log Earning assets		
Independent variables	OLS	Fixed effects		OLS	Fixed effects		OLS	Fixed effects		OLS	Fixed effects	
Log capital (CAP_{it})	0.599*	0.790*	0.736*	0.137*	0.148*	0.131*	0.105*	0.121*	0.102*	0.055*	0.010*	0.010*
	(18.119)	(37.744)	(25.168)	(5.050)	(14.015)	(5.745)	(4.060)	(10.429)	(4.862)	(2.581)	(5.036)	(5.505)
Log labour (l_{it})												
EMP_{it}	0.055	0.127		0.466*	0.582*		0.426*	0.572*		0.023	0.017**	
	(1.430)	(1.569)		(6.002)	(9.749)		(5.791)	(7.988)		(1.212)	(2.005)	
$SALARY_{it}$			0.173*			0.176*			0.170*			0.015*
			(4.539)			(3.945)			(4.864)			(5.051)
Lagged output (y_{it-1})	0.508*	0.150*	0.351*	0.391*	0.102*	0.358*	0.476*	0.110*	0.408*	0.953*	0.571*	0.486*
	(12.285)	(5.562)	(6.439)	(4.109)	(3.526)	(4.045)	(5.438)	(3.926)	(4.340)	(39.803)	(6.833)	(6.727)
Time dummies	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Number of observations	836	836	913	837	837	914	837	837	914	824	824	901
R^2	0.910	0.981	0.962	0.965	0.991	0.967	0.958	0.989	0.969	0.955	0.965	0.975

Panel B $\Delta y_{it} = \Delta b_t + \lambda_1 \cdot \Delta y_{it-1} + \lambda_2 \cdot \Delta l_{it} + \lambda_3 \cdot \Delta k_{it} + \Delta u_{it}$

Sample (adjusted): 1991-2001	Δy_{it}: Variation of Log interest income			Δy_{it}: Variation of Log Gross income			Δy_{it}: Variation of Log Net interest income			Δy_{it}: Variation of Log Earning assets		
Independent variables	OLS	Fixed effects		OLS	Fixed effects		OLS	Fixed effects		OLS	Fixed effects	
Δ Log capital (ΔCAP_{it})	0.374**	3.122*	**2.477***	0.053*	0.033*	**0.047***	0.055*	0.008	0.029	0.071*	0.022	0.022
	(2.266)	(11.341)	**(7.916)**	(7.787)	(3.465)	**(2.742)**	(7.274)	(0.608)	(1.412)	(9.896)	(1.716)	(1.606)
Variation Log labour (Δl_{it})												
ΔEMP_{it}	3.547	1.305		0.206*	0.113**		0.205*	0.055		0.018	0.153	
	(1.155)	(0.892)		(2.907)	(2.025)		(2.727)	(0.749)		(0.204)	(1.633)	
$\Delta SALARY_{it}$			**1.445***			**0.273***			0.320*			0.051***
			(7.539)			**(4.703)**			(4.729)			(2.025)
Lagged Δ output (Δy_{it-1})	1.015*	0.244*	**0.405***	0.023***	0.015	**0.149****	0.008	0.043***	0.114*	0.055	0.069	0.072
	(47.097)	(4.795)	**(5.683)**	(1.957)	(1.767)	**(2.409)**	(0.447)	(1.946)	(2.778)	(0.882)	(1.238)	(1.289)
Time dummies	No	Yes	**Yes**	No	Yes	**Yes**	No	Yes	Yes	No	Yes	Yes
Number of observations	700	700	**827**	701	701	**828**	701	701	828	690	690	817
R^2	0.840	0.951	**0.943**	-0.132	0.299	**0.618**	0.041	0.225	0.636	-0.088	0.125	0.154

Estimates of a statistic two-factor Cobb-Douglas production function. Results are reported for pooled ordinary least squares (OLS) and firm fixed effects (a_i) regressions, with and without time dummies (b_t). Values in parenthesis are t-statistics. White Heteroskedasticity-Consistent Standard Errors & Covariance.
*, ** and *** indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.

We explore now the role of competition in the loan and deposit markets in stimulating banks to improve their efficiency. We assume that the concentration (measured by market shares) is the outcome of the interaction of competitive behaviour, and the relative efficiencies of the firms. We first focus on the impact of market power in domestic market on the efficiency of the banks. We analyse separately the effects of loan and deposit markets competition on bank performance. Then, we try to find evidence of substitution or complementary between competition in both markets.

The residuals u_{it} is an indicator of the failure of the bank to achieve its best efficiency in period t. The empirical approach reported below is an application of the idea that a bank which is performing badly, in particular losing market share or facing falling profits, will generally have an incentive to improve its short run efficiency.

In the equation (5), the variable $\Delta u_{it} = -(u_{it} - u_{it-1})$ indicates the extent to which the bank makes an effort in a particular period to improve its relative efficiency, or alternatively allows its efficiency drift. A positive value indicates that the bank is becoming more efficient; a negative value that the bank is allowing its short run efficiency to slip.

According to the theoretical framework, the degree of competition in both markets –loan and deposit markets– may affect changes in the u_{it}, because the bank manager chooses the effort under the constraints and the incentive mechanisms provided by the competitive environment. More concretely, the changes in the u_{it} depends on the changes in both levels of competition, in loan and deposit markets, and on the interaction term. Consequently we estimate the following model:

$$\Delta y_{it} = \Delta b_t + \boldsymbol{l}_1 \cdot \Delta y_{it-1} + \boldsymbol{l}_2 \cdot \Delta l_{it} + \boldsymbol{l}_3 \cdot \Delta k_{it} + s_1 \cdot \Delta h_{it} + \Delta u^*_{it}(LC, DC, LC.DC) + \Delta v_{it} \qquad (6)$$

Note that Δy_{it} is a first difference of log values; it is therefore appropriate to express all regressors as first differences in logs. The changes in the different type of competition

that the bank may face $\Delta u_{it}^{*}(LC, DC, LC.DC)$, are explanatory variables of this regression. The competition in the product market at firm, industrial or geographical level may stimulate the bank to improve its efficiency.

We have a sequence of estimated equations to investigate the robustness if the key results, with regard to both changes in the equation specification and changes in the dependent variable. The empirical equation is completed by introducing firm and year fixed effects, as well as economic-cyclical effect. We would not expect firm dummies to be significant given that the equation is in first differences. The results of the estimated equations are displayed in Tables 5-9. Tables 5 and 6 present the results of the effects of competition in the loan market on the efficiency of the banks, Tables 7 and 8 show the results of the effects of competition in the deposit market, and finally, in Table 9 the competition in both markets is related to the changes in bank performance.

The results presented in Table 5 show a positive impact of the changes in loan market competition on the changes in bank performance. We compare the impact of the different measures of loan market competition. Taking into account the results of the previous analysis (presented in Table 4), we use as dependent variables the variation of Log interest income (regressions in columns 1- 5) and the variation of Log gross income (regressions in columns 7-11). In the regression (6) the dependent variable is the variation of Log total financial income of the bank, that is the sum of interest and non-interest incomes of a bank.

Returning to the results, we see first that the variation of the net interest income is a better measure for the productivity growth of the bank, as the R-squared of the regressions shows. In all specifications the variation of the loan's market share, as a measure of the market power, impacts on productivity growth of within two periods. We take into account that competition might affect productivity growth in the long-run rather than in the short-run. By introducing lagged changes in market share we can capture incentives effects: a falling market share should stimulate the bank to take action to improve its relative position, so a negative coefficient is expected. In fact, the

results show that banks facing intensive loan market competition appear to be more productive.

Table 5: Impact of changes in loan market competition on productivity growth (1990-2001). GMM results

Independent variables	Dependent variable: Dy_{it} = Variation of log interest income					**(6) Incl. Non-interest income**	Dependent variable: Dy_{it} = Variation of log Gross income				
	(1)	**(2)**	(3)	(4)	(5)		(7)	**(8)**	(9)	(10)	(11)
Dy_{it-1}	0.735* (12.91)	**0.69*** **(13.51)**	0.748* (13.48)	0.746* (13.31)	0.855* (17.87)	**-0.045** (-2.18)**	-0.265* (-3.89)	**-0.271*** **(-3.97)**	-0.268* (-3.95)	-0.276* (-3.99)	-0.190** (-2.30)
$DSALARY_{it-1}$	1.339* (7.35)	**1.18*** **(7.28)**	1.309* (7.31)	1.413* (7.82)	1.784* (8.34)	**0.010 (1.25)**					
$DEMP_{it-1}$							0.089 (1.77)	**0.088 (1.76)**	0.088 (1.71)	0.087 (1.74)	0.085 (1.73)
$DCAP_{it-1}$	6.518* (24.43)	**6.90*** **(25.59)**	6.379* (23.09)	6.391* (22.99)	2.571 (1.77)	**0.089* (6.489)**	0.040* (3.36)	**0.044*** **(3.70)**	0.045* (3.71)	0.041* (3.35)	0.039* (3.13)
$DLOANMKSH_{it-2}$	-7.86** (-2.22)	**-7.43*** **(-2.55)**	-8.063** (-2.44)	-6.52*** (-2.00)		**-0.135 (-1.78)**	-0.749* (-4.78)	**-0.757*** **(-4.79)**	-0.755* (-4.80)	-0.750* (-4.65)	
$DLHHI_{t-1}$		**-1.04*** **(-8.78)**				**-0.055* (-14.08)**		**-0.012*** **(-2.64)**			
$DCOMPET_{t-1}$			1.792*** (1.93)						0.082 (1.20)		
$DGEOLMKSH_{it-1}$				-0.075 (-1.75)	-0.048 (-1.32)					0.003 (1.58)	0.003 (1.59)
$DGDP_t$	-0.003 (-0.12)	**-0.023 (-0.37)**	-0.252* (-3.20)	-0.0003 (-0.01)	0.081*** (1.89)	**0.004** (2.93)**	-0.006* (-7.73)	**-0.005*** **(-5.23)**	-0.004** (-2.20)	-0.006* (-7.64)	-0.006* (-7.43)
Time dummies	Yes	**Yes**	Yes	Yes	Yes	**Yes**	Yes	**Yes**	Yes	Yes	Yes
Fixed effects	Yes	**Yes**	Yes	Yes	Yes	**Yes**	Yes	**Yes**	Yes	Yes	Yes
Num cross-sections	86	**86**	86	86	86	**86**	86	**86**	86	86	86
Total panel observ.	756	**756**	756	749	827	**749**	622	**622**	622	622	622
R-squared	0.965	**0.970**	0.966	0.966	0.941	**0.472**	0.391	**0.397**	0.392	0.397	0.360
S.E. of regression	0.283	**0.262**	0.277	0.277	0.368	**0.39**	0.01	**0.01**	0.01	0.01	0.01
Durbin-Watson stat	1.63	**1.57**	1.61	1.65	2.07	**2.36**	2.08	**2.08**	2.09	2.13	2.23

The equations are estimated using the Dynamic Panel Data package written and described by Arellano and Bond (1991). All columns report a consistent one-step estimator where the minimized criterion takes no account of heteroskedasticity but the standard errors are robust to heteroskedasticity of general form. Asymptotic t-statistics are reported in parentheses.
*, **, *** indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.
In regression (6), the dependent variable is the variation of Log total financial income of the bank:

$$\frac{Log(\text{Interest Income}_{it} + \text{Non interest income}_{it}) - Log(\text{Interest Income}_{it-1} + \text{Non interest income}_{it-1})}{Log(\text{Interest Income}_{it-1} + \text{Non interest income}_{it-1})}$$

Source: Own estimations based on data bases from *CECA* and *AEB.*

Regarding to industry competition variables, which enter with a one-year lag, affect also the productivity growth. More specifically, the Herfindalh index, as a proxy of loan industry concentration (then an inverse of competition) is negatively related to the dependent variable, and the change in the number of competitors is positively related to the dependent variable 'Variation of log interest income'. These results confirm the positive impact of industry-level competition on productivity growth. However, the increase of loan market competition at geographical level is not significant as control mechanism to motivate organisational efficiency and growth in banks.

In order to verify possible different behaviours between banks and saving banks, we estimate these regressions for both subaggregates in Table 6. This comparative analysis between commercial banks and savings banks show that in banks the competition in loan market at firm level in the hole Spanish market plays an important role in stimulating banks to improve their efficiency. However, in saving banks this type of competition is not an explanatory variable of their productivity growth. Furthermore, the increase of loan market competition at geographical level stimulates saving banks to improve their efficiency. In fact, it is the kind of competition that introduces more pressure on the saving bank to improve its own efficiency. As a consequence, whereas Spanish banks may face a national loan market competition, saving banks may face local loan markets competition.

Table 6: Impact of changes in loan market competition on productivity growth. (1990-2001). Comparative analysis commercial banks *versus* savings banks. GMM results

	Commercial banks				Saving banks			
Dependent variable: Dy_{it}	Variation of log interest income		Variation of log gross income		Variation of log interest income		Variation of log gross income	
	(1)	(2)	**(3)**	(4)	(5)	**(6)**	(7)	(8)
Independent variables								
Dy_{it-1}	**0.686*** **(17.12)**	0.807* (20.87)	**-0.195**** **(2.86)**	-0.155*** (-2.33)	0.551* (14.26)	**0.460*** **(16.15)**	-0.429* (-9.14)	-0.247* (-6.42)
$DSALARY_{it-1}$	**1.150*** **(8.64)**	1.695* (10.62)			2.560* (7.01)	**2.960*** **(12.44)**	-0.006 (-0.14)	0.121* (3.66)
$DEMP_{it-1}$			**0.102*** **(2.13)**	0.092*** (2.23)				
$DCAP_{it-1}$	**6.074*** **(12.68)**	2.021* (6.10)	**0.046*** **(2.14)**	0.057** (2.62)	0.737* (3.02)	**0.712*** **(3.43)**	-0.002 (-0.07)	-0.025 (-0.95)
$DLOANMKSH_{it-2}$	**-6.173*** **(-3.05)**		**-0.540*** **(-3.03)**		2.798 (1.02)		-0.358 (-1.28)	
$DGEOLMKSH_{it-1}$		-0.069 (-1.10)		0.003 (1.14)		**-0.236*** **(-5.11)**		-0.008 (-1.56)
$DGDP_t$	**-0.002** **(-0.036)**	0.335* (4.89)	**-0.010** **(-1.46)**	-0.015*** (-2.09)	-0.036* (-5.05)	**-0.032*** **(-4.73)**	-0.007* (-9.88)	-0.007* (-8.33)
Time dummies	**Yes**	Yes	**Yes**	Yes	Yes	**Yes**	Yes	Yes
Fixed effects	**Yes**	Yes	**Yes**	Yes	Yes	**Yes**	Yes	Yes
Num cross-sections	**36**	36	**36**	36	50	**50**	50	50
Total panel observ.	**338**	303	**280**	280	446	**446**	442	492
R-squared	**0.915**	0.970	**0.376**	0.365	0.997	**0.997**	0.468	0.365
S.E. of regression	**0.535**	0.262	**0.013**	0.013	0.074	**0.075**	0.008	0.008
Durbin-Watson stat	**2.50**	1.57	**2.01**	2.15	1.71	**1.57**	1.84	2.31

The equations are estimated using the Dynamic Panel Data package written and described by Arellano and Bond (1991). All columns report a consistent one-step estimator where the minimized criterion takes no account of heteroskedasticity but the standard errors are robust to heteroskedasticity of general form. Asymptotic t-statistics are reported in parentheses.
*, **, *** indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.

Source: Own estimations based on data bases from *CECA* and *AEB.*

Table 7 present the results of the model specifications that investigate the impact of changes in competition in deposit market on the productivity growth of a bank. We use as dependent variables the variation of Log interest income (regressions in columns 1-4) and the variation of Log gross income (regressions in columns 6-9). In the regression (5) the dependent variable is the variation of Log total financial income of the bank, that is the sum of interest and non-interest incomes of a bank. We compare the impact of the different types of competition in deposit market. The results show a positive impact of the changes in deposit market competition on the changes in bank performance. We find that the increase of competition in deposit market at firm and industry levels spurs the

bank to improve efficiency by, for example, laying off staff. However, the competition in local deposit market does not affect to bank's effort in improving its relative position. Comparing with the results of impact of changes in loan market competition on productivity growth (Table 5), the deposit market competition exercises minor pressure on the productivity growth of a bank than the loan market competition does.

Table 7: Impact of changes in deposit market competition on productivity growth (1990-2001). GMM results

	Dependent variable: Δy_{it} = Variation of log interest income				**(5) Incl. Non-interest income**	Dependent variable: Δy_{it} = Variation of log Gross income			
Independent variables	**(1)**	(2)	(3)	(4)		**(6)**	(7)	(8)	(9)
Δy_{it-1}	**0.739***	0.624*	0.737*	0.838*	**-0.039**	**-0.160****	-0.306*	-0.270*	-0.158**
	(12.68)	(11.18)	(12.77)	(16.98)	**(-1.91)**	**(-2.20)**	(-3.84)	(-3.47)	(-2.15)
$\Delta SALARY_{it-1}$	**1.348***	1.166*	1.351*	1.683*	**0.009**				
	(7.38)	(7.41)	(7.44)	(7.63)	**(1.08)**				
ΔEMP_{it-1}						**0.076**	0.063	0.057	0.077
						(1.58)	(1.41)	(1.29)	(1.58)
ΔCAP_{it-1}	**6.567***	7.192*	6.515*	2.628	**0.097***	**0.045***	0.047*	0.041*	0.041*
	(23.81)	(27.78)	(23.87)	(1.76)	**(6.86)**	**(3.66)**	(4.21)	(3.55)	(3.28)
$\Delta DEPOMKSH_{it-2}$	**-0.0005**	-0.0004***	-0.0005		**$-7.3 \cdot 10^{5}$***	**-0.014****	$1.77 \cdot 10^{5}$	$1.67 \cdot 10^{5}$	
	(-2.04)	(-1.98)	(-1.75)		**(-4.28)**	**(-2.18)**	(1.38)	(1.26)	
$\Delta DHHI_{t-1}$		-2.154*			**-0.055***		-0.015**		
		(-9.18)			**(-9.32)**		(-2.45)		
$\Delta GEODMKSH_{it-1}$			0.161	0.222				-0.009	-0.011
			(1.58)	(1.75)				(-1.44)	(-1.87)
ΔGDP_t	**0.0025**	0.244*	0.005	0.082	**0.004***	**-0.007***	-0.005*	-0.006*	-0.006*
	(0.02)	(7.34)	(0.20)	(1.89)	**(2.92)**	**(-7.82)**	(-4.03)	(-7.96)	(-7.82)
Time dummies	**Yes**	Yes	Yes	Yes	**Yes**	**Yes**	Yes	Yes	Yes
Fixed effects	**Yes**	Yes	Yes	Yes	**Yes**	**Yes**	Yes	Yes	Yes
Num cross-sections	**86**	86	86	86	**86**	**86**	86	86	86
Total panel observ.	**779**	749	749	749	**742**	**622**	615	615	622
R-squared	**0.965**	0.971	0.966	0.966	**0.436**	**0.371**	0.407	0.410	0.367
S.E. of regression	**0.279**	0.254	0.277	0.277	**0.012**	**0.011**	0.010	0.010	0.011
Durbin-Watson stat	**1.65**	1.62	1.64	1.65	**2.39**	**2.09**	2.10	2.06	2.12

The equations are estimated using the Dynamic Panel Data package written and described by Arellano and Bond (1991). All columns report a consistent one-step estimator where the minimized criterion takes no account of heteroskedasticity but the standard errors are robust to heteroskedasticity of general form. Asymptotic t-statistics are reported in parentheses.
*, **, *** indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.
In regression (5), the dependent variable is the variation of Log total financial income of the bank:

$$\frac{Log(\text{Interest Income}_{it} + \text{Non interest income}_{it}) - Log(\text{Interest Income}_{it-1} + \text{Non interest income}_{it-1})}{Log(\text{Interest Income}_{it-1} + \text{Non interest income}_{it-1})}$$

Source: Own estimations based on data bases from *CECA* and *AEB.*

When we analyse separately Spanish commercial banks and Spanish saving banks, we find that the increase in local deposit market competition is positively related to future productivity growth in the saving banks aggregate -as equation (6) shows (Table 8)-. This result confirms that Spanish saving banks operate in local markets instead in national markets.

Table 8: Impact of changes in deposit market competition on productivity growth. (1990-2001). Comparative analysis commercial banks *versus* savings banks.

GMM results

	Commercial banks				Saving banks			
Dependent variable: Δy_{it}	Variation of log interest income		Variation of log gross income		Variation of log interest income		Variation of log gross income	
	(1)	(2)	(3)	(4)	(5)	**(6)**	(7)	(8)
Independent variables								
Δy_{it-1}	0.684* (16.77)	0.684* (16.77)	-0.125*** (-1.88)	-0.125*** (-1.86)	0.506* (18.03)	**0.574*** **(14.70)**	-0.250* (-6.52)	-0.244* (-6.27)
$\Delta SALARY_{it-1}$	1.154* (8.52)	1.154* (8.52)			3.301* (13.82)	**2.582*** **(7.11)**	0.121* (3.66)	0.115* (3.49)
ΔEMP_{it-1}			0.089*** (1.82)	0.090*** (1.86)				
ΔCAP_{it-1}	6.070* (12.61)	6.070* (12.61)	0.054* (2.47)	0.051* (2.33)	0.765* (3.17)	**0.716*** **(2.94)**	-0.020 (-0.75)	-0.034 (-1.31)
$\Delta DEPOMKSH_{it-2}$	-0.0002 (-0.14)		-0.010 (-1.75)		0.018 (0.40)		-0.009*** (-1.98)	
$\Delta GEODMKSH_{it-1}$		-0.0002 (-0.15)		-0.007 (-1.40)		**-0.055**** **(-2.02)**		-0.004 (-1.12)
ΔGDP_t	0.015 (0.25)	0.015 (0.25)	-0.013*** (-1.80)	-0.013*** (-1.82)	-0.029* (-4.10)	**-0.037*** **(-5.19)**	-0.006* (-8.06)	-0.006* (-8.26)
Time dummies	Yes	Yes	Yes	Yes	Yes	**Yes**	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	**Yes**	Yes	Yes
Num cross-sections	36	36	36	36	50	**50**	50	50
Total panel observ.	303	303	280	280	496	**446**	492	492
R-squared	0.951	0.951	0.360	0.357	0.996	**0.997**	0.367	0.363
S.E. of regression	0.389	0.389	0.013	0.013	0.077	**0.075**	0.008	0.009
Durbin-Watson stat	1.84	1.84	1.97	2.00	1.68	**1.57**	2.33	2.36

The equations are estimated using the Dynamic Panel Data package written and described by Arellano and Bond (1991). All columns report a consistent one-step estimator where the minimized criterion takes no account of heteroskedasticity but the standard errors are robust to heteroskedasticity of general form. Asymptotic t-statistics are reported in parentheses.
*, **, *** indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.

Source: Own estimations based on data bases from *CECA* and *AEB.*

Finally, Table 9 presents the results of the issue of the comparison and integration of competition in loan markets and competition in deposit markets as different mechanisms for limiting managerial slack. When we include competition in loan markets interacted with deposit market competition, we find some evidence of substitution between deposit market competition and loan market competition, both at industrial and geographical level. The negative interaction term indicates that as loan Herfindalh index falls (industrial competition rises), the impact of industrial competition in deposit market on productivity goes down (deposit Herfindalh index rises). Furthermore, the negative sign of '$DGEOLMKSH_{it-1}$* $DGEODMKSH_{it-1}$' shows that as local loan markets competition falls, the effect of local deposit markets competition on productivity goes up. So when loan market competition is low, a rise in deposit market competition induces a rise in annual total factor productivity growth, and vice-versa. However, with regard to the issue of reverse causality, the obvious reverse causal relationship between competition and productivity growth goes in a direction opposite to that found here. That is, high productivity growth would lead to market dominance and high market shares (Nickell *et al.*, 1997).

Regard to the interaction term '$DLOANMKSH_{it-2}$* $DDEPOMKSH_{it-2}$', we find a positive and significant effect of this variable in the regressions that use as dependent variable the variation of interest and non-interest income (equations 4-6) or the variation of gross income (equations 7-9). This positive sign indicates that both competitions in loan and deposit markets at firm level are complementary mechanisms for limiting managerial slack. So when loan market competition is high, a rise in deposit market competition induces a rise in annual total factor productivity growth, and vice-versa.

Table 9: Impact of competition in loan and deposit markets on productivity growth (1990-2001). GMM results

	Dependent variable: Dy_{it} = Variation of log interest income			Dependent variable: Dy_{it} = Variation of log (interest + Non- interest income)			Dependent variable: Dy_{it} = Variation of log Gross income		
Independent variables	(1)	(2)	(3)	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Dy_{it-1}	0.735* (12.43)	0.617* (11.36)	0.617* (11.35)	**-0.061 (-0.75)**	**-0.072 (-0.85)**	**-0.026 (-0.37)**	**-0.296* (-3.74)**	**-0.306* (-3.86)**	**-0.297* (-3.79)**
$DSALARY_{it-1}$	1.340* (7.28)	1.148* (7.36)	1.148* (7.36)						
$DEMP_{it-1}$				**-0.047 (-0.70)**	**-0.051 (-0.76)**	**-0.073 (-1.10)**	**0.064 (1.43)**	**0.063 (1.41)**	**0.048 (1.14)**
$DCAP_{it-1}$	6.568* (23.79)	7.050* (27.75)	7.048* (27.71)	**0.030*** (1.82)**	**0.041* (2.48)**	**0.043* (2.74)**	**0.041* (3.58)**	**0.047* (4.14)**	**0.049* (4.43)**
$DLOANMKSH_{it-2}$ * $DDEPOMKSH_{it-2}$	4.204 (1.32)	3.031 (1.14)	3.059 (1.15)	**0.768* (4.83)**	**0.714* (4.52)**	**0.684* (4.28)**	**0.418* (5.81)**	**0.391* (5.33)**	**0.365* (4.45)**
$DDHHI_{t-1}$ * $DDHHI_{t-1}$		-10.699* (-9.34)	-10.70* (-9.34)		**-0.132* (-3.31)**	**-0.132* (-3.43)**		**-0.068* (-2.27)**	**-0.071* (-2.31)**
$DGEOLMKSH_{it-1}$ * $DGEODMKSH_{it-1}$			-0.0003** (-2.18)			**-0.021* (-2.71)**			**-0.014*** (-2.05)**
$DGDP_t$	0.001 (0.05)	0.258* (7.57)	0.257* (7.56)	**-0.001 (-1.39)**	**0.002 (1.79)**	**0.002*** (1.81)**	**-0.006* (-8.03)**	**-0.005* (-4.31)**	**-0.005* (-4.30)**
Time dummies	Yes	Yes	Yes	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Fixed effects	Yes	Yes	Yes	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Num cross-sections	86	86	86	**86**	**86**	**86**	**86**	**86**	**86**
Total panel observ.	749	749	749	**615**	**615**	**615**	**615**	**615**	**615**
R-squared	0.966	0.972	0.972	**0.239**	**0.254**	**0.277**	**0.412**	**0.417**	**0.430**
S.E. of regression	0.278	0.251	0.251	**0.012**	**0.012**	**0.012**	**0.010**	**0.010**	**0.010**
Durbin-Watson stat	1.65	1.59	1.59	**2.16**	**2.15**	**2.19**	**2.13**	**2.12**	**2.05**

The equations are estimated using the Dynamic Panel Data package written and described by Arellano and Bond (1991). All columns report a consistent one-step estimator where the minimized criterion takes no account of heteroskedasticity but the standard errors are robust to heteroskedasticity of general form. Asymptotic t-statistics are reported in parentheses.

*, **, *** indicate significance at the 0.01, 0.05 and 0.10 levels, respectively.

In regression (5), the dependent variable is the variation of Log total financial income of the bank:

$$\frac{Log(\text{Interest Income}_{it} + \text{Non interest income}_{it}) - Log(\text{Interest Income}_{it-1} + \text{Non interest income}_{it-1})}{Log(\text{Interest Income}_{it-1} + \text{Non interest income}_{it-1})}$$

Source: Own estimations based on data bases from *CECA* and *AEB.*

4. Main conclusions

We have investigated the role of product market competition in generating improved productivity performance in banks. More specifically, we have analysed the impact of competition in loan market and of competition in deposit market on improving efficiency of banks. We have found, using data from about of 83 Spanish credit institutions –46 savings banks and 37 banks- over the period 1991-2001, that all two of these product markets competitions are associated with some degree of increased productivity growth. The results are robust to the use of multiple estimation techniques, and multiple characterisations of the output and concentration variables.

In this sense, the increase of the loans' market share (an inverse measure of competition) and the Herfindalh concentration index (an inverse measure of industry-level competition) are negatively related to future productivity growth. This loan market competition affects productivity growth in the long-run rather than in the short-run. These results confirm the positive impact of industry and firm level competition on productivity growth. However, the increase of loan market competition at geographical level is not significant as control mechanism to motivate organisational efficiency and growth in banks.

The comparative analysis between commercial banks and savings banks show that in banks the competition in loan market at firm level plays an important role in stimulating banks to improve their efficiency. However, in saving banks this type of competition is not an explanatory variable of their productivity growth. Furthermore, the increase of competition in local loan markets stimulates saving banks to improve their efficiency. Then, whereas Spanish banks may face a national loan market competition, saving banks may face local loan markets competition.

We find also a positive impact of the changes in deposit market competition on the changes in bank performance, although this external factor exercises minor pressure on the productivity growth of a bank than the loan market competition does. The increase of competition in deposit market at firm and industry levels spurs the bank to improve

efficiency. However, the competition in local deposit markets does not affect to bank's effort in improving its relative position.

Regard to the differences between Spanish commercial banks and Spanish saving banks, we find that the increase in local deposit markets competition is positively related to future productivity growth in the saving banks aggregate. This result confirms that Spanish saving banks operate in local markets instead in national markets.

Finally, there is some evidence to suggest that competition in deposit market at industrial and geographical levels can substitute for competition in loan market at the same industrial and geographical levels. Thus, the impact of loan market competition on productivity performance is lower when banks are under deposit market competition. However, with regard to the issue of the comparison and integration of competitions at firm level in loan and deposit markets, these types of competition turn out to complementary mechanisms for limiting managerial slack. So when loan market competition is high, a rise in deposit market competition induces a rise in annual total factor productivity growth, and vice-versa.

To sum up, competitions in loan and deposit markets are external factors that become an incentive to the bank to improve its relative efficiency. In highly competitive markets only the most efficient banks will survive. In less competitive markets less efficient banks may be able to maintain substantial market shares in protected market segments: so the relationship between efficiency and market share will be weaker. However, we must point out that interest rates depend on competitive structure of the markets. As these interest rates determine the interest income and expense, the market power and concentration (proxy of competition) can improve performance of banks through changes in interest rates but not through mitigating their agency costs.

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Appendix I: Sample of Spanish banks. December 2001 *(Euro Miles)*

Rk	Spanish Savings Banks	Loans	Deposits	TOTAL ASSETS
1	C.E. i Pensions de BARCELONA - La Caixa	48,894,662	53,371,509	79,609,998
2	C.A. y M.P. de MADRID	38,824,945	41,668,620	65,692,181
3	C.E. de CATALUNYA	15,217,869	16,183,086	28,345,584
4	C.A. de GALICIA	8,883,015	11,092,278	21,170,382
5	C.A. de VALENCIA, CASTELLÓN y ALICANTE - Bancaja	15,748,932	12,937,796	20,860,679
6	C.A. del MEDITERRÁNEO	15,071,920	14,760,809	18,809,606
7	C.A. y M.P. de ZARAGOZA ARAGÓN Y RIOJA - Ibercaja	10,460,312	12,146,933	15,527,064
8	BILBAO BIZKAIA KUTXA	7,190,610	10,529,307	13,468,704
9	UNICAJA	8,681,112	10,995,879	13,224,335
10	CAJA ESPAÑA de Inversiones, C.A. y M.P.	6,393,484	8,476,512	12,870,293
11	C.A. de SALAMANCA y SORIA - Caja Duero	5,009,167	8,825,274	10,324,960
12	C.A. y M.P. de GIPÚZKOA y SAN SEBASTIÁN	5,607,239	7,217,383	9,455,783
13	C.A. de VIGO , OURENSE e PONTEVEDRA -Caixanova	5,566,628	7,248,549	9,080,990
14	C.A. de CASTILLA LA MANCHA	4,621,642	6,342,910	7,799,623
15	C.A. y M.P. de CÓRDOBA. CajaSur	5,449,108	5,962,821	7,241,054
16	M.P. y C.A. de HUELVA y SEVILLA	5,304,865	5,129,161	6,905,791
17	C.E. del PENEDÉS	4,879,462	5,781,913	6,851,907
18	C.A. Y M. P. de NAVARRA	4,504,167	5,513,257	6,784,607
19	C.A. de MURCIA	4,391,591	5,169,035	6,731,495
20	C.A. de ASTURIAS -Cajastur	3,327,115	5,120,939	6,314,475
21	C. General de A. de GRANADA	4,472,511	4,755,316	5,722,094
22	CAJA SAN FERNANDO de SEVILLA y JEREZ	3,848,611	3,988,803	5,280,103
23	C.A. Municipal de BURGOS	2,521,292	3,557,831	5,032,992
24	C.A. de la INMACULADA DE ARAGÓN	3,417,783	3,491,116	4,786,797
25	C.A. y M.P. de las BALEARES	3,528,827	3,955,762	4,783,188
26	C. General de A. de CANARIAS	2,891,416	3,535,118	4,341,453
27	C.E. de SABADELL	3,176,918	3,246,455	4,267,463
28	C.A. de VITORIA y ÁLAVA	2,483,964	3,336,407	4,239,808
29	C.A. y M.P. de EXTREMADURA	2,008,250	2,764,202	3,648,414
30	C.E. de TERRASSA	2,429,486	3,043,050	3,553,823
31	C.A. de SANTANDER Y CANTABRIA	2,368,303	2,855,697	3,475,679
32	C.E. de TARRAGONA	2,293,825	2,886,583	3,281,816
33	C. Insular de A. de CANARIAS	2,159,107	2,736,879	3,202,102
34	C.E. de GIRONA	1,698,449	2,488,785	2,885,144
35	C.E. LAIETANA	1,897,159	2,308,694	2,852,807
36	C.A. y M.P. del C.C.O. de BURGOS	1,074,727	1,959,767	2,591,949
37	C.A. y M.P. de SEGOVIA	1,407,566	1,681,834	2,304,455
38	C.A. y M.P. de ÁVILA	1,257,987	1,662,132	2,288,867
39	C.E. de MANRESA	1,378,187	1,710,550	2,133,625
40	M.P. y C. General de A. de BADAJOZ	1,266,120	1,651,627	2,084,623
41	C.A. de LA RIOJA	1,212,578	1,282,627	1,632,151
42	C.E. Comarcal de MANLLEU	748,463	928,732	1,059,144
43	C.A. Provincial de GUADALAJARA	466,545	596,365	674,714
44	C.A. y M.P. de ONTINYENT	417,324	394,563	479,742
45	C. Provincial de A. de JAÉN	227,090	242,824	315,159
46	C.E. de POLLENÇA	131,166	165,491	181,115

Source: CECA (Confederación Española de Cajas de Ahorros).

December 2001 *(Euro Miles)*

Rk	Spanish Banks	Loans	Deposits	TOTAL ASSETS
1	BBVA	99,509,141	96,615,730	192,866,501
2	BSCH	75,866,890	90,959,989	180,990,634
3	BANESTO	23,184,682	25,737,256	49,089,540
4	BANCO POPULAR	16,512,934	16,800,779	27,264,630
5	BANCO SABADELL	12,935,294	14,447,744	21,738,536
6	BANKINTER	14,725,917	13,753,895	21,333,509
7	BANCO PASTOR	5,942,085	6,550,489	9,899,980
8	BANCO ATLANTICO	4,670,361	6,004,202	8,587,743
9	BARCLAYS BANK S.A.E	3,816,856	3,679,885	7,675,951
10	BANCO URQUIJO	2,279,538	1,787,819	5,483,860
11	BANCO ZARAGOZANO	3,078,598	3,573,750	5,261,241
12	BANCO GUIPUZCOANO	2,363,104	3,180,010	5,250,899
13	BANCO VALENCIA	3,810,668	3,207,999	4,953,796
14	BANCO ANDALUCIA	3,710,995	2,810,516	4,469,693
15	BANCO HERRERO	2,849,425	3,312,871	3,923,931
16	CITIBANK ESPAÑA	2,710,151	937,008	3,483,373
17	BANCA MARCH	2,619,556	2,671,366	3,457,368
18	BANCO CASTILLA	2,016,210	1,843,296	2,409,311
19	BANCO LUSO ESPAÑOL	395,904	541,838	2,161,158
20	BANCO VASCONIA	1,394,815	956,757	2,008,173
21	BANCO GALICIA	1,704,760	1,450,682	1,990,646
22	BANCO VITORIA	986,335	957,374	1,701,305
23	BANCO GALLEGO	946,896	1,119,499	1,559,170
24	BANCO ESPIRITO SANTO	991,693	905,265	1,549,444
25	BANCO SIMEÓN	927,904	1,105,908	1,361,522
26	BANCOVAL	49,398	1,111,853	1,322,075
27	BANCO MAPFRE	1,080,784	772,201	1,219,579
28	BANCO MURCIA	984,556	595,566	1,129,059
29	BANCO DE LA PEQUEÑA Y MEDIANA EMP.	355,632	558,086	942,430
30	BANCO ASTURIAS	508,710	536,374	782,218
31	BANKOA	498,279	407,736	689,300
32	FIBANC	161,580	545,324	616,482
33	BANCO EXTREMADURA	365,892	441,891	520,216

Source: AEB (Asociación Española de Banca).

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