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RESUMEN
Recientemente, la investigación en economía bancaria ha tratado de establecer en qué medida la innovación financiera y la tecnología están afectando a los costes, los ingresos y los beneficios. La mayor parte de los estudios no han encontrado complementariedades en costes, beneficios o ingresos ni entre las actividades tradicionales y las no tradicionales ni entre las tradicionales entre sí. En este estudio se analizan estas complementariedades en un entorno de 'banca amplia': el sector bancario español. Los resultados indican que, tras incluir las operaciones fuera de balance en el mix productivo, las economías de gama en costes y beneficios se incrementan de forma significativa. Asimismo, la valoración que los consumidores realizan de los servicios bancarios se detecta únicamente cuando las operaciones fuera de balance se consideran en la definición de output.

Palabras clave: banca, costes, beneficios, economía de gama, operaciones fuera de balance.

ABSTRACT
There is a recent trend in banking research aiming to assess how financial innovation and technology are affecting bank cost, revenue and profits. Most of the studies have not found significant cost, profit or revenue complementarities either between traditional and non-traditional banking products or between traditional activities themselves. We study complementarities in a 'broad banking' environment: the Spanish banking sector. The results indicate that after including off-balance sheet business in the output mix, cost and profit scope economies increase significantly. Besides, consumer valuation of financial services is only detected when the off-balance sheet business is added to the output definition.

Keywords: banking, cost, profit, scope economies, off-balance sheet.

JEL Classification: G21, L11

1. Introduction

Financial innovation and technology have been introducing new products and service delivery channels. These trends are affecting bank cost, revenue and profit complementarities. There are some previous studies for the US banking industry, most of which have not found significant complementarities either between traditional banking products (loans and deposits) or between those traditional activities and off-balance sheet business (Clark, 1988; Pulley and Braunstein 1992; Mester, 1992; Pulley and Humphrey, 1993; Jagtiani et al., 1995; Humphrey and Pulley, 1997; or Rogers, 1998). The main contribution of this paper is to show the extent to which these results are conditioned by the use of traditional output mix definitions that do not properly account for innovations in banking production function, informational complementarities or technological improvements. It should be noted that comparisons between different studies are conditioned by differences in regulation that have limited the scope of bank activities and a variety of methodological approaches employed to estimate cost (profit or revenues) complementarities.

Some studies have sufficiently dealt with output definition problems and methodological issues separately but, to our knowledge, not simultaneously. Moreover, there is a lack of studies that measure output complementarities in countries where banks have been traditionally permitted to offer a broad range of financial products. Competitive issues are also of great importance here and the use of industrial organization (IO) tools and theoretical assumptions appears relevant for this type of analysis.

In this study, we aim to test how output innovation and product mix definition may, at least partially, explain the existence of cost, revenue or profit complementarities in the banking sector, as the standard theoretical models of the banking firm show. To test these hypotheses we estimate cost, profit and revenue complementarities in Spanish banking using a composite cost function and including various on and off-balance sheet output measures. Specifically, loan commitments and mutual fund distribution activities are considered along with traditional lending, deposits-taking and securities activities. The Spanish banking system is a good laboratory since –unlike the US before the Gramm-Leach-Bliley Act of 1999- banks have been allowed to offer all sort of financial products and engage in all kinds of financial businesses for, at least, two decades. The estimation of cost

and profit complementarities permits to assess how off-balance sheet business may increase the informational and customer relationship properties of banking (hypothesis 1) and generate cross-selling advantages (hypothesis 2). Additionally, the revenue side will provide with an estimate of the valuation of 'broad banking' by customers (hypothesis 3). Finally, changes in market power and in market structure with off-balance sheet activities (hypothesis 4) are also estimated.

The paper is divided in five different sections. In section 2, we survey the main institutional and empirical background with regard to the effects of the regulatory treatment of broad banking on bank costs and profits. Next, section 3 contains the methodological background and the discussion of the hypothesis of this research. Section 4 analyses various issues with regard to the data and the empirical approach of the paper. Section 5 presents the main results. The paper ends with a brief summary of the conclusions and their policy implications.

2. Institutional and empirical background

2.1. The broadening of banking services

Bank regulation varies both across countries and over time. Although liberalization has been a dominating trend in international banking during the last decades, there have been significant differences across countries in the development of financial market and/or intermediaries activities depending upon, *inter alia*, historical experience and institutional legal factors.

The expansion of capital markets and intensified competition have resulted in a considerable reduction of transaction costs and information asymmetries so that financial intermediation has required a new rationale in the modern financial services industry. Allen and Santomero (1997) proposed participation costs and risk management as the main factors explaining the new role of financial institutions. In parallel, Scholtens and Weesveen (2000) suggest that modern intermediation theories need to explore how banks have conducted risk management over time. As for the banking industry, universal banking has been shaping as an expression of the generalized broadening of banking activities, where the degree of specialization depend upon the objectives and the role played by each institution in its financial system (Santomero and Eckles, 2000).

In the US, regulation has traditionally prevented banks from engaging in activities such as portfolio management, mutual or pension fund distribution, insurance or industrial participations both directly and through subsidiaries. However, the Gramm-Leach-Bliley Act allows US banks to diversify their portfolio permitting banks to undertake equity management, mutual fund distribution and other financial activities (Scholtens 1999; Barth et al., 2000). However, non-bank intermediaries (such as large mutual fund families, insurance companies or brokerage and consulting firms) have a large and consolidated tradition in offering these or similar services. These agents have dominated the disintermediation process in the US and they compete directly with banks only since the lifting of regulatory barriers.

The European tradition is different. Many European banks have enjoyed these 'broad banking' advantages much earlier than the US. A comparative analysis may be useful at this point. Table 1 shows the regulatory treatment on the mixing of banking, securities and insurance activities in the US, Japan and the European Union (EU-15) in 1997 (taken from Barth et al., 2000). Mixing with securities activities was generally unrestricted or permitted in the EU-15 and only few restrictions applied to insurance activities and ownership of commercial banks and firms. However, these activities were practically prohibited or restricted in the US and Japan until recently. In any event, disintermediation have expanded with financial markets, increasing interaction between banks and capital markets and the traditional distinction between market-based (ie. US, UK) and institutional-based financial systems (ie. Germany, France, Spain) has been somewhat blurred (Scholtens, 1999). Nevertheless, the classification between market-based and bank-based financial systems still appears to be relevant since it is still employed in many international studies and shows substantial differences in various measures of economic/financial performance (Levine, 2002)[1].

[1] Regulatory restrictions seem to play a key role in characterizing a national financial system as market-based or bank-based. In an international study covering 1980-1995 data, Levine (2002) employs an aggregated measure of regulatory restrictions on commercial bank activities for 48 countries. Specifically, he assesses which national regulatory authorities allow commercial banks to engage in securities, insurance or real state activities and the extent to which banks can own and control non-financial firms. In this context, Levine finds

2.2. Cost, revenue and profit issues

Standard models of the banking firm assume the existence of complementarities between deposit taking and loan supply, since they are viewed as two sides of the same demand liquidity function although the volume, origin and operative characteristics of both activities are different (Kashyap et al., 1999). The introduction of innovations beyond traditional banking –such as off-balance sheet business- is also expected to produce benefits. Firstly, some off-balance sheet activities represent a technological expansion of lending, as loan commitments -lines of credit, credit cards- which expand the scope of the customer relationship and its informational properties (Berger and Udell, 1995; Das and Nanda, 1999; Degryse and Van Caseele, 2000). Secondly, there are some other non-traditional and fee-earning activities more directly related with portfolio management and financial markets operations -such as portfolio management and mutual or pension funds distribution- that are expected to reduce risk (Gallo et al., 1996), increase scale economies and produce cross-selling benefits (Kane, 1995 and Golter, 1996)[2].

However, the empirical evidence has not supported these theoretical expectations either between on and off-balance sheet activities or even between traditional activities themselves. The majority of studies are applied to the US banks. In the cost side, most of the empirical studies have shown the existence of scope economies for balance sheet activities (including deposits as an output) although they are generally small both globally and among output pairs (Benston et al., 1982; Clark, 1988; Pulley and Braunstein 1992; Pulley and Humphrey, 1993; Noulas et al., 1993; Ferrier et al., 1993). The few studies analyzing profit complementarities have also found small profit scope economies among balance sheet outputs although significantly different from zero (Humphrey and Pulley, 1997; and Rogers, 1998).

---

that Spain (characterized as a bank-based country) is one of the countries with a lower level of regulatory restrictions -in line with our definition of broad banking-, and, for example, the US is one of the countries with a higher level of regulatory restrictions.

[2] Appendix A summarizes some of the most important contributions to on- and off-balance sheet effects on bank cost, profits and revenues.

As for the few studies analyzing cost and profit complementarities including off-balance sheet business, the evidence is mixed. Mester (1992) does not find complementarities between loans and off-balance sheet securitization while Rogers (1998) finds significant but small complementarities between traditional output and 'new financial services'. Complementarities also appear when a wide range of off-balance sheet activities is considered jointly (including derivatives, collateral and loan commitments) although they vanish as bank size increases (Jagtiani et al., 1995; Jagtiani and Khantavit, 1996; Clark and Siems, 2002). Finally, Rime and Stiroh (2003) examine efficiency at Swiss banks using a distribution free approach, finding that off-balance sheet business introduce both cost and profit inefficiencies compared to a narrow (traditional) definition of output mix.

Overall, the evidence regarding the benefits of diversification is unclear. In order to estimate those benefits, three different issues arise in this context: (1) most of the studies refer to the US before the mixing of banking with other financial activities was permitted; (2) the evolution and structure of off-balance sheet activities in these studies may differ substantially from other countries with a larger tradition in broad banking; and (3) the empirical approaches to estimate complementarities in multioutput technologies have been different. The composite function presents significant advantages in estimating complementarities in multioutput technologies compared with translog, quadratic or Fourier-Flexible functions. However, the composite has not been applied, to our knowledge, to estimate complementarities including off-balance sheet business and the existing studies refer to industries where broad banking was not permitted[3], as Pulley and Braunstein (1992) or Berger et al., (1996) for the US, and McKillop et al., (1996) for giant Japanese banks.

2.3. Relevance of the Spanish case

The Spanish experience may be illustrative, at this point, since Spanish banks have controlled the largest share of growing 'disintermediated' financial flows during the late 1980s and

[3] Dietsch and Lozano-Vivas (2000) show the relevance of considering different regulatory and economic environment conditions when estimating cost-efficiency scores (measured by a common frontier) in Spanish and French banking systems. Significant changes were found when accounting for these variables.

the 1990s with both a high growth of capital market investments, loan commitments and mutual funds management, as the main example of the expansion of broad banking (Figure 1). In particular, mutual funds assets managed by banks rose by 176,5% (in real terms) during 1993-1999, while loan commitment grew at 89,5% (in real terms) during the same period[4]. Broad banking is also reflected on-balance sheet business, as shown by the evolution of securities, equity and industrial participations growing by 35% (in real terms) during 1993-1999. It should be noted that disintemediation and off-balance sheet expansion has been compatible with traditional business since customers loans and deposits have experienced also a significant growth (62,1% and 19,7%, respectively, in real terms)[5].

Financial disintermediation in Spain has been clearly 're-conducted' by banks. Figure 2 shows the bank share in financial intermediation (assets managed by bank and non-bank intermediaries, respectively, as a percentage of total assets of financial intermediaries) in 1999. The share of bank intermediation is particularly significant in Spain, where these institutions (including subsidiaries) controlled more than the 93% of financial intermediation business. The relative weight of banks is also considerable in France (82,4%) and Germany (74,1%) while in the United Kingdom (56,1%) and the US (24,8%) is substantially lower, showing the largest competition from non-bank financial intermediaries in market-based financial systems. This trend is also reflected in the evolution of non-interest income as a percentage of total income (not shown)[6]. This ratio has increased at 93,4% during 1993-1999 in Spain, at 60,5% in France and at 32,1% in Germany. However, this growth has been lower in the US (13,9%) and even negative in the United Kingdom (-7,8%).

[4] The figure also shows the relative weight of bank intermediaries in conducting 'disintermediated' funds in Spain since bank share of the industry mutual funds assets has always been over 90%, showing the low competition offered from other non-bank financial intermediaries in selling these products.

[5] It is interesting to note that the growth of off-balance sheet contingent assets including guarantees, loan commitments and documentary credit over bank total assets (including these contingent assets) has changed from 13,4% to 22,8% during 1993-1999 in Spain.

[6] The information on non-interest income has been computed with OECD Bank Profitability data.

Spanish banks may be enjoying the advantages of institutional-based financial systems where there is a more limited range of financial investment possibilities for households and firms and mild non-bank financial competition. This financial structure permitted the so-called intertemporal risk smoothing, where financial savings remain relatively stable and banks benefit from long-term contractual (lending) relationships, lowering the price of their loans during economic downturns and rising it at the top of the business cycle, reducing aggregate and credit rationing risks (Allen and Gale, 1996; Allen and Santomero, 2001).

3. Methodological background and hypotheses.

3.1. A multioutput framework: direct and indirect function approaches

Global scope economies (*GCSE*) are defined as the percentage change in costs (profits or revenues) when banking services are offered jointly as opposed as when each service is offered separately (Mester, 1987). When defining the cost function (TC), the standard approach consists of variable costs depending on variable input prices, variable output quantities and given input and output quantities (Berger and Mester, 1997):

$$TC = TC(w, y, z) \tag{1}$$

where w is a vector of variable input prices; y is a vector of variable input quantities; and z is a vector of given netputs[7], included to show the effects of given netputs on costs due to their complementary or substitution relationships with variable netputs[8]. The definition of global scope economies compares complete specialization with a joint production of financial services. However, as noted by Pulley and Braunstein (1992) and Berger et al., (1996) complete specialization does not seem to be a realistic view of bank production and it could be more appropriate to consider banks as 'quasi-specialized' institutions, defining the quasi-specialized cost scope economies (*QCSE*) as:

[7] So that $z = (z_1, \ldots, z_n)$ and if $z_i > 0$, it is an output, whereas if $z_i < 0$, it is an input.

[8] Following Hughes et al., (2001), we will include deposits as outputs along with loans and other earning assets, assuming that deposits incorporate transaction costs to the output function.

$$
\begin{aligned}
QCSE \;=\; & [TC(\{1-(m-1)\}\in\; Q_1,\in Q_2,\ldots,\in Q_{n+m};\bar{r}) \\
& + TC(\in Q_1,\; \{1-(m-1)\in\}Q_2,\ldots,\in Q_{n+m};\bar{r}) \\
& +\ldots + TC(\in Q_1,\in Q_2,\; \ldots,\{1-(m-1)\in\}Q_{n+m};\; \bar{r}) \\
& - TC(\; Q_1,\; Q_2,\ldots,Q_{n+m};\bar{r})] \;/\; TC(\; Q_1,\; Q_2,\ldots,Q_{n+m};\bar{r})
\end{aligned}
\tag{2}
$$

where Q_i is one of the n on- plus m off-balance sheet outputs, $\in$ is the specialization parameter, so that when $\in$ =0 expression (2) turns to *GCSE*. When $\in$ >0 we obtain different measures of sub-additivity in costs catching both scale and scope effects for a given output mix. Institution size become a very relevant issue at this point since specialization and sub-additivity change with bank output level. Output mix strategies vary significantly with bank size.

Together with costs, the profit side in output mix complementarities is highly relevant, specifically when including off-balance sheet output, where those complementarities are expected to be larger than cost advantages (Kane, 1995; Golter, 1996; Rogers, 1998). As for profit scope economies, the definition will depend upon some important assumptions regarding the maximization and pricing behavior of bank firms. First of all, the standard indirect profit function approach assumes perfect competition in bank markets, where banks are price-takers in both input and output markets (Humphrey and Pulley, 1997; and Berger and Mester, 1997). Under this approach, there will be a given vector of on and off-balance sheet outputs (y), a vector of inputs (x) and also a vector of netputs $Q = (y, -x) = (Q_1,\ldots, Q_{n+m}, -x1, \ldots, -x_n)$. The standard profit function is defined as $\pi = P'Q$, where P is a vector of output prices (p) and input prices (r) so that $P=(p,r)' = (p_1,\ldots,p_{n+m},r_1,\ldots,r_n)'$. In a competitive environment, prices became exogenous. However, perfect competition hypothesis does not seem to be plausible in most banking markets, where a certain degree of market power is observed (Humphrey and Pulley, 1997). Therefore, an alternative indirect function is employed here, where firms maximize profits for a given vector of output quantities (y) and input prices (r) choosing output prices (p) along with output quantities:

$$
\underset{p,\,x}{Max}\; \pi \;=\; P'Q \;=\; (p,r)(y,\; -x)' \qquad s.t. \quad g(p,y,r) \;=\; 0 \qquad h(y,x) \;=\; 0
\tag{3}
$$

when $g(p,y,r,z)$ is a bank's pricing opportunity set for given values of y and r in the transformation function. The Lagrangian yields the optimal choice of output prices ($p = p[y,r,z]$) and input quantities ($x=x[y,r]$), and the alternative indirect profit function is defined as:

$$\pi = P'Q = [p(y,r),r][y, -x(y,r)]' = \pi(y,r) \tag{4}$$

Following (2), the 'quasi –specialized' (*QPSE*) profit scope economies function can be, then, defined as:

$$\begin{aligned} QPSE = & [\pi(Q_1, Q_2,...,Q_{n+m};\bar{r}) - \\ & \pi(1-(m-1)\in\} Q_1,\in Q_2,...,\in Q_{n+m};\bar{r}) \\ & - \pi(\in Q_1, \{1-(m-1)\in\} Q_2,...,\in Q_{n+m};\bar{r}) \\ & -...-\pi(\in Q_1,\in Q_2, ...,\{1-(m-1)\in\} Q_{n+m};\bar{r})] \\ & / \pi(Q_1, Q_2,...,Q_{n+m};\bar{r}) \end{aligned} \tag{5}$$

Both cost and profit scope economies will be, then, estimated under the above competitive assumptions. In any event, output mix needs to be assessed both globally and between (on and off-balance sheet) output pairs since many scope economies (diseconomies) relationships between certain outputs can not be assessed separately within the global scope economies definition. Therefore, output pair complementarities are also defined both for costs (*CSC*) and profits (*PSC*) as:

$$CSC = (-)\frac{\delta^2 TC(Q_1, Q_2, ..., Q_{n+m}; r_1, ..., r_K)}{\delta Q_i \delta Q_j} \quad ; \quad \forall\, i \neq j \qquad i,j = 1,...,n+m; \tag{6}$$

and

$$PSC = \frac{\delta^2 \pi(Q_1, Q_2, ..., Q_{n+m}; P_1, ..., P_K)}{\delta Q_i \delta Q_j} \quad ; \quad \forall\, i \neq j \qquad i,j = 1,...,n+m; \tag{7}$$

where *CSC* (*PSC*) is defined as the change in marginal cost (profit) of producing output *i* relative to changes in output *j*, so that when *CSC>0* (*PSC*>0), there are complementarities in costs (profits) of producing jointly outputs *i* and *j*.

Within this theoretical framework, we aim to test the two following hypotheses:

- *Hypothesis 1*: In a broad banking environment, expected cost and profit complementarities between traditional activities (eg. loan supply and deposits-taking) will increase significantly when their extended informational and technological properties beyond the balance sheet (lines of credit, loan commitments) are included in the output mix definition.
- *Hypothesis 2*: Cross-selling cost and profit scope economies or diseconomies between on and off-balance sheet outputs (not necessarily related to lending activities) may differ substantially depending on output mix definition.

3.2. Cost and profit scope economies and the one-stop banking hypothesis

A third hypothesis arises by looking at the revenue side of bank activities. This is the following:

- *Hypothesis 3*: Consumers valuation of broad banking services (one-stop banking hypothesis) will only come into light when including traditional and non-traditional activities jointly in the output mix.

Hypothesis 3 requires some additional assumptions as to evaluate consumer valuation of broad banking properly. Under certain conditions, revenue scope economies will illustrate synergies in the joint consumption of financial services (one-stop banking hypothesis). For banks to obtain greater revenues in the joint production of financial services, output prices have to vary with different output mixes (Berger et al., 1996). Revenue economies of scope would exist in a competitive environment only if: (1) consumers are willing to pay a premium for jointly provided financial services; and (2) there are cost diseconomies of scope. If there were no cost justification for charging higher prices for services provided jointly, competition among banks would eliminate the revenue synergies, even if consumers valued jointness. Therefore, the coexistence of cost and revenue scope economies will be only possible in a less than perfectly competitive environment.

Potential reductions in transaction and searching costs for customer may incentive banks to supply a wide range of services[9].

Under the same assumptions that in [4], an alternative indirect revenue function (*R*) is also defined to analyze complementarities in consumption. The revenue problem seeks to maximize the revenue function:

$$\underset{p}{Max}\ R = p'y \quad \text{s.t.} \quad g(p,y,r) = 0 \tag{8}$$

and the Lagrangian yields the revenue maximizing prices as functions of *y* and *r*:

$$R = p'y = p(y,r)'y = R(y,r) \tag{9}$$

and the 'quasi-specialized' revenue economies of scope (QRSE) and revenue complementarities (RSC) are defined similarly to profits as in (5) and (7).

3.3. Implications for market competition

Competitive assumptions are needed as to evaluate the robustness of the results. Moreover, it is interesting to analyze how changes in output mix may alter market power and market competition since the coexistence of cost and profit (revenue) complementarities is only possible in a less that competitive environment, as shown above. Therefore, a fourth hypothesis is also tested:

- *Hypothesis 4*: The introduction of new off-balance sheet activities in the bank output mix (such as loan commitments or mutual fund distribution) will alter market power although likely associated changes in market competition need to be assessed.

Non-traditional activities may result in pricing strategies (such as price bundling), where banks seek to compensate a decreasing growth rate of interest revenue with an increase in non-interest revenue by charging higher prices in non-traditional business.

[9] Berger et al., (1996) show that approximating the division of banking services into price-taking versus price-setting behavior suggests that perhaps one-third of banking revenues are associated with services where price taking is expected while two-thirds are associated with services where price-setting behavior occurs. Therefore, the alternative revenue function may reflect better the evolution of bank revenues since banks are considered as price setters in one or various markets.

4. Data and empirical approach.

4.1. Data and variable definition

Cost, profit and revenue complementarities are estimated for a large sample of Spanish banks over 1993-1999 using semi-annual data. This period covers the larger expansion of 'broad banking' in Spain with two main features: (1) a very high growth of mutual funds managed by banks as the main example of 're-conducted disintermediation' and (2) a simultaneous significant growth of loan products both on an off-balance sheet (ie. loan commitments) [10]. The sample includes 38 commercial and savings banks summing up to 531 semi-annual observations during 1993-1999 and accounting for 75-80% of the total assets of the Spanish banking industry[11].

In order to estimate scope economies and cost complementarities in a 'broad banking' environment, data on costs, profits, revenues, output quantities and input prices is required. The variables employed in the empirical approach are defined as follows:

- **TC**: total costs, as the sum of all interest and operative costs including deposits, staff and physical capital costs.
- **PF**: profit before taxes.
- **TR**: total revenue, including interest and non-interest income.
- **LN**: Loan portfolio, including customer and interbank loans.
- **DP**: sight and term deposits.
- **OE**: other earning assets different from loans, including securities, shares and industrial participations.

[10] The period also coincides with the post-deregulated competitive environment after the branch liberalization that took place in Spain in 1989 and the subsequent wave of bank mergers.

[11] A complete list of the institutions in the sample is available upon request. In 1993, the sample accounted for 76% of the total assets of the industry and in 1999, the 80%. The total market share in terms of off-balance sheet business of this sample of banks is even larger (above 95%) over the period. We were unable to include the smallest savings banks and the cooperative banks in our sample since they do not manage (on their own) the largest part of their off-balance sheet business and, therefore, this type of data are not available for them.

- **LC**: loan commitments, including lines of credit and other off-balance sheet loan commitments (credit cards).
- **MF**: mutual fund off-balance sheet' assets.
- **DC**: price of deposits as the ratio 'interest expenses to short-term funding' (including customer and interbank deposits and short-term equity debt).
- **SC**: unit staff costs, defined as the ratio 'staff cost to total number of workers'.
- **KC**: unit costs of physical capital as the ratio 'building maintenance and depreciation to fixed assets'.

Table 2 shows the summary statistics of these variables. All the variables were computed employing balance sheet and income statement data provided by the Spanish Banking Association (AEB) and the Spanish Confederation of Savings Banks (CECA). Data on mutual funds distribution is provided by National Financial Markets Commission (CNMV).

4.2. The composite cost function and the output mix

A composite cost function is employed to model the behavior of costs, profits and revenues in a multioutput framework. Compared with other commonly used functional forms –such as the translog or quadratic- the composite produces more robust and efficient results in modeling multioutput technologies (Pulley and Braunstein, 1992). The composite actually nests a standard translog, a generalized translog and a quadratic functional forms. Multiplicative forms such as the translog usually impose a strong separability between inputs and outputs and input demand elasticities are defined equally and independently of changes in input prices. As noted by Carroll and Ruppert (1984) and Snee (1986) the composite cost function offers an alternative specification by transforming both sides of the cost (profit or revenue equation) and permitting to model empirically the dependent variable both in logarithms or in levels as to contrast the results in both cases. A generalized composite cost function is, then, defined as a Box-Cox transformation of total costs:

$$TC^{(\phi)} = \left(\begin{array}{l} \left[\alpha_0 + \Sigma\alpha_i q_i + \frac{1}{2} \Sigma\Sigma\alpha_{ij} q_i q_j + \Sigma\Sigma\delta_{ik} q_i \ln r_k \right] \\ .\exp \left[\beta_0 + \Sigma\beta_k \ln r_k + \frac{1}{2} \Sigma\Sigma\beta_{kl} \ln r_k \ln r_l + \Sigma\Sigma\mu_{ik} q_i \ln r_k \right] \end{array} \right)^{(\phi)} + \varepsilon \quad (10)$$

$$s.t. \quad TC^{(\phi)} = (TC^{\phi} - 1)/\phi \quad when \ \phi \neq 0$$
$$= \ln TC \quad when \ \phi = 0$$

where q_i is the vector of output quantities ($i= 1,..., n+m$), and r_K is the vector of input prices ($k = 1,…n$). Then, the composite in (10) will adopt a logarithmical form when $\phi = 0$, while it will correspond to a generalized form in levels when $\phi = 1$ [12].

To estimate the composite function in (10), three inputs ($k = 1, …,3$) are defined as to compute the price of deposits (DC), labor (SC) and physical capital (KC). Together, three different outputs are included. We employ two definitions of traditional and non-traditional output mix as to estimate changes in cost (profit, revenue) complementarities with 'broad banking':

- Traditional output mix: (1) loans (LN); (2) deposits (DP); and (3) other earning assets (OE), representing a traditional balance sheet output mix.
- Augmented output mix: (1) loans (LN) plus loan commitments (LC); (2) deposits (DP); and (3) other earning assets (OE) plus mutual funds (MF).

Therefore, this methodology consists of aggregating off-balance sheet outputs to similar on-balance activities so that changes in costs, profit or revenues related to output innovations are captured. This output aggregation procedure poses a clear advantage since it permits to associate similar activities so that their informational and strategic characteristics may be jointly assessed. However, we need to take into account that correlation analysis is imperfect in being able to accurately identify separate influences among variables that are not actually orthogonal to one another, as it happens with some of the activities analyzed. Since subadditivity is a combination of scope and scale effects, the aggregation procedure may not account properly for the effects of output aggregation in the scale component of global scope economies. One alternative would be to

[12] We include a parameter for ϕ in the empirical estimations as to transform the election of the composite functional form in a testable hypothesis.

subtract the known effects of the 'aggregated' variables from the cost, revenue and profit data before estimating the scope relationships. Unfortunately, these values are not known and can only be approximated in a model with all 5 outputs separately. Therefore, in order to check for the robustness of the aggregation procedure to scale effects with output changes, a five-output composite function is also defined with the following output mix:

- Alternative five-output definition: (1) loans (LN); (2) loan commitments (LC); (3) deposits (DP); (4) other earning assets (OE); and (5) mutual funds (MF).

With these input prices and output mix definitions global cost, profit and revenue economies of scope (*GCSE, GPSE* and *GRSE*) can be estimated following equation (10), having in mind the structural form of the cost, profit and revenue functions in (1), (4) and (9), respectively. The reduce form of the cost (alternatively profit or revenue) equation would be:

$$TC^{(\phi)} \ (or\ PF^{(\phi)}\ or\ TR^{(\phi)}) = \{F(q,\ln r) \cong \exp[G(\ln r)]\}^{(\phi)} + \varepsilon \qquad (11)$$

so that 'quasi specialized' cost, profit or revenues economies of scope (*QCSE, QPSE* and *QRSE*) are defined as:

$$QCSE = [(m-1)\alpha_0 - \frac{1}{2}\sum_i \sum_{j \neq i} \alpha_i q_i q_j] / F(q,\ln r) \qquad (12)$$

$$QPSE\ (or\ QRSE) = [-(m-1)\alpha_0 + \frac{1}{2}\sum_i \sum_{j \neq i} \alpha_i q_i q_j] / F(q,\ln r) \qquad (13)$$

Then, to analyze sub-additivity from complete diversification ($\in = 0$) to complete specialization ($\in = 1/m$), six different specialization levels are defined between $\in = 0$ and $\in = 1/m$ for the three output definition ($\in = 0$, $\in = 0.01$, $\in = 0.05$, $\in = 0.1$, $\in = 0.2$, $\in = 0.3$)[13] and the alternative 5-output definition ($\in = 0$, $\in = 0.01$, $\in = 0.05$, $\in = 0.1$, $\in = 0.15$, $\in = 0.2$). 'Quasi specialized' economies of scope permit to undertake an additional analysis by separating global

[13] As shown in (2) this methodology permits to analyze sub-additivity from pure scope economies ($\in = 0$) to pure scale economies ($\in = 1/m$). Significance (standard errors) of scope economies and complementarities estimations are obtained following the procedure illustrated by Pulley and Braunstein (1992), consisting of differentiating the scope equation with respect to the composite parameters and obtaining the values of the gradient at convergence and the variance and covariance matrix.

scope economies in two components, fixed scope economies and complementarities. From (12) and (13) we will have:

$$QCSE = [(m-1)\alpha_i / F(q,\ln r)] - [\frac{1}{2}\sum_i \sum_{j\neq i} \alpha_i q_i q_j / F(q,\ln r)]$$

$$QPSE \ (or \ QRSE) = [-(m-1)\alpha_i / F(q,\ln r)] + [\frac{1}{2}\sum_i \sum_{j\neq i} \alpha_i q_i q_j / F(q,\ln r)] \qquad (14)$$

$$(fixed\ scope\ economies) \pm [complementarities]$$

4.3. Controlling for changes in competition with output innovations

Hypothesis 4 assumes that adding off-balance sheet activities alter market power, while changes in the underlying market structure should be evaluated. Testing this hypothesis will also provide estimated scope economies with robustness since the validity of these results depend on the competitive assumptions mentioned above. Two different procedures are employed to achieve this goal following the New Industrial Organization literature. The first one is the H-statistic proposed by Panzar and Rosse (1987) to study the underlying market structure. The second one refers to changes in competition over time and consists in the estimation of the mark-up of price over marginal costs and the Lerner Index for various output definitions.

The H-statistic is defined as the elasticity of total revenues to changes in factor prices and it is computed following other studies such as De Bandt and Davis, (2000); and Bikker and Haaf (2002). The empirical approach consists in the estimation of the following equation:

$$\ln TR = h\ (\ln r_i,\ \ln Q,\ \ln(LN/Q),\ \ln(DP/funding)) \qquad (15)$$

where $\ln TR$ is log of total interest and non-interest revenues; $\ln r_i$ = logs of three input prices (price of deposits and other funding; price of labor, and price of physical capital). There is an output capacity control variable, $\ln Q$ -which is the value of total output- and two specialization variables, $\ln(LN/Q)$ -the ratio of loans to total assets- and $\ln(DP/funding)$- the log of the ratio of the value of deposits in total bank funding. The H-statistic is the sum of the derivatives, $\sum \delta \ln TR / \delta \ln r_i$. H can be negative (input costs falling and revenue rising) suggesting strong monopoly power. If H = 1.0, then changes in costs are passed on to output prices, suggesting perfect competition. When H is positive but less than 1.0, monopolistic competition holds. The empirical approach of the H-

statistic to banking requires to assume that banks are single product firms. Similarly to the multioutput approach, two main definitions of total output are given. The first one only includes on-balance sheet assets. The second one incorporates off-balance sheet innovations by adding loan commitments and mutual funds to the output definition[14]. In order to measure the effect of non-interest revenue on competition we also include the estimation for interest revenue alone. The H-statistic equation in [15] is estimated using a fixed-effects panel data model[15].

Changes in market power over time are inferred by estimating the Lerner index. The Lerner index can be derived from a general profit maximization function in a market with *m* firms:

$$\underset{q_j}{Max}\,\Pi_j = p(y)y_j - c(y_j, w_j) \quad with \ \sum_j y_j = y \qquad j = 1,\ldots,m \tag{16}$$

where Π_j is the profit function of bank *j*; *p* is the output price; and $c(y_i,w_j)$ is the cost function of bank *k*, where y_i is the output quantity and w_j is the vector of input prices. From first order conditions we obtain:

$$p - c'(y_j, w_j) = \frac{1}{\varepsilon^*}\theta_j \quad s.t. \quad \frac{1}{\varepsilon^*} = \frac{\delta p}{\delta y} y_j \tag{17}$$

where the mark-up of price over marginal costs ($(p- c'(y_i,w_j)$) equals the inverse of the semi-elasticity of demand ($1/\varepsilon^*$) times a market structure parameter (θ_j). The Lerner index will be, then, defined as the mark-up relative to output price ($[(p- c'(y_i,w_j)]/p$). Since marginal cost has to be estimated, the composite function is employed here also to estimate the marginal cost of total output.

[14] The estimation of marginal cost within a multioutput framework will give different marginal cost estimations for each one of the outputs analyzed so that a price will have to be defined for each one of these outputs and the overall changes in competition could not be globally assessed.

[15] As noted by Bresnahan (1989) the H-statistic results will only be consistent when the industry is in long-run equilibrium. The standard procedure is to estimate the H-statistic using the ratio of net income to total assets (ROA) as the dependent variable. If the value of the H-statistic is not significantly different from zero, the industry is presumed to be in long-run equilibrium. It should be also taken into account that the robustness of the H-statistic results increases with the time period considered so that we do not split the time horizon to guarantee robustness in a long-run perspective.

Since the aim is to compare the effect of output innovations on competition, the Lerner index is estimated considering total assets and total assets plus off-balance sheet (including loan commitments and mutual funds) as the output definitions, in order to find out if the level of competition varies significantly with output innovations. The Lerner is computed for two time periods (1993-1995 and 1996-1999) separated by the advent of the Single Market in Europe and a change in the business cycle.

5. Empirical results

5.1. Cost and profit complementarities in traditional and non-traditional banking

The composite cost and profit functions were estimated to test hypothesis 1 -scope economies increasing in traditional activities with off-balance sheet technological and informational improvements- and hypothesis 2 –cross-selling benefits from output diversification beyond the balance sheet. Estimated parameters are shown in the Appendix B. Table 3 presents the results for the cost function. Global scope economies in the joint production of balance sheet outputs –loans, deposits and other earning assets- rise to 19% where a 3% correspond to fixed scope economies and a 16% to cost complementarities. These economies decrease monotonically with diversification. However, when the output includes off-balance sheet –adding loan commitments to loans and mutual funds to other earning assets- these economies move up to 44%, showing the potential complementarities beyond the balance sheet.

The results are even more informative when analyzing cost complementarities between output pairs. Economies between deposits and loans rise to 11% although they increase to 42% if loan commitments are considered together with loans, showing the relevance of relationship lending on achieving the theoretically assumed complementarities of traditional banking (Kashyap et al., 1999). Nevertheless, the cost differences between traditional and market-based activities are clearly reflected in the diseconomies found between loans (or deposits) and other earning assets, even when mutual funds activities are included, a result in line with Jagtiani et al. (1995). However, as shown above, the overall effects of diversification seem to be positive from the cost perspective.

Hypotheses 1 and 2 also need to be tested regarding the profit side. Table 4 shows the main results derived from the profit composite function. Estimated global profit scope economies are negative (-22%) when considering only balance sheet outputs. Nevertheless, these global diseconomies disappear when adding off-balance sheet services –where profit opportunities are expected to be higher- to output mix, becoming virtually zero, a similar result to Berger et al. (1996) for the US. Complementarities between output pairs, however, reveal some interesting additional information. First of all, estimated profit complementarities between deposits and loans are unexpectedly negative (-34%). However, this situation reverses if loan commitments are included together with loans, showing that profit advantages in Spanish traditional banking only appear when the connection between lending activity and deposit services is widely defined. Secondly, complementarities between loans and securities appear in the profit side and are high and significant (79%). Put simply, this result may be showing the portfolio complementarities between loans and market-based activities. These benefits are even higher if mutual funds are included along with other earning assets. Finally, profit complementarities between deposits and other earning assets are negative, even when mutual funds are included, apparently rejecting profit cross-selling advantages between traditional and non-traditional saving products.

Overall, hypothesis 1 seem to be plausible since there appear to be significant improvements in cost and profit scope economies when lending and deposit taking activities are considered together with off-balance sheet' loan commitments, showing the relevance of defining properly the scope of relationship lending. Secondly, regarding hypothesis 2, profit improvements have also been found with output diversification beyond the balance sheet although these benefits are more significant among certain outputs than globally and, apparently, there are not cross-selling advantages between deposits and other savings instruments such as mutual funds.

5.2. One-stop banking beyond the balance sheet

Together with costs and profits, complementarities in the consumption of banking services when including off-balance sheet business (hypothesis 3) are obtained by estimating revenue scope economies. The results from the revenue composite function are shown in Table 5 (the

estimated parameters are also shown in the Appendix B). Global revenue scope diseconomies are found between balance sheet outputs. The positive value of the fixed economies component has to be considered as spurious since it would imply positive revenues when the output level is zero[16]. However, the diseconomies turn positive although insignificant (1%) when off-balance sheet business is included. Estimated fixed scope economies are zero, as expected, in this case.

In any event, it is difficult to appreciate how consumers value one-stop banking globally. Therefore, revenue complementarities between specific financial services are shown. According to Berger, Humphrey and Pulley (1996), revenue complementarities are not found between loans and deposits. Moreover, they are negative (-15%). It should be noted, however, that the valuation of the joint supply of lending and deposit services become positive and significant (29%) when including loans commitments along with loans. As for profits, there are also revenue complementarities between loans and other earning assets (54%) that are even higher when including off-balance sheet activities such as mutual funds (88%) showing the positive valuation of a wide range of financial possibilities by households and firms. However, as for profits, consumers do not appear to value the joint consumption of deposits services with other earning assets. Therefore, regarding hypothesis 3, consumers apparently value one-stop banking in Spain, although this valuation can be only detected when including off-balance sheet business along with traditional services.

Since both cost and (profit) revenue complementarities have been found, these results will be only valid in a less than competitive environment. This is shown in the next subsection, where changes in market power and market structure with output mix are estimated.

5.3.Robustness check for scope economies estimations: a five-output composite function.

As indicated above, a five-output composite function is also estimated to check for the robustness of the results to changes in scale with innovations. Off-balance sheet activities (mutual funds and loan commitments) are considered here as different outputs so that their informational properties cannot be jointly assessed although each one of them can be related separately to the

[16] A similar result is obtained in Berger et al. (1996).

rest of the outputs within this alternative definition. Therefore, these estimations will serve as to check for the robustness of the results to changes in scale effects and to analyze complementarities for each one of the five activities separately.

The results for the cost, profit and revenue global scope economies and output-pair complementarities are shown in Table 6. Overall, these results are clearly in line with those obtained employing the aggregation method since global cost scope economies are positive and significant (23%) and profit and revenue global scope economies are also found to be positive but lower (2% and 5%, respectively). Consequently, these results –as those obtained when aggregating off-balance sheet outputs- contrast with the profit and revenue diseconomies found within the traditional output mix definition (loans, deposits and other earning assets) in earlier studies. Complementarities between outputs are also in accordance with the aggregation method results. Significant cost and profit complementarities are found between the various combinations of loans, deposits and loan commitments (ranging from 0.16% to 0.46%), while significant revenue complementarities between deposits and loan commitments, as well as between loans and loan commitments are also found. These results appear to show the relevance of lending relationships in explaining the transformation function of bank intermediaries. Finally, important profit and revenue complementarities are found between loans and other earning assets and between loans and mutual funds, showing their cross-selling and portfolio diversification advantages, while profit and revenue diseconomies are found between deposits and mutual funds.

5.4. The market power beyond the balance sheet

Spanish bank market structure should be explored to contrast if diversification has brought significant changes in competition among Spanish banks (hypothesis 4). These results are shown in Table 7. The Lerner index is computed from the FF as to compare the evolution of competition within the Spanish banking industry alternatively employing a traditional definition of bank output (total assets) and a definition of output beyond the balance sheet (total assets plus loan commitments and mutual funds). The results suggest an increase in competition between 1993 and 1999 when only balance sheet business is considered. When adding off-balance sheet outputs, the

Lerner index rises significantly[17] and it seems to be higher in large, well diversified banks. Therefore, diversification may imply a countervailing effect to the rising competition in traditional markets, increasing non-interest revenue and fee-earning activities as to compensate the reduction in loan rates.

How these changes have affected the underlying market structure? The H-statistic was computed for both balance sheet output definition and the alternative output definition (including loan commitments and mutual funds). The estimations were undertaken considering interest revenue and total revenue separately. As shown in Table 7, the estimated values of the H-statistic when the output is total assets are 0.48 (interest revenue) and 0.59 (total revenue). Including off-balance sheet activities, these values are 0.45 (interest revenue) and 0.57 (total revenue). Hypotheses H=0 and H=1 can be rejected in all cases and therefore, monopolistic competition holds. Long-run equilibrium seem to be achieved in all cases, as shown also in Table 7, since the H-statistic is not significantly different from zero when ROA is employed as the dependent variable.

Combining the mark-up and Lerner index results with the H-statistic, it can be argued that perfect competition does not seem to characterize Spanish bank market' structure. Although off-balance sheet business may alter the competition indicators, the changes are not significant enough as to modify the estimated market structure.

6. The coexistence of cost and revenue complementarities: conclusions and competitive caveats

Innovations and changes in regulation are changing the financial landscape all over the world. Financial institutions, as multiouput technologies, are largely conditioned by the development of new products and the limits imposed by regulation to diversify their activities beyond the traditional bounds (broad banking). Since both innovations and regulations have experienced significant transformations across countries and over time, we wonder the extent to which those changes may be affecting banks' cost, profit and revenue differently. Many previous studies have

[17] A mean-difference test was applied to test for the significance of changes in the Lerner index both across time and between the different output definitions.

analyzed these parameters but most of them refer to the US in the pre-deregulated environment, with different methodologies to model multioutput technologies and rarely considering off-balance sheet business.

The Spanish banking system seems to be a good laboratory to study the behavior of cost, profits and revenues in a 'broad banking environment' including new business lines in the output mix. A composite function is employed to estimate cost, profit and revenue economies of scope. Three main hypotheses were tested. The main results confer an important role to output mix in revealing cost, profit or revenue scope economies and complementarities between output pairs. In particular, certain cost and profit complementarities predicted in theoretical models (ie., between deposits and loans) only appear when their off-balance sheet technological expansion (loan commitments) is incorporated (hypothesis 1), while other cost and profit global scope economies improved significantly when including mutual funds along with other earning assets, showing certain cross-selling and portfolio diversification benefits (hypothesis 2). Together, revenue complementarities were computed as a proxy for consumer valuation of one-stop banking, as the joint supply of various financial services (hypothesis 3). Revenue complementarities between deposits and loans were only found when loan commitments were included, while complementarities between loans and other earning assets increased significantly when mutual funds were added. The results obtained in a 'broad banking system' contrast with previous evidence in more restricted environments.

Finally, it should noted that the coexistence of costs and profit (revenue) complementarities is possible under a less than perfectly competitive environment, as it has been empirically tested by analyzing market power with output diversification (hypothesis 4). However, the results of the competitive analysis reveal that diversification increases market power although these changes have not yet contributed to alter the underlying bank market structure in Spain significantly.

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APPENDIX A. COST AND PROFIT ISSUES AND OUTPUT MIX. SOME ILLUSTRATIVE CONTRIBUTIONS

Authors	Year	Scope	Output	Methodology	Contribution
Benston et al.	1982	United States	Traditional	Various comparisons (translog, fourier)	Seminal work on scale economies behaviour and cost functions in banking
Berger et al.	1996	United States	Traditional	Composite function	An empirical analysis of consumer valuation of banking services
Clark	1988	Survey	-	-	A comprehensive survey of the previous literature
Clark and Siems	2002	Survey	On- and off-balance sheet	X-efficiency	Importance of off-balance sheet business when measuring efficiency
Das and Nanda	1999	Theoretical	-	-	Strong relationship between specialization, information asymmetries and competition
Degryse and Van Caseele	2000	European	Traditional	OLS and logit regressions	Differences in pricing behavior and information depending on specialization
Dietsch and Lozano-Vivas	2000	France and Spain	Traditional	Distribution free approach and common cost frontiers	Importance of environmental variables in efficiency
Ferrier et al.	1993	United States	Traditional	Non-parametric frontier	Diseconomies of diversification. Inefficiency more important than scale
Gallo et al.	1996	United States	On and off-balance sheet	Various regression methodologies	Important implications on off-balance sheet business on risk and profitability
Golter	1996	Survey	On and off-balance sheet	-	Implications for banks of mutual funds growth
Humphrey and Pulley	1997	United States	Traditional	Indirect composite profit function	Decomposition on internal and external influences on profits
Jagtiani et al.	1995	United States	On and off-balance sheet	Translog function	Relevance of regulation and off-balance sheet business on scale and scope economies
Jagtiani and Khantavit	1996	United States	On and off-balance sheet	Translog function	Relevance of off-balance sheet business on scale and scope economies
Kane	1995	United States	On and off-balance sheet	Various regression methodologies	Valued-added of offering mutual funds at large banks in terms of risk and return

Kashyap et al.	1999	Theoretical	-	-	A model for the coexistence of lending and deposit-taking activities
McKillop et al.	1996	Japan	Traditional	Composite cost function	Inefficiencies for certain output mixes at large Japanese banks
Mester	1992	United States	On and off-balance sheet	Modified translog function	No advantages from product mix diversification excepting for lending
Noulas et al.	1993	United States	Traditional	Translog function	Importance of regularity conditions in measuring scope economies
Pulley and Braunstein	1992	United States	Traditional	Composite cost function	A seminal work on the convenience of the composite function in measuring scope economies
Pulley and Humphrey	1993	United States	Traditional	Composite cost function	Regulatory effects (narrow banking proposals) are measured through scope economies decomposition
Rime and Stiroh	2003	Switzerland	On and off-balance sheet	Translog and distribution-free approach	Large relative cost and profit inefficiencies in universal Swiss banks
Rogers	1998	United States	On and off-balance sheet	Revenue and profit frontiers	Advantages of expanding with products with similar characteristics to traditional ones

APPENDIX B. PARAMETER ESTIMATES FOR COMPOSITE COST, PROFIT AND REVENUE FUNCTIONS

A1. PARAMETER ESTIMATES FOR THE COMPOSITE COST FUNCTION

Number of observations = 1147

Parameter	Estimate	t-statistic
ϕ	-0.1282	-2.14
α_0	1084.82	2.68
α_1	0.111622	0.50
α_2	0.970088	4.41
α_3	0.044007	0.31
α_{11}	0.000002	1.55
α_{22}	0.0000035	2.40
α_{33}	-0.00000008	-1.27
α_{12}	-0.000003	-2.73
α_{21}	0.0000013	0.61
α_{22}	-0.0000085	-0.48
δ_{11}	0.043389	1.02
δ_{12}	0.102703	3.55
δ_{21}	0.0995549	3.42
δ_{22}	-0.128820	-3.89
δ_{31}	0.0578551	0.60
δ_{32}	0.014871	0.52
β_1	0.947671	10.28
β_2	0.079999	0.06
β_{11}	0.170083	8.74
β_{22}	0.042365	1.42
β_{12}	-0.069343	-3.50

R^2=0.97

A2. PARAMETER ESTIMATES FOR THE COMPOSITE PROFIT FUNCTION

Number of observations = 1147

Parameter	Estimate	t-statistic
ϕ	0.30217	4.85
α_0	635.297	0.93
α_1	0.12316	0.97
α_2	0.070653	0.90
α_3	-0.20975	-0.68
α_{11}	0.0000004	0.71
α_{22}	0.00000002	0.04
α_{33}	0.00000005	0.51
α_{12}	-0.0000002	-0.48
α_{21}	-0.0000004	-0.89
α_{22}	0.0000001	0.60
δ_{11}	0.02350	1.03
δ_{12}	-0.01001	-0.53
δ_{21}	-0.1221	-0.53
δ_{22}	-0.01773	-1.07
δ_{31}	-0.02617	-0.75
δ_{32}	0.04161	0.68
β_1	0.68116	2.33
β_2	-0.10492	-0.44
β_{11}	-0.08471	-0.21
β_{22}	0.07909	0.94
β_{12}	-0.12392	-3.42
R^2=0.96		

A3. PARAMETER ESTIMATES FOR THE COMPOSITE REVENUE FUNCTION

Number of observations = 1147

Parameter	Estimate	t-statistic
ϕ	0.5115594	2.95
α_0	10799.0	1.06
α_1	3.77863	0.97
α_2	1.93065	1.14
α_3	-0.018649	-0.04
α_{11}	0.000003	0.84
α_{22}	0.000002	0.63
α_{33}	-0.0000007	-1.17
α_{12}	-0.000003	-0.86
α_{21}	-0.000002	-1.26
α_{22}	0.000003	1.34
δ_{11}	0.143641	0.59
δ_{12}	-0.297619	-0.78
δ_{21}	0.262678	1.38
δ_{22}	-0.387159	-1.09
δ_{31}	-0.121068	-1.01
δ_{32}	-0.048683	-0.42
β_1	1.26747	7.36
β_2	-0.36115	-0.90
β_{11}	0.088978	4.93
β_{22}	0.180579	2.07
β_{12}	-0.149424	-4.17
R^2=0.95		

TABLE 1. REGULATORY TREATMENT OF THE MIXING OF BANKING, SECURITIES AND INSURANCE ACTIVITIES AND THE MIXING OF BANKING AND COMMERCE (1997)

EU-15, United States and Japan

COUNTRY	SECURITIES	INSURANCE	COMMERCIAL BANK OWNERSHIP OF COMMERCIAL FIRMS	COMMERCIAL BANK OWNERSHIP OF COMMERCIAL BANKS
AUSTRIA	Unrestricted	Permitted	Unrestricted	Unrestricted
BELGIUM	Permitted	Permitted	Restricted	Unrestricted
DENMARK	Unrestricted	Permitted	Permitted	Unrestricted
FINLAND	Unrestricted	Restricted	Unrestricted	Unrestricted
FRANCE	Permitted	Permitted	Permitted	Permitted
GERMANY	Unrestricted	Restricted	Unrestricted	Unrestricted
GREECE	Permitted	Restricted	Unrestricted	Unrestricted
IRELAND	Unrestricted	Restricted	Unrestricted	Unrestricted
ITALY	Unrestricted	Permitted	Restricted	Restricted
LUXEMBURG	Unrestricted	Permitted	Unrestricted	Restricted
NETHERLANDS	Unrestricted	Permitted	Unrestricted	Unrestricted
PORTUGAL	Unrestricted	Permitted	Permitted	Unrestricted
SPAIN	Unrestricted	Permitted	Unrestricted	Permitted
SWEDEN	Unrestricted	Permitted	Restricted	Unrestricted
UNITED KINGDOM	Unrestricted	Permitted	Unrestricted	Unrestricted
UNITED STATES	Restricted	Prohibited, generally	Prohibited, generally	Prohibited, generally
JAPAN	Restricted	Prohibited	Restricted	Prohibited, generally

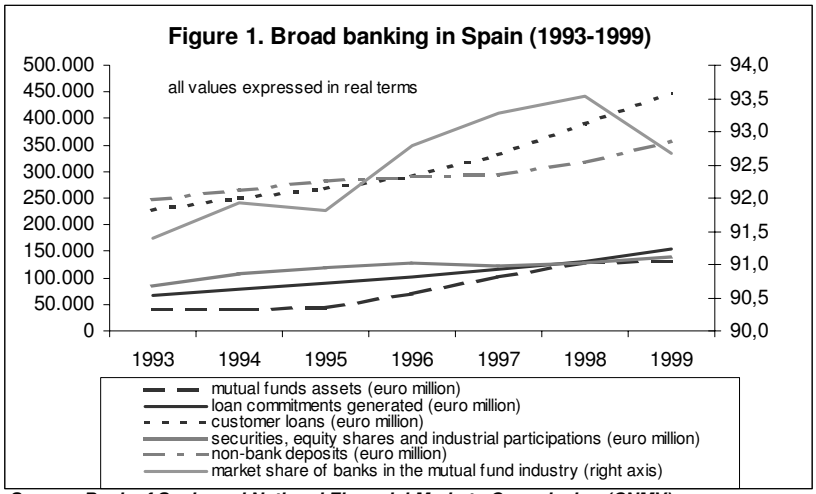
Notes:

FOR SECURITIES AND INSURANCE:
- Unrestricted: A full range of activities in the given category can be conducted directly by the bank.
- Permitted: A full range of activities can be conducted, but all or some must be conducted in subsidiaries.
- Restricted: Less than a full range of activities can be conducted in the bank or subsidiaries.
- Prohibited: The activity cannot be conducted in either the bank or the subsidiaries.

FOR THE OWNERSHIP OF COMMERCIAL FIRMS OR OTHER COMMERCIAL BANKS:
- Unrestricted: 100 percent ownership permitted.
- Permitted: Unrestricted but ownership is limited based upon bank's equity capital.
- Restricted: Less than 100 percent ownership.
- Prohibited: Prohibited.

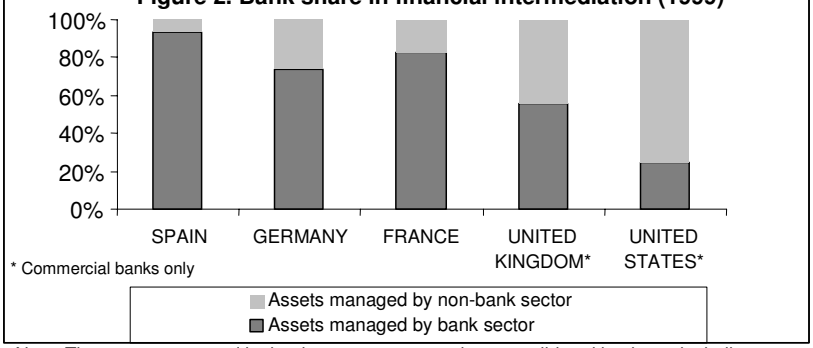
Securities activities include underwriting, dealing with brokering all kinds of activities and all aspects of the mutual fund business. Insurance activities include underwriting and selling insurance products/services as principal as agent.

Source: Barth, Brumbaugh and Wilcox (2000)



Source: Bank of Spain and National Financial Markets Commission (CNMV).

Figure 2. Bank share in financial intermediation (1999)



Note: The assets managed by bank sector correspond to consolidated business including subsidiaries such as bank-owned mutual or pension funds management companies or insurance and brokerage firms. Non bank sector includes specialized credit institutions, insurance companies, mutual and pension funds companies, finance companies security brokers and dealers and other funding corporations.

Source: Bank Profitability (OECD) and national financial accounts.

TABLE 2. SUMMARY STATISTICS FOR THE POSITED EXPLANATORY VARIABLES

Variable	*Mean*	*Standard deviation*	*Minimum*	*Maximum*
TC	290.3	403.2	84.2	772.3
PF	71.8	145.5	14.5	306.3
TR	385.0	356.7	95.5	804.8
LN	3016.8	6408.2	852.1	17386.2
DP	3309.5	5947.9	926.4	17687.3
OE	1204.9	2273.8	118.2	5358.9
LC	1701.7	3141.2	69.3	6397.1
MF	2372.0	4824.7	542.5	8897.3
DC	0.053	0.054	0.043	0.072
SC	16.40	26.78	12.13	29.38
KC	0.18	0.30	0.11	0.46

TABLE 3. COST SCOPE ECONOMIES AND COMPLEMENTARITIES AND OUTPUT MIX. SPANISH BANKING SYSTEM (1993-1999).
Composite function results (testing hypotheses 1 and 2)
Global scope economies>0 = economies; Global scope economies<0 = diseconomies
3 Inputs: deposits, labor and physical capital
Number of observations = 531

GLOBAL COST SCOPE ECONOMIES

(1) Output mix (deposits; loans; securities + other earning assets)

Specialization	Global scope economies	Fixed-scope economies	Cost complementarities
ε = 0.0	0.19*	0.03*	0.16*
ε = 0.01	0.18*	0.03*	0.15*
ε = 0.05	0.14*	0.03*	0.11*
ε = 0.1	0.10*	0.03*	0.07*
ε = 0.2	0.03*	0.03*	0.00*
ε = 0.3	0.01*	0.04*	-0.03*

(2) Output mix (deposits; loans + loan commitments; securities + other earning assets + mutual funds)

Specialization	Global scope economies	Fixed-scope economies	Cost complementarities
ε = 0.0	0.44	0.01	0.43*
ε = 0.01	0.39	0.02	0.37*
ε = 0.05	0.21	0.02	0.19
ε = 0.1	0.32	0.02	0.30
ε = 0.2	-0.23*	0.02	-0.25*
ε = 0.3	-0.35*	0.02	-0.37*

COST COMPLEMENTARITIES FOR SPECIFIC OUTPUT PAIRS

Specialization	Complementarities deposits-loans	Complementarities loans-securities + other earning assets	Complementarities deposits-securities + other earning assets
ε = 0.0	0.11*	-0.58*	-0.24*
ε = 0.01	0.10*	-0.57*	-0.24*
ε = 0.05	0.02*	-0.55*	-0.26*
ε = 0.1	0.02*	-0.52*	-0.28*
ε = 0.2	-0.21*	-0.46*	-0.32*
ε = 0.3	-0.32*	-0.38*	-0.35*

Specialization	Complementarities deposits-loans + loan commitments	Complementarities loans-securities + other earning assets + mutual funds	Complementarities deposits-securities + other earning assets + mutual funds
ε = 0.0	0.42*	-0.63*	0.06*
ε = 0.01	0.36*	-0.64*	0.03*
ε = 0.05	0.15	-0.65	-0.07
ε = 0.1	-0.08	-0.67	-0.20
ε = 0.2	-0.41*	-0.67*	-0.40
ε = 0.3	-0.57*	-0.61*	-0.55*

* statistically significant at 1 per cent level

TABLE 4. PROFIT SCOPE ECONOMIES AND COMPLEMENTARITIES AND OUTPUT MIX. SPANISH BANKING SYSTEM (1993-1999).
Composite function results (testing hypotheses 1 and 2)
Global scope economies>0 = economies; Global scope economies<0 = diseconomies
3 Inputs: deposits, labor and physical capital
Number of observations = 531

GLOBAL PROFIT SCOPE ECONOMIES

(1) Output mix (deposits; loans; securities + other earning assets)

Specialization	Global scope economies	Fixed-scope economies	Cost complementarities
ε = 0.0	-0.22	0.13	-0.35*
ε = 0.01	-0.21	0.15	-0.36*
ε = 0.05	-0.18	0.17	-0.35
ε = 0.1	-0.14	0.15	-0.29
ε = 0.2	-0.09*	0.13	-0.22*
ε = 0.3	-0.06*	0.19	-0.25*

(2) Output mix (deposits; loans + loan commitments; securities + other earning assets + mutual funds)

Specialization	Global scope economies	Fixed-scope economies	Cost complementarities
ε = 0.0	0.01	0.00	0.01*
ε = 0.01	0.01	0.00	0.01*
ε = 0.05	-0.02	0.00	-0.02
ε = 0.1	-0.06	0.00	-0.06
ε = 0.2	-0.11*	0.00	-0.11*
ε = 0.3	-0.14*	0.00	-0.14*

PROFIT COMPLEMENTARITIES FOR SPECIFIC OUTPUT PAIRS

Specialization	Complementarities deposits-loans	Complementarities loans-securities + other earning assets	Complementarities deposits-securities + other earning assets
ε = 0.0	-0.34*	0.79*	-0.09*
ε = 0.01	-0.32*	0.78*	-0.09*
ε = 0.05	-0.25	0.70	-0.06*
ε = 0.1	-0.16	0.62	-0.01
ε = 0.2	-0.27*	0.17*	-0.17*
ε = 0.3	0.15*	0.26*	0.18*

Specialization	Complementarities deposits-loans + loan commitments	Complementarities loans-securities + other earning assets + mutual funds	Complementarities deposits-securities + other earning assets + mutual funds
ε = 0.0	0.31*	0.87*	-0.15*
ε = 0.01	0.31*	0.84*	-0.14*
ε = 0.05	0.29*	0.75*	-0.10*
ε = 0.1	0.27*	0.64*	-0.04*
ε = 0.2	0.24*	0.40*	0.07*
ε = 0.3	0.24*	0.28*	0.19*

* statistically significant at 1 per cent level

TABLE 5. REVENUE SCOPE ECONOMIES AND COMPLEMENTARITIES AND OUTPUT MIX. SPANISH BANKING SYSTEM (1993-1999).
Composite function results (testing hypothesis 3)
Global scope economies>0 = economies; Global scope economies<0 = diseconomies
3 Inputs: deposits, labor and physical capital
Number of observations = 531

GLOBAL REVENUE SCOPE ECONOMIES

(1) Output mix (deposits; loans; securities + other earning assets)

Specialization	Global scope economies	Fixed-scope economies	Cost complementarities
ε = 0.0	-0.09	0.19	-0.28
ε = 0.01	-0.08	0.15	-0.23
ε = 0.05	-0.07	0.14	-0.21
ε = 0.1	-0.06*	0.18	-0.24*
ε = 0.2	-0.04*	0.11	-0.15*
ε = 0.3	-0.03*	0.21	-0.24*

(2) Output mix (deposits; loans + loan commitments; securities + other earning assets + mutual funds)

Specialization	Global scope economies	Fixed-scope economies	Cost complementarities
ε = 0.0	0.01	0.00	0.01
ε = 0.01	0.01	0.00	0.01
ε = 0.05	-0.02	0.00	-0.02
ε = 0.1	-0.04	0.00	-0.04
ε = 0.2	-0.08*	0.00	-0.08*
ε = 0.3	-0.09*	0.00	-0.09*

REVENUE COMPLEMENTARITIES FOR SPECIFIC OUTPUT PAIRS

Specialization	Complementarities deposits-loans	Complementarities loans-securities + other earning assets	Complementarities deposits-securities + other earning assets
ε = 0.0	-0.15	0.54*	-0.16
ε = 0.01	-0.12	0.53*	-0.13
ε = 0.05	-0.08	0.50*	-0.08
ε = 0.1	0.03	0.46*	-0.04
ε = 0.2	0.12*	0.38*	0.11*
ε = 0.3	0.18*	0.28*	0.17*

Specialization	Complementarities deposits-loans + loan commitments	Complementarities loans-securities + other earning assets + mutual funds	Complementarities deposits-securities + other earning assets + mutual funds
ε = 0.0	0.29*	0.88*	-0.86*
ε = 0.01	0.29*	0.86*	-0.83*
ε = 0.05	0.27*	0.78*	-0.67*
ε = 0.1	0.26*	0.68*	-0.49*
ε = 0.2	0.25*	0.50*	-0.14*
ε = 0.3	0.25*	0.34*	0.16*

* statistically significant at 1 per cent level

TABLE 6. ROBUSTNESS CHECK: SCOPE ECONOMIES IN THE SPANISH BANKING SYSTEM WITH A FIVE-OUTPUTS DEFINITION (1993-1999).

Composite function results

Global scope economies>0 = economies; Global scope economies<0 = diseconomies
3 Inputs: deposits, labor and physical capital
Number of observations = 531

GLOBAL COST, PROFIT AND REVENUE SCOPE ECONOMIES

Output mix (deposits; loans; securities + other earning assets; mutual funds; loan commitments)

Specialization	Global scope economies			Fixed-scope economies			Complementarities		
	COST	PROFIT	REVENUE	COST	PROFIT	REVENUE	COST	PROFIT	REVENUE
ε = 0.0	0.23*	0.02*	0.05*	0.08*	0.00	0.00	0.15*	0.02*	0.05*
ε = 0.01	0.20*	0.01*	0.05*	0.09*	0.00	0.00	0.11*	0.01*	0.05*
ε = 0.05	0.12*	-0.08*	0.04*	0.02	0.00	0.00	0.10*	-0.08*	0.04*
ε = 0.10	0.05*	-0.18*	0.02	0.09*	0.00	0.00	-0.04*	-0.18*	0.02
ε = 0.15	0.01*	-0.28*	0.01	0.07	0.00	0.00	-0.06*	-0.28*	0.01
ε = 0.2	-0.01*	-0.38*	-0.01	0.13	0.00	0.00	-0.14	-0.38*	-0.01

COST, PROFIT AND REVENUE COMPLEMENTARITIES FOR SPECIFIC OUTPUT PAIRS

Specialization	Complementarities deposits-loans			Complementarities deposits-securities + other earning assets			Complementarities deposits-mutual funds			Complementarities deposits-loan commitments			Complementarities loans-securities + other earning assets		
	COST	PROFIT	REVENUE	COST	PROFIT	REVENUE	COST	PROFIT	REVENUE	COST	PROFIT	REVENUE	COST	PROFIT	REVENUE
ε = 0.0	0.25*	0.16*	-0.12*	-0.57*	-0.15*	-0.14*	-0.19	-0.11*	-0.43*	0.46*	0.17*	0.27*	-0.48*	0.76*	0.33*
ε = 0.01	0.18*	0.14*	-0.11*	-0.55*	-0.14*	-0.14*	-0.19	-0.10*	-0.43*	0.37*	0.16*	0.27*	-0.45*	0.74*	0.31*
ε = 0.05	-0.18	0.08*	-0.11*	-0.47	-0.11*	-0.13	-0.18*	-0.09*	-0.41*	0.07*	0.13*	0.26*	-0.35	0.65*	0.27*
ε = 0.10	-0.51	-0.01	-0.10*	-0.37	-0.08*	-0.12	-0.17	-0.06*	-0.38	-0.21*	0.09*	0.24*	-0.25*	0.55*	0.23
ε = 0.15	-0.74*	-0.13	-0.10	-0.26*	-0.04	-0.11	-0.16*	-0.03	-0.18	-0.38*	0.05*	0.23*	-0.18*	0.47*	0.17
ε = 0.2	-0.85	-0.28	-0.09	-0.15*	0.01	-0.10	-0.15	0.01	-0.11	-0.45*	-0.01	0.15*	-0.14	0.40*	0.14

Specialization	Complementarities loans-mutual funds			Complementarities loans-loan commitments			Complementarities securities + other earning assets-mutual funds			Complementarities securities + other earning assets-loan commitments			Complementarities mutual funds-loan commitments		
	COST	PROFIT	REVENUE	COST	PROFIT	REVENUE	COST	PROFIT	REVENUE	COST	PROFIT	REVENUE	COST	PROFIT	REVENUE
ε = 0.0	-0.72	0.64*	0.42*	0.43*	0.31*	0.35*	-0.38	0.01*	0.25	-0.44	-0.32*	-0.20	-0.39	-0.38	-0.22*
ε = 0.01	-0.69	0.63*	0.40*	0.42*	0.30*	0.33*	-0.37	-0.01*	0.24	-0.43	-0.31*	-0.20	-0.39	-0.36	-0.21*
ε = 0.05	-0.60	0.55*	0.33*	0.42	0.28*	0.28*	-0.36	-0.01*	0.23*	-0.39	-0.24*	-0.18*	-0.39	-0.28	-0.18*
ε = 0.10	-0.51	0.47*	0.25	0.24*	0.24*	0.22	-0.35*	-0.03*	0.21*	-0.35	-0.18*	-0.17*	-0.38	-0.21	-0.16
ε = 0.15	-0.44	0.40*	0.19*	0.14	0.18*	0.16	-0.33*	-0.07*	0.16*	-0.33	-0.13*	-0.15	-0.24	-0.14	-0.11
ε = 0.2	-0.39	0.31*	0.12	0.02	0.12*	0.11	-0.3*	0.13*	0.08*	-0.30	-0.09	-0.04	-0.12	-0.10	-0.03

* statistically significant at 1 per cent level

TABLE 7. OUPUT MIX AND RELATED CHANGES IN SPANISH BANKING MARKET STRUCTURE (1993-1999).
Number of observations = 531

LERNER INDEX
Composite cost function results

Basis points = BP

	Lerner (total assets) (%)	**Lerner (total assets + loan commitments + mutual funds) (%)**
1993-1995	19.7	31.5
1996-1999	12.9	34.3
ENTIRE PERIOD	15.4	32.3

H-PANZAR ROSSE
Panel data with fixed-effects and time dummies

	H-Panzar-Rosse (INTEREST REVENUE)		**H-Panzar-Rosse (TOTAL REVENUE)**	
Control variable for output capacity	Total assets	Total assets + off-balance sheet	Total assets	Total assets + off-balance sheet
H-statistic	0.48^{MC}	0.45 ^{MC}	0.59 ^{MC}	0.57 ^{MC}
Long-run equilibrium test	0.014^{LRE}	0.013^{LRE}	0.014^{LRE}	0.013^{LRE}

MC: monopolistic competition (H=0 and H=1 hypotheses rejected)
LRE: Long-run equilibrium (H=0 not rejected when Return on Assets is employed as dependent variable)
NOTE: All the estimations reported were statistically significant at 1 per cent level.

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