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Deregulation and Productivity: The Case of Spanish Banks *

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RESUMEN

El trabajo propone una nueva aproximación para medir el crecimiento en la productividad total de los factores (PTF) incorporando diferentes tipos de medidas de desregulación. El crecimiento en la PTF se descompone en el efecto externo, de escala y de markup (en precios de outputs). La contribución del componente externo al crecimiento en la PTF se descompone a su vez en el efecto debido a diferentes tipos de cambios regulatorios y en el efecto del cambio tecnológico. La ecuación de descomposición del crecimiento de la PTF se ha incluido como una ecuación adicional en el sistema de costes a estimar. La aplicación empírica se realiza para el caso de la industria bancaria española (cajas de ahorros y bancos comerciales), utilizando datos de panel, dado el proceso de desregulación profundo y rápido al que ha estado sometida esta industria en los últimos años. Los resultados sugieren que la desregulación, en general, ha contribuido positivamente al crecimiento en la PTF para los dos tipos de entidades bancarias analizadas. En particular, la desregulación en el ámbito nacional (europeo) ha ejercido un mayor impacto sobre el crecimiento de la PTF de las cajas de ahorros (bancos comerciales).

Palabras clave: Productividad total de los factores, markup, desregulación, cambio tecnológico.

JEL classificación: D24, D40, G21

ABSTRACT

This paper deals with measuring total factor productivity (TFP) growth of financial institutions incorporating different types of deregulatory measures. TFP growth is decomposed into external, scale, and markup (in output prices) components. The contribution of the external component is further dissected into several types of deregulation and technical change components. We include the TFP growth relationship as an additional equation in estimating the cost system. The empirical model uses panel data on Spanish banks (savings and commercial), primarily because the Spanish banking sector went through rapid deregulatory changes. We find that deregulations, in general, contributed positively to TFP growth for both savings and commercial banks. Furthermore, domestic (European) deregulations had a greater effect on TFP growth of savings (commercial) banks.

Keywords: Total factor productivity, markup, deregulation, and technical change.

JEL classification: D24, D40, G21

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1. Introduction

In recent years important structural changes took place around the world as a result of the globalization of markets, the creation of economic blocks, etc. Because of these changes many sectors of the industrialized countries have gone through major deregulatory changes to acclimate themselves to new environments. Standard microeconomic theory tells us that the presence of any binding constraints (due to regulations or otherwise) in the allocation of resources increases the cost of producing any given level of outputs or services. This is because the presence of constraints leads to inefficient (non-optimal) allocation of inputs, resulting in increased costs. Conversely, when an industry encounters slack in regulations (or is deregulated), it is expected to generate some cost savings (given the level of outputs), which might be reflected in higher productivity growth. Thus increased competition and productivity gain seem to be the two motivating forces behind deregulation.[1] Since deregulation is exogenous to the firm, and may affect productivity, it is necessary to adjust the productivity growth residuals to accommodate effects of such external factors. Inclusion of these external factors to explain productivity growth will allow us to examine whether a competitive environment resulting from deregulation promotes productivity growth. Although deregulatory measures adopted by many sectors of industrialized countries have affected the cost-output relation of the firms and their performances, such effects have not been taken into account in the measurement and decomposition of productivity growth using a systematic and unified approach.

There is another gap in the literature on TFP growth decomposition. TFP growth is computed using the Divisia index. Therefore, the sum of the TFP growth components obtained from the parametric model (dual or primal approach) has to be equal to the TFP growth obtained using the Divisia index. But in practice, a wide gap between the two measures is often observed, especially when TFP growth (which is the sum of the TFP growth components) is estimated using parametric models.[2]

The present paper has two main objectives. First, we link deregulation with performance of firms using a unified approach in which effects of different types of deregulation are accounted for. For this, we use a dual cost function and decompose TFP growth into external

[1] In a recent empirical study based on approximately 670 companies in the UK, Nickell (1995) found that a competitive environment resulting from deregulation provides incentives for growth and productivity of firms.
[2] Hulten (2000) points out that in productivity analysis the non-parametric approach of productivity measurement (Divisia index) has to be used with the parametric approach to check the consistency of the results.

factors,[3] scale, and markup (in output markets) components. Second, we consider an approach that avoids the discrepancy between the Divisia and the parametric measures of TFP growth (irrespective of the functional form chosen to represent the underlying production technology).

Our empirical application is focused on the Spanish banks (both savings and commercial banks), primarily because in recent years the Spanish banks have gone through a series of deregulation measures targeted at both the savings and commercial banks, or both. We accommodate the effects of different types of regulation on productivity by allowing the production technology to change with changes in regulation. Although we use Spanish banking data, the present exercise is not limited to the Spanish banking industry.

The rest of the paper is organized as follows. Measurement and decomposition of productivity growth is introduced in Section 2. Section 3 describes the methodology and the empirical model. The data for the empirical application and a brief overview of the recent deregulatory changes in the Spanish banking industry are described in Section 4. The final section contains a summary of our findings and conclusions.

2. Measurement and decomposition of productivity growth

The word productivity in economics is used quite broadly. Here we use TFP as the appropriate measure of productivity. In a single output case TFP growth ($\overset{\bullet}{TFP}$) is formally defined as $\overset{\bullet}{TFP} = \dot{Y} - \sum_j S_j \dot{X}_j$, where Y is output, X_j is input (j = 1, …, J) , S_j is the share of input X_j in the total cost (i.e., $S_j = w_j X_j/\Sigma_j w_j X_j$) -- w_j being the price of input X_j, and a dot over a variable indicates its rate of change. If there are multiple outputs the TFP growth formula is expressed as $\overset{\bullet}{TFP} = \sum_l R_l \dot{Y}_l - \sum_j S_j \dot{X}_j$ where $R_l = p_l y_l / \sum_l p_l y_l$ -- p_l being the price of output y_l (l = 1,…, L). Using the above definitions $\overset{\bullet}{TFP}$ can be computed from the observed data. The resulting measure is called the Divisia index of TFP growth, and gives us information about output growth that is unexplained by the growth of the inputs used.

The non-parametric approach (Divisia index) cannot be used to obtain information on the factors affecting productivity growth. The main advantage of the parametric approach is that we

[3] This component of TFP growth is further decomposed into deregulation and technical change components.

can both estimate and decompose TFP growth.[4] In this respect, the choice of the cost function has some advantages over the production as well as the profit function in productivity growth analysis. First, a cost function can handle multiple outputs quite easily. In contrast, a single equation multiple output production function cannot be estimated econometrically using the input and output data. Second, a cost function can be estimated without imposing any restriction on the implied returns to scale. This is not possible in a profit function (for which returns to scale has to be less than unity). Third, in a service industry like banks outputs may be demand determined (not a choice variable). Consequently, a cost function approach is more appropriate. Finally, in a cost function approach it is not necessary to assume that output markets are competitive. The cost function parameters can be consistently estimated even if output markets are non-competitive, and it is also possible to derive a component of TFP growth attributable to non-competitive market output (divergence of output price from marginal cost).

The traditional framework for productivity growth measurement starts with the dual cost function $C = C(y, w, t)$, where y is an output vector produced with J inputs and w is the input price vector. The time trend variable (t) is introduced into the cost function to capture exogenous technical change. Under constant returns to scale (CRS) and competitive output markets, TFP growth and technical change ($TC = -\partial \ln C / \partial t$) are identical (Solow, 1957). In such a case it is not necessary to estimate anything econometrically. However, even with a CRS technology, other factors that can explain productivity growth may exist. If these factors are observed, we can separate the contribution of factors that are under the control of the firms (internal factors) and those that are exogenous to the firm (external factors) by estimating the underlying production technology econometrically.

If the objective of producers is to minimize cost (given outputs), and the constant returns to scale and perfectly competitive output market assumptions are relaxed, then it is possible to establish a relationship between the Divisia index and the TFP growth components (Denny et al., 1981), viz.,

$$\dot{TFP} = TC + (1 - RTS^{-1})\dot{Y}_C + (\dot{Y}_P - \dot{Y}_C) \equiv TC + Scale + Markup, \qquad (1)$$

[4] Some of the earlier works can be found in the Cowing and Stevenson (1981) edited volume ``Productivity Measurement in Regulated Industries''. For some recent studies see, for example, Atkinson and Halverson (1984), Baltagi and Griffin (1988), Kumbhakar (1992), Bhattacharyya et al. (1997), among others.

where $\dot{Y}_C = \sum_l \left[\varepsilon_{cy_l} / \sum_l \varepsilon_{cy_l} \right] \dot{y}_l$, $\dot{Y}_P = \sum_l \frac{p_l y_l}{R} \dot{y}_l$, and $\varepsilon_{cy_l} = \partial \ln C / \partial \ln y_l$. TC and RTS in (1) can be obtained from a parametric cost function ($C = C(w, y, t)$) when RTS is defined as $RTS^{-1} = \sum_l \partial \ln C / \partial \ln y_l$. Thus the first component of TFP growth is TC and the second component is the *Scale* component (being related to RTS), which is zero if RTS is unity. The last component is non-zero if output markets are non-competitive. That is, if output prices depart from their respective marginal costs then $\dot{Y}_P \neq \dot{Y}_C$.

There are other important external factors (those that define the environment where the firms operate) that could affect productivity growth. These factors are usually taken into account in the endogenous growth literature. Morrison (1986) and Morrison and Siegel (1999) include these factors in the productivity growth analysis. They point out that such external factors affect the cost-output relationship of the firm and can be explicitly included into the model as shift variables. In our case, the deregulatory measures are such external factors that are expected to reduce the profit margin and increase productive efficiency of firms, at least in the long run.[5]

Since we want to establish a link between regulatory changes and productivity growth, we introduce different types of deregulations in our model. These are allowed to affect the cost-output relationship in a quite flexible manner. To do that, we assume that the minimum cost function is $C = C\ (y,\ w,\ T)$, where $T = T(t,\ z)$ is the technology shifter – z being a vector of external factors (identified by deregulatory changes) and t is the time trend variable. Using the same procedure outlined in Denny et al. (1981) and Kumbhakar and Lozano (2002) it can be shown that

$$\dot{TFP} = EF + (1 - RTS^{-1})\dot{Y}_C + (\dot{Y}_P - \dot{Y}_C) \equiv EF + Scale + Markup, \qquad (2)$$

where EF is the component due to the external factors, which is further decomposed into TC and TC_z, i.e., $EF = -[TC\ + TC_z]$, where TC_z is the contribution of the z variables in TFP growth. All other components are defined in (1). Thus, TC_z is an additional component in the TFP growth equation.

[5] See, for example, Winston (1993) and Vickers (1995).

It is worth mentioning here that if one is interested only in TFP growth then it is not necessary to estimate the cost function econometrically. It can be easily computed from the data using a discrete approximation of the TFP growth formula. However, if the interest is to decompose it into *EF*, *Scale* and *Markup* components then it is necessary to estimate the cost function econometrically.

3. Methodology

Since decomposition of the TFP growth equation is based on the definition of the Divisia index, it should be equal to the sum of these three components (those appearing on the right hand side of equations (1) and (2)) calculated from the estimated parameters of the parametric model. Theoretically, this equality should hold irrespective of the functional form chosen to represent the production technology.[6] This is because the parametric TFP growth decomposition is based on the definition of the Divisia index of productivity growth. However, in practice a wide gap between the two measures is often observed (Capalbo, 1988 and Hulten, 2000). This gap cannot be solely explained in terms of the difference between the true and estimated parameters. The choice of functional form should not be guided by how close the estimated TFP growth rates are to those generated by the Divisia index. We propose to use the definition of the TFP growth formula as an additional equation in the econometric model as the best way to avoid this divergence problem. Thus, we use the TFP growth equation together with the cost system (the cost function and the cost share equations) to estimate the underlying production technology.

3.1 The econometric model

We use a multi-product translog cost function[7] to represent the underlying technology, which is specified as

$$\ln C = \alpha + \sum_{j=1}^{J} \beta_j \ln w_j + \sum_{l=1}^{L} \gamma_l \ln y_l + 0.5 \left(\sum_{j=1}^{J} \sum_{k=1}^{J} \beta_{jk} \ln w_j \ln w_k + \sum_{l=1}^{L} \sum_{m=1}^{L} \gamma_{lm} \ln y_l \ln y_m \right)$$

[6] TFP growth is often decomposed into two other components associated with technical and allocative inefficiencies (Kumbhakar, 2000). Again, since TFP growth remains the same the sum of the components (no matter how many components there are) should be identical to the Divisia TFP growth.

[7] Diewert (1976) shows that the implicit functional form of the Divisia/Tornqvist-Theil index is the translog.

$$+\sum_{j=1}^{J}\sum_{l=1}^{L}\varsigma_{jl}\ln w_j \ln y_l + \sum_{r=1}^{R}\mu_r z_r + \sum_{j=1}^{J}\sum_{r=1}^{R}\beta_{rj} z_r \ln w_j + \sum_{l=1}^{L}\sum_{r=1}^{R}\beta_{rl} z_r \ln y_l$$

$$+\beta_t t + 0.5\beta_{tt} t^2 + \sum_{j=1}^{J}\theta_j t \ln w_j + \sum_{l=1}^{L}\lambda_l t \ln y_l \quad (3)$$

where *w* and *y* are input prices and outputs. The *z* variables are the deregulation dummy variables that are defined as[8]

$$z_r = \begin{cases} 0 & \text{before the deregulatory measure } (r) \text{ is adopted} \\ 1 & \text{thereafter} \end{cases}$$

for $r = 1, 2, \ldots, R$ (*R* being the number of quantifiable deregulatory measures). We accommodate effects of different types of regulation on productivity by allowing the production technology to change with the deregulation dummies. Although the *z* variables are related to time, it is possible to identify their effects on cost as long as the *z* variables are not a linear function of *t* -- the time trend variable.

Since the cost function is homogeneous of degree one in input prices, we impose the linear homogeneity restrictions by dividing the prices and total variable cost by the price of one input. The cost share functions, obtained from Shephard's lemma, are

$$S_j = \beta_j + \sum_{k=1}^{J}\beta_{jk}\ln w_k + \sum_{l=1}^{L}\varsigma_{jl}\ln y_l + \sum_{r=1}^{R}\beta_{rj} z_r + \theta_j t, \quad j = 1,\ldots,J. \quad (4)$$

Finally, using the cost function in (3), we obtain the following algebraic forms of EF, *RTS*, $\dot{Y}_P$ and ε_{cy_l}. These are

$$TC_t = -[\partial \ln C/\partial t], TC_z = -\left[\sum_{s=1}^{S}\left(\ln C_t \mid z_{s,t+1} - \ln C_t \mid z_{s,t}\right)\right],\ RTS^{-1} = \sum_l \varepsilon_{cy_l},$$

$$\dot{Y}_C = \sum_l \left[\varepsilon_{cy_l} / \sum_l \varepsilon_{cy_l}\right]\dot{y}_l \text{, and } \varepsilon_{cy_l} = \partial \ln C/\partial \ln y_l .$$

The above expressions can then be used in the TFP growth formula (see equation (2)), to obtain

[8] Block et al. (1980), Ariga et al. (1999), Gual (1999) and Bottasso and Sembenelli (2001) employ a similar approach to test the deterrent effect of prosecutions for price fixing by the department of Justice; the impact on estimated markups due to regulatory measures taken by the Fair Trade Commission against the Japanese government; the joint effect of deregulation and market integration on the structure of European banking markets; and the impact the European market program on market power and total factor productivity on a large sample of Italian firms, respectively.

$$\dot{TFP} = EF + (1 - RTS^{-1})\dot{Y}_C + (\dot{Y}_P - \dot{Y}_C) \quad (5)$$

in which the components appearing on the right hand side are expressed in terms of observed data and unknown parameters. Thus, the TFP growth equation in (5) can be used as an additional equation in the translog cost system.[9] There are at least two advantages associated with the inclusion of the TFP growth equation. First, inclusion of the TFP growth equation does not increase the number of parameters to be estimated. Therefore, from an econometric point of view, parameter estimates are likely to be more efficient. Second, the use of (5) as an additional equation in estimating the parameters of the model forces the two sides of the equation to be equal (except for the error term that is appended to it). This error term is assumed to have a zero mean, so that the observed TFP growth does not deviate systematically from the sum of (estimated) the TFP growth components.

An error term is also added to the cost function in (3) and the (*J-1*) cost share equations in (4). To capture heterogeneity of banks associated with management style, size, etc., the error term in the cost function is allowed to have a bank-specific component and a bank- and time-specific noise component. Given that we have the entire population of firms, we assume the bank-specific components to be fixed parameters so far as estimation is concerned. On the other hand, the bank- and time-specific noise component is assumed to be distributed independently and identically distributed across banks and over time. Since the cost shares are ratios, bank-specific effects are likely to be cancelled out. The random error terms in equations (3)-(5) are allowed to be freely correlated, but are assumed to be independent over time and across firms. We used the non-linear iterative seemingly unrelated regression (NLITSUR) procedure to estimate the parameters of the system (equations (3)-(5)).

4. An application to the Spanish Banking system

We apply the methodology proposed in the preceding section to estimate and decompose the TFP growth of the Spanish banking system (SBS). This particular application is chosen because the SBS has gone through many deregulatory changes (both national and European) in the last two decades. In this section we describe the data first and then discuss briefly the history of deregulation.

4.1. Data

The data used in this study comes from the annual publication "Consejo Superior Bancario" and "Anuario de la Confederación de Cajas de Ahorros'", covering the period 1986-2000. During this period the number of savings banks declined substantially due to mergers and acquisitions. Twenty-eight mergers and acquisitions took place during the period of our study. Our final sample consists of an unbalanced panel of 67 commercial banks (consisting of 970 observations) and 92 savings banks (879 observations). We treated the merged banks as new banks for controlling bank-specific effects.

In the banking literature a considerable disagreement exists for the definition of inputs and outputs. We adopted the intermediation (asset) approach in modeling bank production (Sealey and Lindley, 1977). Three variable inputs, viz., purchased funds and core deposits, labor, and physical capital are used. Expenditures on these inputs account for almost all banking costs. The output variables include loans (home loans, other loans, and interbank loans)[10] and securities. The last category is measured as gross total assets less loans and physical capital, so that all financial assets are considered to be outputs. Expenses of each input are divided by their respective quantities to obtain the specific input prices.

Following Berger et al. (1997) we specify equity as a quasi-fixed input because insolvency risk affects banks' cost and profit.[11] [12] The branch variable (number of branches), treated as a technological condition of production (Mester, 1987), is another quasi-fixed input. Lang and Welzel (1998) argued in favor of including this variable because banks operate in markets with varying population densities. Another reason for its inclusion is that the studies in banking show that scale economies tend to be overstated when the number of branches is not

[9] Note that the traditional translog cost system is usually defined by the cost function (in (3) and the (J-1) cost share equations (in (4)).

[10] A change in accounting practice in 1992 forced us to aggregate all loan categories -- home loans, other loans, and interbank loans -- into a single measure of loans, thus enabling us to extend the present study through 1995. Lozano-Vivas (1997) discusses the issues regarding aggregation of these three outputs.

[11] See Hughes et al. (1995) and Berger and Mester (1997) for a detailed discussion on the importance of the inclusion of financial capital.

[12] It is worth noting that our measure of inputs, outputs and quasi-fixed inputs contains almost 100% of the balance sheet of the banks. Recently, Lozano-Vivas and Humphrey (2002) found that many prior studies in the banking industry have overstated productivity growth. This bias is eliminated when all outputs and inputs are included in the analysis, ensuring that the balance sheet restriction is met.

included in the cost function. This is because outputs are highly correlated with number of branches and therefore some of the branch effect is picked up by the outputs.

We identified several deregulatory changes, outlined in the next subsection, with their timings reported in Table 1. One dummy variable is defined for each deregulatory measure. We did this exercise separately for the savings and commercial banks since deregulatory measures occurred at different times for both savings and commercial banks.

4.2 The Spanish Banking System: A Brief History of Deregulation

The SBS consists of commercial banks (which include both private and foreign banks), savings banks, and credit cooperatives. However, the private commercial banks and savings banks account for roughly 95% of all SBS assets.

The SBS has recently gone through considerable deregulatory reforms. After a series of small steps undertaken in 1969, nation-wide deregulation efforts were intensified during the mid 1980s. The primary reason for this rapid domestic liberalization process was to overcome the fear that banks in Spain would be at a competitive disadvantage after the removal of barriers to inter-country competition in financial services within the European Monetary Union (EMU). As a member of the EMU the Spanish banking industry is affected not only by deregulation measures at the national level, but also at the European level. Thus, banks in Spain enjoy the freedom of cross-border services, single bank licensing, home country control and mutual recognition, as well as the harmonization of banking regulations imposed by the European Commission to all EMU member countries. In addition to these deregulation measures, the SBS undertook prudent regulatory measures in order to ensure its stability. Consequently, the SBS went through: (i) National deregulation measures,[13] viz., elimination of controls on interest rates and commissions, branch expansion limits, reserve and investment requirements, and entry barriers; (ii) European deregulation measures: removal of control of capital flows, First Banking Directive (FBD), Second Banking Directive (SBD), and harmonization of prudent regulations; and (iii) prudent regulation measures: minimum capital requirements and deposit insurance.[14] A

[13] For details on these issues, see Caminal, Gual and Vives (1990), Gual and Vives (1992), Canals (1997) and Hasan, Hunter and Lozano-Vivas (1999).

[14] The deposit insurance measure is not taken account of in our analysis since this was implemented in 1977, before the beginning of our sample. On the other hand, since financial capital is introduced as control variable in our empirical model we are explicitly controlling for the changes in the regulatory measures associated with it. Consequently, those deregulatory measures are not included in Table 1.

chronological view (timing view) of such measures is interesting for our analysis, especially to define the deregulatory dummy variables (see Table 1).[15]

Table 1: Deregulatory changes

Year	National	European
1987	Interest rate and fees	
1988		
1989	Branching limitations (sb)	
1990	Reserve and investment requirements	
1991		
1992		Control on capital flows
1993		Harmonization of prudential regulation
1994		Second Banking Directive

(cb): commercial banks; (sb): savings banks.

5. Results

We estimate the model (equations (3)-(5)) (i) with and without the TFP growth equation and (ii) with and without the deregulation dummies. The system is also estimated separately for commercial and savings banks. Each of these models is estimated using the non-linear iterative seemingly unrelated regression (NLITSUR) technique. Most of the estimated parameters in each model are found to be statistically significant at the 5% level of significance.[16] The joint significance of the deregulatory dummies for both the savings and commercial banks is tested using the likelihood ratio (LR) test. The LR test rejects exclusion of the deregulation dummies for both savings and commercial banks at the 1% level of significance. We thus report results only from the models that include both the TFP growth equation[17] as well as the deregulation dummies. First, we present the results on TFP growth using the Divisia Index. This is followed

[15] For a detailed discussion of the classification and goal pursued with the implementation of these deregulatory changes by the regulatory authority see Kumbakhar and Lozano-Vivas (2002).
[16] The estimated parameters are not reported here to save space. They are, however, available from the authors upon request.
[17] The LR or any other test cannot be used to test whether the TFP growth equation should be included or excluded from the cost system. A similar case is whether to use the cost alone or the full cost system. No econometric test has been developed to examine whether one should use only the cost function or the cost function along with the cost share equations in estimation.

by the results obtained from the estimated model (equations (3)-(5)). Finally, we report the TFP growth components.

5.1. *TFP growth*

TFP growth results using the Divisia index is reported in Table 2 for both savings and commercial banks. These results show that the output growth for savings banks during the period is around 6.91% while the aggregated input growth is 5.16%. Thus, the mean TFP growth (Divisia) is 1.75% per year. On the other hand, the output growth of commercial banks is 4.94%, which is two percentage points lower than the savings banks' output growth. The aggregate input growth is 2.60%. Consequently, the TFP growth per year for commercial banks is 2.34%. Thus, although savings banks have a higher output growth per year, the TFP growth is higher for commercial banks. The TFP growth for both savings and commercial banks are positive over the period 1986-2000. It can also be seen from Table 2 that TFP growth results obtained from the parametric econometric model and the Divisia index are almost the same. These results also hold if we analyze the evolution of yearly TFP growth (see Table 3 and Figures 1 and 2). We take these results as evidence in favor of using the TFP growth equation. If we estimate TFP growth from the parametric model that excludes the TFP growth equation (5) from the system (the approach that is usually used), we notice a gap between the two TFP growth results. These results are not reported here but can be obtained from the authors upon request.

Table 2. TFP growth, 1986-2000.

	Savings Banks		Commercial Banks	
	Mean	S. D.	Mean	S. D.
Aggregated Output Growth	6.91	0.0534	4.94	0.0913
Aggregated Input Growth	5.16	0.0469	2.60	0.0840
TFP (Divisia Index)	1.75	0.0191	2.34	0.0412
TFP (Estimated)	1.74	0.0147	2.43	0.0391

Table 3. TFP growth by year (1987-2000)

Year	Savings Banks		Commercial Banks	
	TFP (Divisia Index)	**TFP (Estimated)**	**TFP (Divisia Index)**	**TFP (Estimated)**
1987	0.02492	0.02473	0.03107	0.03089
1988	0.03141	0.02916	0.03846	0.03645
1989	0.02957	0.02957	0.04591	0.04103
1990	0.00950	0.00785	0.02687	0.02995
1991	-0.00212	0.00140	0.01615	0.01877
1992	-0.00219	-0.00254	0.00861	0.00810
1993	0.00632	0.00860	-0.01383	-0.01214
1994	0.01109	0.01332	-0.00327	-0.00429
1995	0.01418	0.01461	0.00585	0.01138
1996	0.01849	0.01819	0.01826	0.02129
1997	0.02144	0.02058	0.02757	0.03184
1998	0.02423	0.02287	0.03486	0.03750
1999	0.02832	0.02735	0.04433	0.04376
2000	0.03020	0.02896	0.04810	0.04656
Mean	**0.01753**	**0.01748**	**0.02349**	**0.02436**

Table 4. TFP Growth and its Components, Savings Banks

Year	TFP	EXTERNAL FACTORS				
	(ESTIMATED)	**(EF)**	**(TC_t)**	**(TC_Z)**	**SCALE**	**MARKUP**
1987	0.02473	0.00354	0.00345	_	0.01383	0.00736
1988	0.02916	0.00168	0.00134	0.00034	0.01345	0.01403
1989	0.02957	0.01199	0.01107	0.00092	0.01478	0.00280
1990	0.00785	-0.00120	-0.00181	0.00060	0.00705	0.00201
1991	0.00140	-0.00655	-0.00423	-0.00232	0.00311	0.00484
1992	-0.00254	-0.01429	-0.01015	-0.00414	0.00677	0.00498
1993	0.00860	0.00311	0.00410	-0.00100	0.00539	0.00011
1994	0.01332	0.00455	0.00670	-0.00215	0.00785	0.00092
1995	0.01461	0.00529	0.00419	0.00110	0.00861	0.00071
1996	0.01819	0.00923	0.00307	0.00616	0.00860	0.00036
1997	0.02058	0.01196	0.00735	0.00461	0.00824	0.00038
1998	0.02287	0.01354	0.00910	0.00444	0.00888	0.00045
1999	0.02735	0.01661	0.01382	0.00279	0.01023	0.00051
2000	0.02896	0.01932	0.01633	0.00269	0.00912	0.00052
Mean	**0.01748**	**0.00563**	**0.00460**	**0.00110**	**0.00899**	**0.00286**

Table 5. TFP Growth and its Components, Commercial Banks

Year	TFP (ESTIMATED)	EXTERNAL FACTORS (EF)	(TC_t)	(TC_Z)	SCALE	MARKUP
1987	0.03089	0.00364	0.00364	_	0.00846	0.01879
1988	0.03645	0.00538	0.00217	0.00320	0.00875	0.02233
1989	0.04103	0.01306	0.00665	0.00640	0.00837	0.01961
1990	0.02995	0.01723	0.01092	0.00632	0.00543	0.00728
1991	0.01877	0.00949	0.00309	0.00640	0.00610	0.00318
1992	0.00810	-0.00139	-0.00868	0.00729	0.00653	0.00296
1993	-0.01214	-0.00974	-0.01266	0.00291	-0.00139	-0.00100
1994	-0.00429	-0.00461	-0.00851	0.00390	0.00040	-0.00008
1995	0.01138	0.00927	0.00462	0.00465	0.00185	0.00026
1996	0.02129	0.01413	0.00758	0.00655	0.00052	0.00664
1997	0.03184	0.02015	0.01222	0.00793	0.00060	0.01109
1998	0.03750	0.02322	0.01528	0.00794	0.00487	0.00941
1999	0.04376	0.02710	0.01956	0.00753	0.01198	0.00469
2000	0.04656	0.02577	0.01835	0.00742	0.01069	0.01010
Mean	**0.02436**	**0.01091**	**0.00530**	**0.00560**	**0.00522**	**0.00823**

5.2 TFP growth and its components

TFP growth and its components (EF, TC, TC_z, scale and markup) for the savings and commercial banks are reported in Tables 4 and 5. The second column of Tables 4 and 5 reports the mean values (by year) of estimated TFP growth for savings and commercial banks, respectively. We find that TFP growth increased from 2.47% in 1987 to 2.89% in 2000 for savings banks. The overall mean TFP growth for the savings banks is 1.75% per year. Commercial banks showed a somewhat higher increase in TFP growth (2.43% per year). Thus, on average, positive TFP growth is observed for both savings and commercial banks. These findings are consistent with those obtained by Kumbhakar et al. (2001) for the Spanish savings banks.[18]

The joint effect of technical change and deregulation changes (labeled as external factors), EF, had a greater impact on the TFP growth of commercial banks. A positive sign on EF indicates that the external factors (including time) enhanced TFP growth (cost diminution). Thus, we observe a downward shift in the cost function, ceteris paribus, from 1990-1992 (1992-1994) for savings banks (commercial banks). A downward shift in the cost function, ceteris paribus, is

[18] Kumbhakar et al. (2001) estimated a profit function and calculated only technical change and technical efficiency change for savings banks. Note that TC is only one component of TFP growth.

observed for the rest of the years for both savings and commercial banks. The mean of EF induced TFP growth for the entire period is 0.56% (1.09%) per year for savings (commercial) banks. A declining trend in EF is observed for savings banks until 1992 after which the trend is reversed. The mean of EF induced TFP growth for commercial banks, however, took a different path, increasing up to 1990, then decreasing until 1994, and finally increasing over the remainder of the sample period.

We now dissect the EF induced TFP growth into technical change and changes in regulatory measures. Since we introduced a vector of deregulation dummies to accommodate effects of different types of deregulation, it is possible to examine the impact of different types of regulations on cost-output relationship. Overall, we find that deregulatory measures contributed positively to TFP growth (TC_z) in every year for commercial banks while is had an adverse effect on savings banks during 1991-1994 (see column 5 of Tables 4 and 5). The mean of deregulation induced TFP growth for savings banks is found to be 0.11% per year, while for the commercial banks it is 0.56% per year. Comparing the effects of national and European deregulatory measures on TFP growth, we find that for savings banks the national deregulatory measures were more beneficial. The European deregulatory measures produced negligible effects on the overall growth of TFP for savings banks. On the other hand, the commercial banks benefited the most from the European deregulatory measures. Based on these results, one could argue that compared to the savings banks, the commercial banks benefited more from the European deregulations so far as TFP growth is concerned. The opposite is true for domestic deregulations.

Coming back to the other components of TFP growth, we find that for savings banks the scale component contributed the most towards TFP growth (sixth column of Table 4). The overall mean of the scale component for the savings banks is 0.89%. On the other hand, the scale component is quite small for commercial banks (sixth column of Table 5), although it is positive for most years[19]. The overall mean is found to be 0.56%. The scale component contributed positively to TFP growth in every year for savings banks while its contribution to TFP growth for commercial banks was negative in 1993.

[19] Note that RTS and the rates of change in outputs affect the scale component. Scale economies (diseconomies) and positive (negative) rates of change in output affect the scale component positively.

The last component of TFP growth is the markup factor, reported in the last column of Tables 4 and 5. If output markets are competitive (i.e. $\partial C/\partial y_l = p_l$) then $(\dot{Y}_P - \dot{Y}_C) = 0$, which in turn implies that the markup component is zero. Thus, a non-zero value of the markup component indicates the presence of non-competitive behavior in output markets. On the whole the contribution of markup factors is positive for both savings and commercial banks (except for the years 1993 and 1994). The overall mean of markup induced TFP growth is 0.82% for commercial banks and 0.28% for savings banks). For commercial banks the markup component is the main driving force behind TFP growth. Thus, the competitive output market assumption is not true, especially for commercial banks.

The main results on TFP growth and its components are summarized in Table 6.

Table 6. Summary Statistics of TFP Growth and its Components,

	Savings Banks		*Commercial Banks*	
	Mean	S. D.	Mean	S. D.
TFP (Estimated)	1.74	0.0147	2.43	0.0391
External Effects (EF)	0.56	0.0098	1.09	0.0136
EF: Technological Change	0.45	0.0095	0.53	0.0130
EF: Deregulation Change	0.11	0.0015	0.56	0.0094
Scale+Markup	1.17	0.0135	1.34	0.0373
Scale	0.89	0.0086	0.52	0.0132
Markup	0.28	0.0108	0.82	0.0358

It can be seen from Table 6 that the three main components (EF, Scale and markup) of TFP growth are all positive for both types of institutions, although the relative importance of the components to the overall TFP growth are different for the savings and commercial banks. About 26% (22%) of the productivity growth of the savings (commercial) banks is explained by technical change. The contribution of deregulatory changes is positive but its magnitude is higher for commercial banks. Its share of the EF component is about 51% (20%) for commercial banks (savings banks). Thus although deregulations contributed positively to the TFP growth of both the savings and commercial banks, these measures helped to enhance productivity of commercial banks more. Contributions of the scale and markup components to the overall TFP growth for savings (commercial) banks are 50% and 16% (21% and 34%) respectively. Thus, we find that the relative importance of the components of TFP growth is not the same for savings and commercial banks.

6. Summary and Conclusions

In this paper we (i) used a unified approach that captures the effects of different types of deregulation measures, technical change, scale and markup in outputs, and (ii) estimated TFP growth in such way that avoids the discrepancy between the nonparametric (the Divisia) and the parametric measures of TFP growth. The first issue is addressed by estimating the cost system model with two sets of time related variables: t as a time trend that captures the technical change, and z as a vector of deregulation dummies that capture the effects of different types of deregulations. The use of these two types of variables allowed us to decompose the contributions of external factors into technical change and changes in regulatory measures. The second issue is addressed by adding the TFP growth equation in the cost system (the cost function and the cost share equations) in estimating the model.

We use the Spanish banking data for the empirical application due to the recent series of deregulation measures of the Spanish banking industry. The main empirical findings of this application are: (i) TFP growth results obtained from the Divisia Index are very close to those obtained from the cost system estimation. The result suggests that our estimation strategy avoids the discrepancy found in the literature between the nonparametric (Divisia index) and the parametric measures of TFP growth. (ii) The TFP growth on average has been positive for both commercial and savings banks in Spain over the sample period. (iii) Overall, the contribution of external, scale and markup effects to TFP growth has been positive for both types of institutions. (iv) Deregulatory measures exerted a positive effect on the TFP growth of the Spanish banking system as a whole. (v) National deregulatory measures are found to have the most effect on the savings banks cost compared to the European deregulatory measures. However, commercial banks show stronger effects from the implementation of the European deregulatory measures, as opposed to the national deregulatory measures.

From the empirical results we come to the conclusion that deregulation measures, in general, helped Spanish banks increase their performance (measured in terms of TFP growth). While commercial banks seem to have adjusted more to face European deregulations, savings banks have shown a more adaptation towards national deregulations.

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Figure 1: Estimated and Observed TFP (Savings Banks)

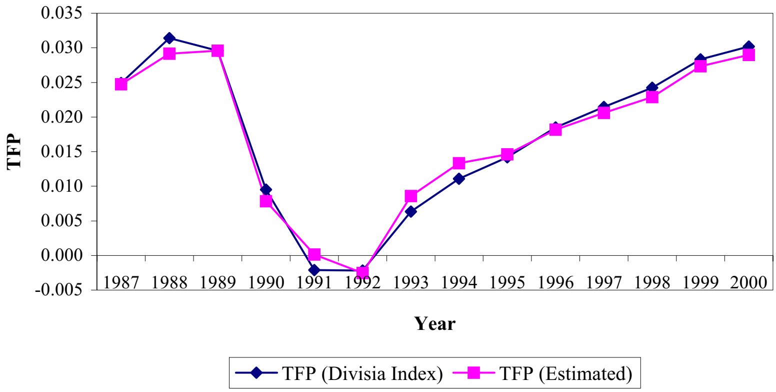
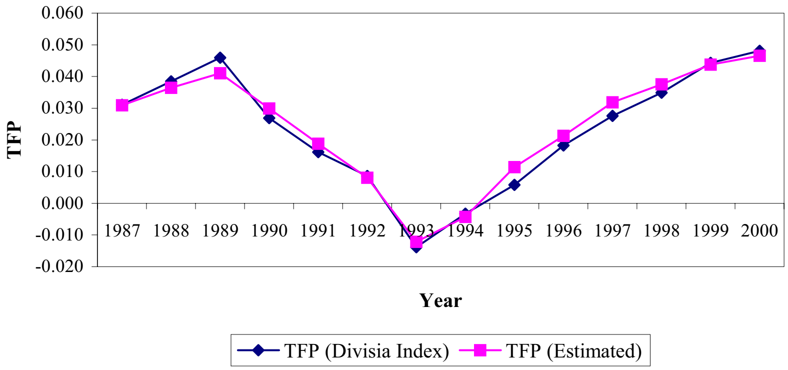


Figure 2: Estimated and Observed TFP (Commercial Banks)



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