View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Research Papers in Economics

UNIVERSIDAD CARLOS III DE MADRID

working papers

Working Paper 05-38
Economics Series 22
May 2005

Departamento de Economía
Universidad Carlos III de Madrid
Calle Madrid, 126
28903 Getafe (Spain)
Fax (34) 91 624 98 75

CHARACTERIZING TECHNICAL PROGRESS *

Carmen Garrido Ruiz [1]

Abstract

Is there an aggregate technical shock? Is the growth rate of TFP a positive constant buffeted by random shocks? We use data on the Spanish economy, disaggregated by sector and region, from two different data sets to investigate the nature of technical change. Our results show that technical change is sector-specific, and operates at the national level. We also find that TFP growth rates are far from being constant. Thus, our findings contradict the basic assumption underlying the model of "*K*apital, *L*abour and exogenous *A*ggregate TFP". We discuss the role of embodied technical change as a source of observed TFP growth. We also find no role for "broad externalities" as a determinant of TFP growth.

* **Acknowledgements:** I want to give special thanks to Michele Boldrin, who gave that paper a very careful reading and provided me with extremely valuable suggestions and comments.
Financial support by Comunidad de Madrid and Unión Europea (F.P.I.) is gratefully acknowledged.

[1] Universidad Carlos III de Madrid. Departamento de Economía. garridoc@eco.uc3m.es

1 Introduction

Since Solow (1957), economists have come to recognize that the so called "Solow residual", or exogenous Total Factor Productivity (TFP, henceforth), is the single most important determinant of aggregate economic growth. As long as the analysis is carried out through aggregate or sectorial production functions, using capital, labor, and human capital as inputs, this result turns out to be quite robust. It holds true across countries, and time periods, and it is not substantially affected by different measurement methods for the growth of "standard" inputs of production, such as capital and labor. Because of the robustness of this finding, the aggregate model of "Kapital, Labor, and exogenous TFP" has become by far the most successful tool used in all areas of applied economics, from growth theory, to the theory of business cycles, to asset pricing, public finance, and so on. It rests on the simple, but powerful, hypothesis that "exogenous aggregate technological progress" does exist, affecting all compartments/sectors of an economic system more or less alike, and growing at a more or less stable long-run rate, 2% a year being the current consensus for its "long-run value".

Aggregate TFP is modeled as a stationary, and time-invariant, stochastic process of the following type:

$$\ln A_t = \overline{A} + gt + \widetilde{\varepsilon}_t$$

where

$$\widetilde{\varepsilon}_t = \rho_\varepsilon \widetilde{\varepsilon}_{t-1} + u_t$$

and u_t is an independent and identically distributed random term.

In applied research, a sequence of A_t is estimated by using aggregate, national income accounting data for output, labour services, measured by total number of hours worked, and additions to the stock of capital as a proxy for the capital services, under the assumption that these services rise proportionately with increases in the stock of capital.

Correctly, a number of authors, such as Griliches, Denison, Jorgenson, and others, have pointed out that the residual can be squeezed down if capital and labor are properly disaggregated to take into consideration differences in the characteristics of the workers (like age, gender,

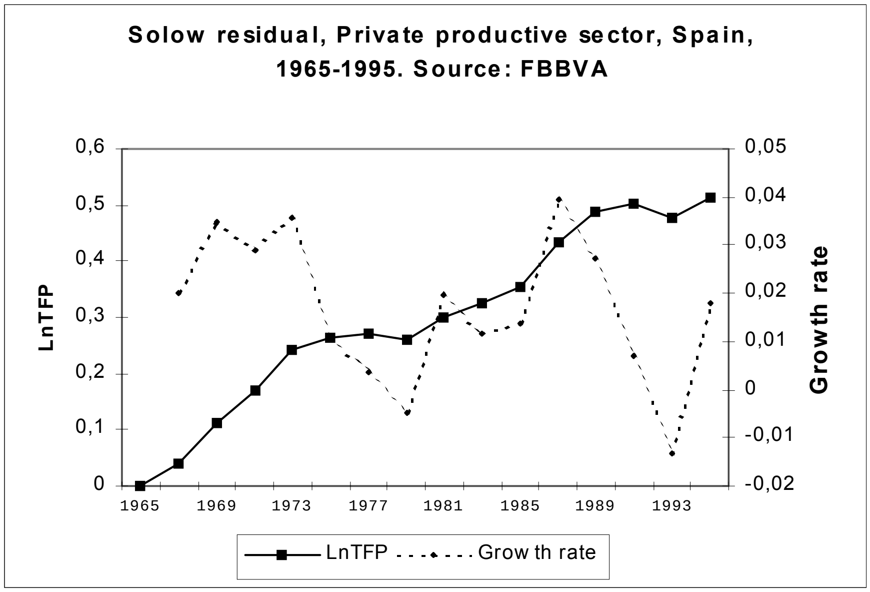


Figure 1:

education...) or in the characteristics of the capital stock (corporate, non corporate...) that could command differences in their respective market earnings.

Post 1960, the Spanish economy has grown rather fast, at least for its historical standards. Over the period 1965-1995, GDP per capita (per worker) grew at an annual rate of 2.63% (3.19%). For the private productive sector, which is the main object of attention of this study, the same statistics are 2.61% and 3.58%, respectively[1]. Applying the aggregate production function with aggregate TFP model to these data gives the following estimates: around 53% of output growth in the private productive sector is accounted for by the Solow residual, capital accumulation contributed 51%, with labour contributing negatively (-4%).

Figure 1 plots the time series of estimated biannual TFP levels for the Spanish economy, as well as the growth rates (annualized). On the face of it, such aggregate data are consistent with the simple hypothesis that there exists "aggregate technological progress, growing at a more or less stable positive growth rate".

[1] Also of note is the growth rate of output per worker in the private productive sector, during the same period, but measured in nominal terms, which amounted to 13.73% per year.

At the other extreme, data on firms' performances, as reflected by the stock market figures for instance, show a great deal of variation. Recent availability of firm level data sets has made it possible to inspect productivity evolution at the level where it belongs, confirming previous observation: TFP dynamics at the firm level is far from smooth (see for instance, Baily et al. (2001), Castiglionesi and Ornaghi (2003), Siotis (2003), Harberger (1998), and Torre (1997)).

At an intermediate level of disaggregation, some authors have also pointed to the differences in the evolution of sectorial productivity. To name only a few, Harberger (1998) based on estimates of TFP growth rates for the US manufacturing sectors, Peneder (2001) for countries in the European Union, Japan and the US, using data for three big sectors (agriculture, industry, services) as well as for a more detailed disaggregation of the manufacturing sectors, Escribá and Murgui (1998) for the Spanish regions, using data on 5 big sectors (agriculture, energy, industry, construction, and private productive services). Indeed, a look at the TFP growth rates of the 15 sectors into which we have disaggregated the Spanish private productive sector[2] shows considerable disparity (see figures 2 and 3).

The purpose of this paper is to investigate if there is empirical validation for the basic assumption underlying the aggregate model of "K, L and exogenous TFP". Hence, we ask two questions: First, is there an aggregate technological shock? And second, is the growth rate of TFP a positive constant buffeted by random shocks?

To address the first question, we look at the comovement of sectorial TFP dynamics. To be precise, we do a simple factor analysis on the innovations to sectorial TFPs. In order to support the hypothesis of an aggregate technological shock, we should find a large common factor underlying sectorial TFP innovations. We do not find evidence of any such aggregate

[2] These sectors are: C1. Agriculture and fishing; C2. Fuel and power products; C3. Ferrous and non-ferrous ores and metals; C4. Non-metallic minerals and minerals' products; C5. Chemical products; C6. Metal products and machinery (includes: Metal products; Agricultural and industrial machinery; Office and data processing machines, precision and optical instruments; Electrical goods); C7. Transport equipment; C8. Food, beverages and tobacco; C9. Textiles and clothing, leather and footwear; C10. Paper and printing products; C11. Rubber and plastic products and other manufactures; C12. Building and construction; C13. Transport and communication services; C14. Financial and insurance institutions; C16. Residual of private productive services (includes: Recovery and repair services, wholesale and repair; Lodging and catering services; Rest of private productive services).

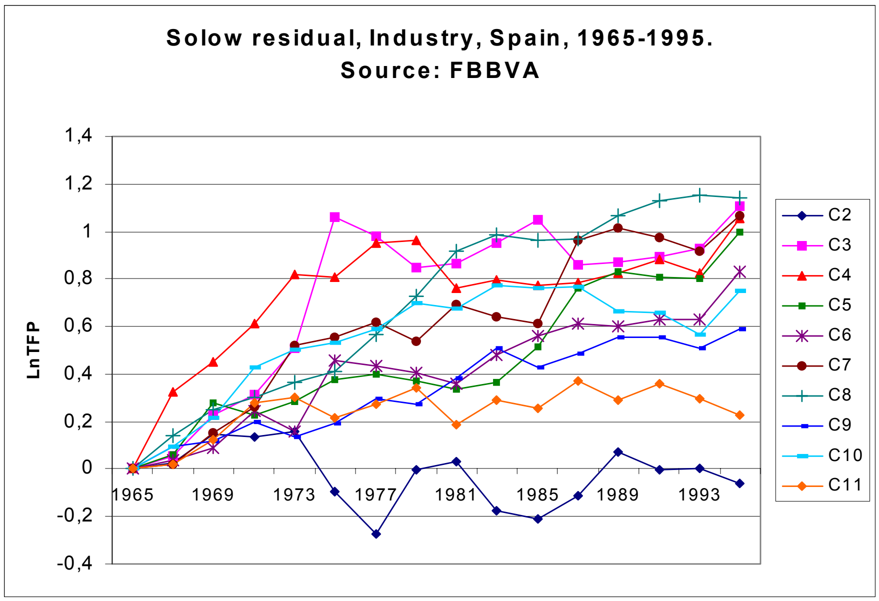


Figure 2:

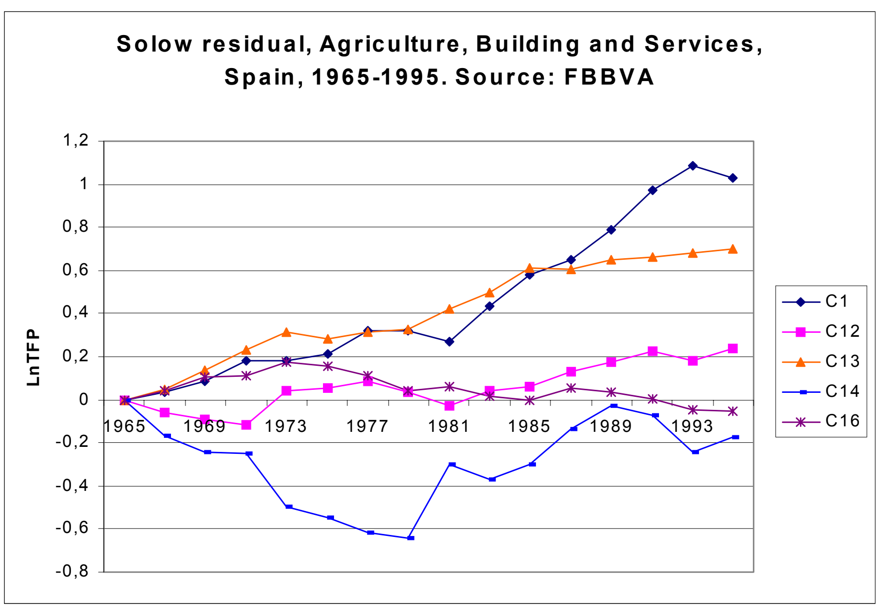


Figure 3:

technical shock. Our findings are robust to the empirical method used to obtain the cyclical component of sectorial TFP series (Hodrick and Prescott filter, and first-differencing the logs of the series), as well as to the data source being used (Fundación BBVA and Ministerio de Economía y Hacienda).

The next step we take is to look at the regional dimension of the data. Is there any evidence of common national shocks? We replicate the factor analysis for regional production functions, aggregate and sectorial. Results from factor analyses of the regional series for each of the 15 private productive sectors consistently yield an important common factor. Thus, sectorial shocks are nation-wide, there are no regionally-specific sectorial shocks. As for the private productive sector as a whole, there is also a common factor, which explains the greatest part of each regional series.

To test the hypothesis that technological progress is more or less stable around a constant mean, we look at sectorial TFP growth rates in detail. Following Harberger (1998), we draw sunrise-sunset diagrams of sectorial TFP dynamics for each of the 5 years long time intervals into which we divide the sample period. A sunrise-sunset diagram represents each sector's contribution to aggregate TFP performance over the 5 years interval. Two main findings are worth anticipating. First, there are negative as well as positive sectorial contributions to aggregate TFP dynamics in any given time interval. This confirms our previous finding that technical change is not sector-neutral. Additionally, it shows that technical change may be negative as well as positive. Second, for any given sector, periods of increasing TFP are followed by periods of declining TFP. Therefore, when inspected at the industry-level, growth does not appear to be a smooth, monotonically increasing process.

To summarize, sectors are hit by independent technical shocks, meaning two things, there is nothing like an aggregate shock hitting simultaneously all sectors, and there is also not anything like strong correlation between given sectors for given intervals. And second, sectorial TFP dynamics exhibit recurrent oscillations. Hence, the evidence seems at odds with the basic hypotheses sustaining the most widely used model of growth, the model of "Kapital, Labour and exogenous TFP".

We devote the final section to discussing the role of embodied technical progress as a source of TFP growth. Since TFP growth is sector-specific and highly variable, one may think of investment-specific technical change, embodied in new machines or in more skilled workers, as a natural explanation for observed diversity. In this line of thought, Castiglionesi and Ornaghi (2003), using microeconometric data for the Spanish manufacturing firms over the period 1990-1999, attribute all of measured TFP growth either to upgrades in the stock of physical capital or to increases in workers' human capital. On the contrary, we show that industry-level data are not appropriate to perform such a test.

Now, assume that all capital were identical, i.e., physical capital suffers physical depreciation only. Under this assumption, we show, our efforts to identify any effect of capital accumulation on TFP growth, using data at the industry level, should have been successful in the presence of "Marshall-Arrow-Romer" type externalities. Hence, rejecting the existence of any such effect confirms the inference obtained from the Harberger-type visualizations of the growth process that growth is not generated by some kind of broad externality.

Next section describes the data sources and procedures used to compute sectorial TFP time series, section 3 explores the existence of an aggregate shock underlying sectorial TFPs, and section 4 looks for a regional determinant of observed TFP dynamics. Section 5, evaluates the validity of the assumption that technical progress comes at a more or less constant positive growth rate. Section 6 discusses the role of embodied technical progress as a source of TFP growth, and argues against broad externalities as a potential source of growth. Section 7 presents concluding remarks, and comments on the issues left for future research.

2 Data and methodology

The data we exploit in this chapter come from Fundación BBVA (*Renta Nacional de España y su Distribución Provincial*, DPRN data set hereafter), on the one hand, and from the Spanish Ministry of Economics and Finance (MORES data set) on the other, and their detailed description is enclosed in appendix A. In this chapter, we focus on the analysis of the Solow residual at various periodicities, i.e., annual growth rates, biannual growth rates or growth rates over longer time periods, for the set of 15 sectors into which we divide the private productive sector of the Spanish economy and each of its regions. For a detailed presentation of data sources, sectorial classifications and how we build each variable, see appendix A. Here, we briefly comment on the variables used in growth accounting.

Growth in output is computed using gross value added to measure output, expressed in constant terms. Growth in the labour input is computed using total number of jobs, both employees and self-employed. Information on the number of hours worked is not available at the level of disaggregation that we will be using and for such an extended time period. However, a look at available data on the number of hours worked at the aggregate level, reveals it has been decreasing all during the sample period. In particular, the number of hours worked weekly by a worker in 1965 was 47.75 (aggregate sector, including agriculture, industry and services, and the public sector). In 1995, weekly hours worked amounted to 36.6. This implies a reduction of nearly a quarter, at an annual growth rate of 0.88% (data from *Encuesta de Población Activa*, published by the Spanish Bureau of Statistics (INE)). Hence, if the contribution of the labour input to output growth was correctly measured, the relative contribution of the capital input to output growth would be increased on the one hand, and measured Solow residual would appear to be much higher than currently estimated.

On the other hand, our measure of the labour input does not take into account the increase in the human capital of the Spanish workforce. Data are only available for a limited number of big sectors. The next figures illustrate the increase in the quality of the labour force: In 1965, only 7.7% of the working population had at least "Estudios Medios" (i.e., 9 years of schooling), in 1995, this percentage had increased to 61.6% of the working population (source: Mas et al., 2001). The way we measure the residual, it incorporates the effects of the upgrade in the quality of the labour input on output growth. A more accurate measurement would therefore result in a reduced contribution of "real" TFP improvements to output growth.

Capital accumulation is computed from data on the stock of capital disaggregated by sector and region provided by IVIE (Valencian Institute of Research in Economics)[3], measured in constant terms using the perpetual inventory method.

Under the traditional assumptions of constant returns to scale of the aggregate and the sectorial production functions, and perfect competition in both the goods and the factors' markets, the Solow residual is computed as

[3] Mas, Pérez and Uriel, 1998.

$$SR = \Delta Y - (1-\alpha)\Delta L - \alpha \Delta K$$

where $\Delta X = \ln X(t) - \ln X(t-1)$, $(1-\alpha)$ is the labour share of output, which under the above mentioned assumptions is equivalent to the labour elasticity of output, and α is the capital share of output, equal to the capital elasticity of output. The discrete time approximation to the factors' elasticities of output is computed using a weighted average of the factors' shares of income at times t and $t-1$, i.e., $\alpha = [\alpha(t-1) + \alpha(t)]/2$. Our main data source, DPRN from Fundación BBVA (1999), provides data on a biannual basis, therefore, all the growth rates series refer to biannual growth rates and the discrete approximation to the factors' shares of income correspondingly averages over data observed every two years. On the contrary, when using data from MORES (Ministerio de Economía y Hacienda, 1998), we use average values of the factors' shares over the entire sample period, 1980-1995.

3 Aggregate *versus* sectorial technical shocks

Our aim in this section is to test the basic assumption underlying the "classical" RBC model that observed fluctuations of economic activity may be attributed to an aggregate technical shock.

We look at the comovement of Total Factor Productivity innovations in each of the 15 private productive sectors, and separate the contribution of an aggregate disturbance from that of a set of independent disturbances to sectorial productivities' dynamics.

3.1 The model

We assume each sector's TFP follows a process that may be decomposed into a trend component and a cyclical component. We assume the trends are smooth, but they are not constrained to be the same across sectors or to display any particular functional form. The hypothesis we want to check is the existence of an aggregate factor underlying the cyclical component of sectorial TFPs. We also assume there are no transmission mechanisms between the sectors. Put formally,

$$y_{it} = y_{it}^{tr} + \nu_{it}$$

where $y_{it} = \ln TFP_{it}, \forall i = 1...15, \forall t = 1965...1995$, y_{it}^{tr} is the trend component, and ν_{it} the cyclical component. The cyclical component has the following structure:

$$\nu_{1t} = a_1 c_t + u_{1t}$$
$$\nu_{2t} = a_2 c_t + u_{2t}$$
$$...$$
$$\nu_{15t} = a_{15} c_t + u_{15t}$$

Hence, each ν_i is associated to an unobservable common factor, c_t, which we interpret as an aggregate disturbance, since this factor determines every other $\nu_j, \forall j \neq i$. The terms u_i are idiosyncratic to each sector, and are assumed to be i.i.d. with $E(u_{it}) = 0$ and $Var(u_{it}) = \psi_i^2, \forall i = 1, ...15$, and $Cov(u_{it}, u_{js}) = 0, \forall i \neq j \ or \ t \neq s$. It is also assumed that c_t and u_{it} are orthogonal, $Cov(c_t, u_{is}) = 0, \forall i, t, s$, and that the c_t are uncorrelated, $Cov(c_t, c_s) = 0, \forall t \neq s$. Previous assumptions imply that the ν's are serially uncorrelated. This will be the case if the smooth trend that we extract from the original series captures all of the autoregressive structure of the series, leaving a white noise residual. We will check that the estimated series of TFP innovations satisfy this basic assumption.

The model sketched is the basis of factor analysis, which is a statistical technique aimed at decomposing a set of random variables into a set of unobserved common factors and a vector of sector-specific disturbances. Hence, the more general model takes the form:

$$\nu_{1t} = a_{11} f_{1t} + a_{12} f_{2t} + ... + a_{1p} f_{pt} + u_{1t}$$
$$\nu_{2t} = a_{21} f_{1t} + a_{22} f_{2t} + ... + a_{2p} f_{pt} + u_{2t}$$
$$...$$
$$\nu_{15t} = a_{151} f_{1t} + a_{152} f_{2t} + ... + a_{15p} f_{pt} + u_{15t}$$

where p is the number of common latent factors. We focus on one and two-factors models, since we may think of one or two combined aggregate disturbances as an "aggregate shock". If the estimated common factor has high explanatory power of observed sectorial TFP shocks, this would imply that all the sectors move together because of an aggregate shock (i.e., supporting the basic assumption of the RBC literature). However, this finding is also consistent with a model where sector-specific shocks are highly correlated, all the more so since the frequency of our data is quite low (biannual observations). Moreover, since the model does not constrain the "common" factor to be any "observable" aggregate shock, there is scope for overestimating the explanatory power of the aggregate shock. In summary, the model will tend to overstate the importance of a truly aggregate disturbance. On the other hand, if the estimated common factor has little explanatory power of observed sectorial dynamics, the data would be consistent with models where technical shocks affect the set of sectors at different moments in time, and comovements between subsets of sectors are small.

The coefficients $a = (a_1, ..., a_{15})$ associated to the common factor are identified only up to an orthogonal transformation, that is up to a sign change. The choice of the signs should be such that most of the coefficients be positive. We are assuming that the aggregate shock hits all sectors proportionately, while may be to different degrees, or even in different directions, sending some sectors above their trends and some other sectors below.

The most widely used procedure to extract a smooth trend from an economic series is the Hodrick and Prescott (1980/1997) filter. We use the Hodrick-Prescott filter (HP filter hereafter) to extract the trend from the sectorial TFP series. And we check that the residual, which we interpret as the innovations to sectorial TFPs is serially uncorrelated as is required for application of the simple factor analysis technique.

Hodrick and Prescott (1980/1997) suggested procedure to extract the growth component, y_t^{tr}, from a given time series, y_t, requires solving the optimization problem:

$$\min_{\{y_t^{tr}\}_{t=1}^{T}} \sum_{t=1}^{T} \left(y_t - y_t^{tr}\right)^2 + \lambda \sum_{t=2}^{T-1} \left[\left(y_{t+1}^{tr} - y_t^{tr}\right) - \left(y_t^{tr} - y_{t-1}^{tr}\right)\right]^2$$

where the parameter $\lambda > 0$, called the smoothing parameter, penalizes the variability in the trend component of the series. Hodrick and Prescott suggested a value of $\lambda = 1600$ to detrend US quarterly time series. This value of lambda was chosen based on the "prior view that a 5% deviation from trend per quarter is moderately large, as is one-eigth of 1% change in the growth rate in a quarter". Assuming that the cyclical component and the second difference of the trend component were identically and independently distributed normal variables with zero means and variances equal σ_1^2 and σ_2^2, the solution to the previous optimization problem when $\sqrt{\lambda} = \sigma_1/\ \sigma_2$ yields the conditional expectation of the y_t^{tr}, given the sample. This motivates the choice of $\lambda = 1600$, from $\sqrt{\lambda} = 5/(1/8)$. Additionally, when $\lambda = 1600$ is used to detrend US macroeconomic series, it produces reasonable results in the sense that the implied business cycle component of the series largely agrees with "conventional wisdom" about the US business cycle. That is, if some component in the data has a period smaller than 8 years (32 quarters) it should be part of the business cycle component of the series.

Ravn and Uhlig (2002), adopting this definition of business cycles, based on the duration of its components, show that the value of lambda should be adjusted when using series with frequency different from the quarterly frequency to preserve the main properties of the business cycle components obtained by HP detrending (relative volatilities of the series with respect to GDP, and cyclical behaviour of the series). Setting the problem in the time domain perspective, they show that by multiplying lambda with the fourth power of the observations' frequency ratio, the ratio of the variance of the cyclical component to the variance of the second difference of the trend component remains constant. More formally, they prove:

$$\lambda_{1/\alpha} = \frac{\sigma^2\left(c_{t;\alpha}\right)}{\sigma^2(\Delta_\alpha^2 y_{t;\alpha}^{tr})} = \frac{1}{\alpha^4}\lambda_1$$

where α is the inverse of the frequency of observation compared to quarterly data, for instance, for annual data $\alpha = 4$.

Thus, moving from quarterly to annual data would imply $\lambda_{1/\alpha} = \lambda_{1/4} = \frac{1}{\alpha^4}\lambda_1 = \frac{1}{4^4}1600 = 6.25$, and moving to biannual data implies $\lambda_{1/\alpha} = \lambda_{1/8} = \frac{1}{\alpha^4}\lambda_1 = \frac{1}{8^4}1600 = 0.390625$.

Marcet and Ravn (2004) propose a further adjustment of the value of λ to take into account cross-country differences in the characteristics of their economic time series. In cross-country studies, the direct application of the HP filter with $\lambda = 1600$ (quarterly data) to non-US series, does not guarantee the comparability of the results, in terms of the properties of the moments of the resulting cyclical components. For instance, as illustrated by Lores Ínsua (2000), the Spanish business cycle is different from the US business cycle: the peak of the spectrum of GDP growth rate falls out of the frequency interval which is associated with the economic cycle by any of the most commonly used filters[4] (the HP filter, with $\lambda = 1600$, keeps the components of the series with fluctuations below 32 quarters, the Baxter-King filter keeps the components with fluctuations between 6 and 32 quarters). This implies that filtering Spanish series with the "standard" value of lambda will result in a cyclical component with low volatility with respect to

[4]For concreteness, the peak of the spectrum of the Spanish GDP growth rate series happens at around 54 quarters (around 13 years). Business cycle frequencies are usually assumed to be those in the range [6,32] quarters. This interval catches only 42% of the variability contained in the Spanish GDP growth rate series. This finding extends to other Spanish macroeconomic series: consumption of non-durables, consumption of durables, gross investment, net exports, employment and the price index, as reported by Lores Ínsua (2000).

the trend component, as compared to the benchmark ratio of volatilities for the US series. Thus, the suggestion by Marcet and Ravn (2004) to adjust the value of lambda such that the ratio of the variance of the cyclical component with respect to the variance of the trend component of the Spanish series (both components obtained using the adjusted value of lambda) should be equal to the value of this ratio for the US series detrended using the standard value of lambda. Put formally, the value of lambda which is appropriate to detrend Spanish time series satisfies:

$$\frac{\sum_{t=2}^{T-1}\left[\left(y_{t+1}^{*tr}(\lambda^{Sp})-y_t^{*tr}\left(\lambda^{Sp}\right)\right)-\left(y_t^{*tr}\left(\lambda^{Sp}\right)-y_{t-1}^{*tr}\left(\lambda^{Sp}\right)\right)\right]^2}{\sum_{t=1}^{T}\left(y_t^{*}-y_t^{*tr}\left(\lambda^{Sp}\right)\right)^2}=V^* \tag{1}$$

where

$$V^*=\frac{\sum_{t=2}^{T-1}\left[\left(y_{t+1}^{tr}(\lambda^{US})-y_t^{tr}(\lambda^{US})\right)-\left(y_t^{tr}(\lambda^{US})-y_{t-1}^{tr}(\lambda^{US})\right)\right]^2}{\sum_{t=1}^{T}\left(y_t-y_t^{tr}(\lambda^{US})\right)^2}$$

where y_t^* is the Spanish time series from which we want to extract the trend component, and y_t is its US equivalent. Let the solution to this problem be $(\lambda^{Sp})^*=\lambda^{Sp,r1}$.

Marcet and Ravn (2004) suggest a second rule to choose the most appropriate value of lambda to detrend Spanish series. This value of λ^{Sp} satisfies:

$$\frac{1}{T-2}\sum_{t=2}^{T-1}\left[\left(y_{t+1}^{*tr}(\lambda^{Sp})-y_t^{*tr}\left(\lambda^{Sp}\right)\right)-\left(y_t^{*tr}\left(\lambda^{Sp}\right)-y_{t-1}^{*tr}\left(\lambda^{Sp}\right)\right)\right]^2=W^* \tag{2}$$

where

$$W^*=\frac{1}{T-2}\sum_{t=2}^{T-1}\left[\left(y_{t+1}^{tr}(\lambda^{US})-y_t^{tr}(\lambda^{US})\right)-\left(y_t^{tr}(\lambda^{US})-y_{t-1}^{tr}(\lambda^{US})\right)\right]^2$$

Let the solution to this problem be $(\lambda^{Sp})^*=\lambda^{Sp,r2}$

Hence, rule 2 imposes that the value of lambda used to detrend Spanish series should be such that total variability of the extracted trend component be just as large as the variability of the trend component of the US series (again, US series detrended using the standard value of lambda).

In order to detrend Spanish sectorial TFP time series, we first computed the solution to problems (1) and (2). We used biannual observations on US GDP (in logs, sample period:

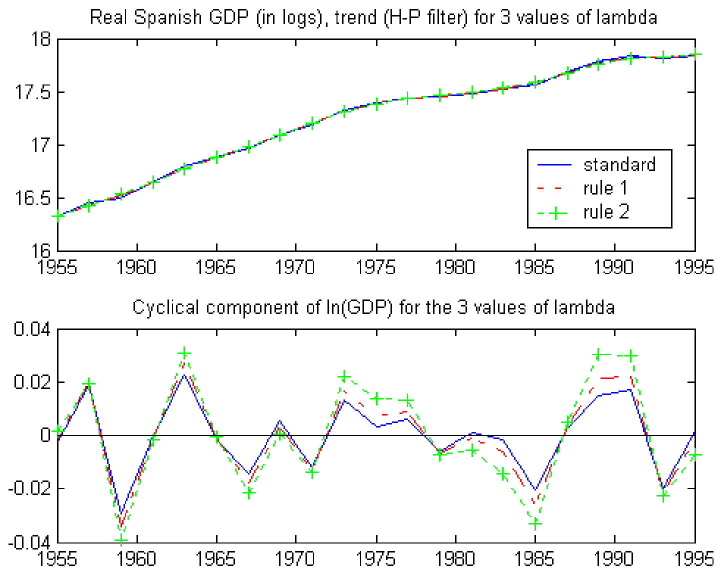


Figure 4: Spanish real GDP, HP trend and deviations from trend for $\lambda = \lambda^{US}$, $\lambda = \lambda^{r1}$and $\lambda = \lambda^{r2}$

1965-1995), to compute the values of the benchmark variabilities of the trend component and the cyclical component, that the Spanish series should fulfill. To take into account the special frequency at which FBBVA data are observed, we adjusted the value of lambda as suggested by Uhlig and Ravn (1997), i.e., lambda equal the fourth power of the observations' frequency ratio. Hence, for biannual data $\lambda_b^{US} = 1600 * (\frac{1}{8})^4 = 0.390625$. We used the Spanish biannual GDP series (in logs) for the same sample period as for the US to compute the optimal values of lambda. Using rule 1, we obtained $\lambda_b^{Spain,R1} = 0.68$. Using rule 2, we obtained $\lambda_b^{Spain,R2} = 1.34$. Figure 4 plots the resulting series of the trend and business cycle component of Spanish $\ln GDP$, using both adjusted values of lambda as well as the "standard" value of lambda, $\lambda_b^{US} = 0.390625$.

We then used both adjusted values of lambda, $\lambda_b^{Spain,R1}$ and $\lambda_b^{Spain,R2}$, to detrend TFP sectorial series at the national level (in logs), obtaining very similar results. The plots of the trends and the cyclical component of sectorial $\ln TFP$ time series are shown in appendix B. Factor analysis of the business cycle component of sectorial TFPs is carried out using the series obtained through HP detrending the series of $\ln TFP_{it}$ with $\lambda_b^{Spain,R1} = 0.68$. The results are shown next.

3.2 Results

Table 1 quantifies the comovement of the business cycle component of sectorial $\ln TFP$ series by the average of pairwise correlations of any given sector with all other sectors.

Table 1. Cyclical behaviour of sectorial TFPs

Sector	Average pairwise correlations	Correlation with cyclical component of GDP
C1	-0,16	-0,33
C2	-0,05	0,22
C3	-0,09	-0,03
C4	0,07	0,25
C5	0,11	0,51*
C6	-0,01	-0,09
C7	0,17	0,72*
C8	-0,1	0,01
C9	0,1	0,22
C10	0,13	0,12
C11	-0,03	0,04
C12	0,08	0,56*
C13	-0,06	-0,04
C14	0,1	0,36
C16	0,14	0,73*

For instance, Transport equipment (sector C7) has an average correlation of 0.17 with the rest of the sectors. And this is the greatest average correlation in absolute terms. The smallest corresponds to Metal products and Machinery (sector C6, a sector agglomerating metal products, agricultural and industrial machinery, office and data processing machines, precision and optical instruments, electrical goods). Hence, comovement of sectorial TFP shocks appears to be quite small.

Before we proceed to the factor analysis, we have to mention that results of the tests that sectorial TFP innovations series are uncorrelated are mixed: In five out of the 15 sectors we do not reject the null hypothesis[5]. For the rest of the sectors, the null is rejected. These sectors present serial correlation at different lags[6]. Applying factor analysis to serially correlated series may lead

[5] These are: C5. Chemical products, C7. Transport equipment, C12. Building, C14. Financial and insurance institutions, C16. Residual of private productive services.

[6] TFP innovations series in sectors C4, C6, C9, C10, C11 present autocorrelation at lag 1.

TFP innovations series in sectors C1, C2, C3, C8 present autocorrelation up to lag 2.

And TFP innovations series in sector C13 has autocorrelation up to lag 3.

to identifying a common component based on shared serial correlation. However, the structure of the serial correlation is different across sectors, and results of the factor analysis applied to our data prove that the serial correlation is not driving the results. Hence, we proceed with the factor analysis using the series obtained by HP detrending. Table 2 shows the explanatory power of the common factors of both a one-factor and a two-factors models of sectorial TFP shocks.

Table 2. Factor Analysis Results
Sectorial TFP business cycle component
HP detrending

Sector	1F-R^2	2F-R^2
C1	0,76	0,76
C2	0,2	0,54
C3	0,01	0,26
C4	0,03	0,2
C5	0,23	0,58
C6	0,03	0,58
C7	0,75	0,82
C8	0,04	0,57
C9	0,04	0,1
C10	0	0,29
C11	0,15	0,17
C12	0	0,29
C13	0	0,08
C14	0,55	0,55
C16	0,76	0,8

Obtained R^2 range from a low of 0 for three sectors in the one-factor model, or 0.08 in the 2-factors model, to an upper bound of 0.76 and 0.82, respectively. The average value of R^2 in the one-factor model is 0.24 and 0.44, in the 2-factors model. And the medians are 0.04 and 0.54, respectively. A close look at the results further shows that the first common factor basically "explains" TFP shocks to sectors C1 (agriculture and fishing), C7 (transport equipment), C14 (financial services) and C16 (other services). While the second factor only adds explanatory power to shocks hitting sectors C2 (fuel and power products), C5 (chemical products), C6 (metal products and machinery), and C8 (food, beverages and tobacco). Hence, the results clearly reject the hypothesis that some aggregate shock underlies sectorial TFP innovations. Neither one of the two common factors identified can be characterized as an *aggregate* disturbance.

Next, we measure how well the common factor does in explaining the shocks to aggregate TFP. The R^2 from the regression of aggregate TFP shocks on the common factor underlying sectorial shocks equals 0.60. Hence, this could lend some support to the aggregate model. However, the common factor explains only up to 33% of observed fluctuations in aggregate economic activity (measured by the adjusted R^2 statistic from the regression of the cyclical component of Spanish GDP on the common factor).

Analysis of sectorial TFP growth rates yields equivalent results in terms of the absence of a common component, which we could interpret as an aggregate disturbance.

First-differencing a series (FD, hereafter) is equivalent to applying a filter to eliminate the fluctuations contained in the series whose frequency is very low while emphasizing the components of the series with very high frequency (mainly seasonal and irregular components). On the contrary, the HP filter attributes higher weight to low frequency components as compared to FD, and less weight to very high frequency components[7]. Hence, the properties of the business cycle components of a series extracted by each of these filtering methods are expected to be different as long as the components of the series at different frequencies have different characteristics (in terms of volatility, serial correlation). Applied to factor analysis, the common factor issued from first-differenced TFP series will appear to have higher explanatory power than the common factor extracted from HP detrended TFP series if the joint variability of the high-frequency components of the series is higher than the joint variability of the "business cycle"-frequency components of the series. As a matter of fact, since we only have biannual data available, the differences between filtering methods are expected to be small, since biannual growth rates miss the seasonal and irregular components contained in quarterly or monthly observations. Thus, the common factors underlying sectorial TFP growth rates should be capturing joint variability mainly belonging to "cyclical frequencies". Table 3 shows the results of both the one- and the two-factors models.

[7] FD attributes lower weight than HP filter to components with fluctuations in the range [10,32] quarters while attributing higher weight to components with fluctuations with very high frequency (higher than every 10 quarters), the seasonal and irregular components. Hence, FD stresses the high frequencies with respect to HP.

Table 3. Factor Analysis Results
Sectorial TFP business cycle component
First-differencing

Sector	1F-R^2	2F-R^2
C1	0,05	0,29
C2	0,1	0,58
C3	0,22	0,48
C4	0,4	0,42
C5	0,39	0,43
C6	0,29	0,63
C7	0,31	0,74
C8	0,26	0,44
C9	0,01	0,02
C10	0,36	0,37
C11	0,09	0,1
C12	0,25	0,26
C13	0	0,12
C14	0,07	0,2
C16	0,34	0,76

Average value of R^2 is 0.21 for the 1-factor model and 0.39 for the 2-factors model. The medians are 0.25 and 0.42, respectively. These results do not differ much from those obtained for the cyclical component of TFP series obtained by HP filtering[8].

We used the data set provided by the Spanish Ministry of Economics and Finance, MORES, disaggregated by sectors and regions for the sample period 1980-1995, to check previous results. As for DPRN (FBBVA data set), the data reject the existence of an aggregate disturbance to sectorial TFP growth rates. Detailed results are reported in appendix D.

Thus, sectors exhibit highly specific TFP dynamics. The common factor has little explanatory power of the innovations to sectorial TFPs. This common factor was not constrained to be any observable factor. Hence, this evidence generalizes the empirical fact that the business cycle components of sectorial TFPs show little procyclicality if any. Table 1 reports cross-correlations of the cyclical component of GDP, measured using the HP filter, with the cyclical component of sectorial TFP series. Significant correlations are marked with an asterisk. Only four sectors, chemical products, transport equipment, building, and the residual of the private productive services, exhibit procyclical TFP.

[8] Detailed results of factor analyses of the business cycle component of sectorial TFPs are provided in appendix C.

4 Aggregate *versus* regionally-specific technical shocks

The next step we take is to look at regional production functions. We ask if there are regionally-specific sectorial shocks. This could be the case, and still not show up as large off-diagonal elements in the correlation matrix of sectorial TFP innovations observed at the nation-wide level, if regions affected by a generalized positive shock (or negative shock) across sectors were too small relative to national output. Hence, we investigate technical shocks to regional production functions, sectorial and aggregate, using the methodology that led our analysis of sectorial TFP shocks at the nation-wide level. First, we observe pairwise correlations of regional[9] TFP dynamics. Next, we ask whether there is a factor, "common" to all the regions, which explains the biggest part of observed regional TFP dynamics. Regionally-specific technical shocks will show up as the failure to find any such "common" factor, both at the aggregate level and for each of the sectors.

4.1 The model

The statistical model is the same as in section 3. Assume each region's TFP series may be decomposed into a smooth trend (which is not assumed to be the same across regions) and a deviation from the trend,

$$y^i_{jt} = y^{itr}_{jt} + \nu^i_{jt}$$

for any given sector $i = 1...16$ (i.e., including the aggregate) and region $j = 1, ...17$.

Assume that regional cyclical components may be partly explained by a common factor (or national), and an idiosyncratic factor (or local). That is,

[9] The regions include the 17 Spanish Comunidades Autónomas. In alphabetical order: Andalucía, Aragón, Asturias, Baleares, Canarias, Cantabria, Castilla-La-Mancha, Castilla y León, Cataluña, Comunidad Valenciana, Extremadura, Galicia, Madrid, Murcia, Navarra, País Vasco, La Rioja.

$$\nu^i_{1t} = a^i_1 n^i_t + u^i_{1t}$$
$$\nu^i_{2t} = a^i_2 n^i_t + u^i_{2t}$$
$$...$$
$$\nu^i_{17t} = a^i_{17} n^i_t + u^i_{17t}$$

The way we lay down the model to test for the existence of regionally-specific technical shocks is closely related to the focus of interest of the empirical literature on the existence and magnitude of "spatial externalities" which affect growth. This is because the regional dimension is not the natural extension of the industry breakdown of aggregate output, rather *firms* are the ideal observation unit to investigate the sources of TFP growth. Hence, we are not pursuing our investigation of the "specificity" of technical shocks one step further to the level of the firms within any given sector, but into a new dimension. What we ask now is whether the more dynamic firms in a given sector (or in more than one sector) happen to be located in a given region instead of being uniformly distributed[10]. If firms are uniformly distributed, then the regional dimension adds no relevant information as to the determinants of TFP dynamics since we will observe the same dynamics in each and every region. Accordingly, the common component will be huge. If, on the contrary, firms are not uniformly distributed, then observed dynamics, both at the sectorial and aggregate level, will be different across regions. Hence, the common factor will have little explanatory power of regional TFP disturbances. *A priori* we do not have any solid empirical foundation to expect one or the other hypotheses to be true. Results of the factor analyses will shed light on the issue. If we find no single common factor has substantial explanatory power of regional TFP disturbances, we are allowed to conclude that firms are heterogeneously distributed across regions, and look for an explanation, as in the extended literature on dynamic knowledge spillovers[11]. On the contrary, if we find that a common factor explains the greatest part of regional technical disturbances, we cannot infer that the distribution of firms is homogeneous. This could be the case but it could as well be capturing measurement errors. For instance, if regional data were constructed from aggregate data, under the particular assumption that regions behave almost the same except for a random term. The availability of two data sets will allow us to check the robustness of the results obtained using

[10]To be precise, differential TFP growth arises because of knowledge spillovers in the regions where economic activity is denser.

[11]Some examples are Glaeser et al. (1992), Henderson et al. (1995), Ciccone and Hall (1996).

our main data set, DPRN from Fundación BBVA.

4.2 Results

Table 1 quantifies the comovement of the cyclical components of regional $\ln TFP$ series in the private productive sector by the average of pairwise correlations of any given region with all other regions.

Table 1. Cyclical behaviour of regional TFPs
Private productive sector

Region	Average pairwise correlations
And	0,61
Ara	0,68
Ast	0,24
Bal	0,65
Can	0,51
Cant	0,6
CLM	0,64
CyL	0,59
Cat	0,69
Val	0,72
Ext	0,39
Gal	0,59
Mad	0,67
Mur	0,59
Nav	0,48
PV	0,45
Rio	0,48

Innovations to regional private productive sector TFPs are much more strongly correlated than innovations to sectorial TFPs are. Hence, we expect the common factor to be highly explanatory of regional dynamics.

Table 2 shows the explanatory power (measured by R^2) of the common factors of a one-factor and a two-factors models of TFP shocks to regional aggregate production functions.

Table 2. Factor Analysis Results
Regional TFP business cycle component
HP detrending

Region	1F-R^2	2F-R^2
And	0,69	0,73
Ara	0,85	0,9
Ast	0,11	0,16
Bal	0,78	0,78
Can	0,48	0,75
Cant	0,68	0,82
CLM	0,73	0,75
CyL	0,63	0,88
Cat	0,86	0,95
Val	0,93	0,93
Ext	0,29	0,78
Gal	0,63	0,79
Mad	0,81	0,85
Mur	0,63	0,71
Nav	0,47	0,87
PV	0,41	0,78
Rio	0,46	0,52

R^2 are in the range 0.11 (Asturias) to 0.93 (Comunidad Valenciana) with median 0.63 for the one-factor model. For the 2-factors model, the median increases to 0.78, and the range goes from 0.16 (Asturias) to 0.95 (Cataluña). In summary, shocks to regional aggregate outputs are well characterized as national. The local shocks being small but for one region, Asturias. The effect of the common factor is even greater if we consider sectorial production functions. The difference measures how distinct regional sectorial compositions of output are. In fact, more detailed results provided in appendix E, show an association of regions according to their sectorial structure. Table 3 reports the explanatory power (measured by adjusted R^2) of the common factor of the one-factor model applied to each sector.

Table 3. 1F-R^2 from Factor Analyses to Regional TFPs by sector
TFP business cycle component computed by HP detrending (lambda=0.68, rule 1)

Region	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C16
And	.81	.94	.92	.88	.88	.97	.59	.93	.92	.91	.95	.88	.96	.99	.96
Ara	.52	.94	.75	.87	.87	.99	.62	.80	.88	.71	.94	.86	.95	.98	.96
Ast	.55	.83	.87	.54	.88	.96	.74	.93	.84	.58	.72	.49	.83	.96	.84
Bal	.49	.86	-	.73	.74	.83	.74	.73	.67	.86	.93	.76	.62	.91	.65
Can	.48	.92	.77	.82	.94	.83	.79	.88	.79	.65	.88	.31	.75	.95	.84
Cant	.34	.88	.28	.72	.92	.91	.82	.50	.61	.45	.78	.72	.71	.94	.84
CLM	.58	.89	.49	.73	.88	.90	.85	.90	.85	.95	.83	.83	.93	.97	.87
CyL	.61	.93	.86	.87	.92	.98	.83	.86	.64	.94	.86	.87	.88	.97	.97
Cat	.74	.85	.88	.84	.93	.98	.88	.81	.95	.94	.91	.80	.93	.99	.88
Val	.74	.90	.85	.84	.91	.96	.45	.88	.85	.92	.97	.83	.93	.98	.84
Ext	.69	.76	.09	.49	.87	.93	-	.77	.64	.76	.92	.84	.80	.99	.96
Gal	.38	.73	.63	.88	.88	.94	.91	.70	.89	.83	.83	.76	.93	.98	.94
Mad	.70	.94	.73	.67	.86	.96	.94	.75	.61	.80	.90	.71	.87	.98	.88
Mur	.93	.89	.74	.77	.70	.96	.84	.37	.84	.50	.88	.74	.88	.95	.26
Nav	.54	.86	.90	.72	.85	.93	.18	.85	.87	.74	.88	.83	.90	.93	.94
PV	.17	.92	.94	.88	.93	.98	.94	.86	.90	.84	.76	.48	.88	.98	.95
Rio	.25	.78	.41	.61	.79	.97	-	.13	.97	.70	.83	.70	.60	.95	.87

Factor analysis of regional TFP growth rates series for the private productive sector, using data from MORES (annual data for 1980-1995) yields a quite different picture. The explanatory power of the national disturbance is only 23% (one-factor model) or 43% (2-factors model).

Actually, to check that the low correlation of the MORES regional data is not due to the shorter sample period, we repeated the analysis using DPRN times series only for the more recent period 1981-1995. We find that one single component accounts for more than 70% of the variability contained in DPRN regional TFP growth rates. As a consequence, we have to conclude that the uncovered difference between both data sets, in terms of the importance of a common factor underlying the regional series, most probably comes from the precise way in which each of these data sources builds the regional time series of the variables implied in the growth accounting exercise. This finding motivates further research on the determinants of regional TFP growth differentials, which is the object of a different paper.

At this point, we hope to have established that TFP innovations are sector-specific and nation-wide. We now turn to the second question: Is the growth rate of TFP well characterized as the sum of a positive constant plus a random term[12]? To explore this issue we look at the

[12] Assume as in the introduction that TFP could be modeled as:

$$\ln A_{it} = \overline{A}_i + g_i t + \widetilde{\varepsilon}_{it}$$

where

$$\widetilde{\varepsilon}_{it} = \rho_{\varepsilon} \widetilde{\varepsilon}_{it-1} + u_{it}$$

evolution of sectorial contributions to overall TFP growth over successive arbitrarily cut time intervals.

5 Sunrise-sunset diagrams

Harberger (1998) proposed a methodology for inspecting sectorial TFP dynamics, he asks how concentrated sectorial contributions to overall TFP growth during a given time interval are. We applied this methodology to the data from FBBVA on the Spanish private productive sector, divided into 15 branches. The sample period is cut into six 5-years intervals, from 1965-70 to 1990-95. Next, we describe the steps to estimate each sector's contribution to overall TFP growth in any given period.

First, we compute each sector's Solow residual (over the whole interval, not annualized), according to the expression:

$$SR_{i\tau} = \Delta Y_{i\tau} - \overline{(1-\alpha)_{\tau}}\Delta L_{i\tau} - \overline{\alpha_{\tau}}\Delta K_{i\tau}$$

where $\Delta X_{i\tau}$ represents the logarithmic difference of variable X, in sector i during time interval τ (i.e., $\Delta X_{i\tau} = \ln X_{it} - \ln X_{it-5}$), Y measures real value added, L measures number of workers, K

with

$$0 < \rho_{\varepsilon} < 1$$

and u_{it} i.i.d.

Then

$$\Delta \ln A_{it} = g_i + \Delta\widetilde{\varepsilon}_{it}$$

with

$$E\left(\Delta \ln A_{it}\right) = g_i$$

$$Var\left(\Delta \ln A_{it}\right) = 2\left(1-\rho_{\varepsilon}\right)Var\left(\widetilde{\varepsilon}\right)$$

$$Corr(\Delta \ln A_{it}, \Delta \ln A_{it-1}) = \frac{\rho_{\varepsilon}-1}{2}$$

$$Corr(\Delta \ln A_{it}, \Delta \ln A_{it-h}) = \frac{\rho_{\varepsilon}^{h-1}\left(\rho_{\varepsilon}-1\right)}{2}$$

the stock of physical capital, and t represents years. Average sectorial labour share over 1965-80, computed from biannual data, is used to compute sectorial Solow residuals during time intervals 1965-70, 1970-75 and 1975-80. Similarly, average sectorial labour share over 1980-1995 is used to compute sectorial Solow residuals during time intervals 1980-85, 1985-90 and 1990-95.

Second, sectorial TFP improvements are expressed in monetary units, by multiplying estimated Solow residuals (5-years growth rates) by initial sectorial outputs measured in base-year monetary units. In this way, it becomes possible to aggregate TFP improvements over different sectors.

Third, we order the sectors in descending order, according to their TFP growth rates, and compute cumulative amounts of TFP gains in base-year monetary units, as well as cumulative amounts of initial sectorial outputs also measured in base-year monetary units. From these two series, we derive the series of cumulated TFP growth rates.

Tables 1 to 6 in appendix G display the above computations in full detail, using data from Fundación BBVA[13]. The most striking finding is that, in every single period, some sectors positively contribute to overall TFP growth while some other sectors show negative TFP growth rates. Table 1 reports summary statistics, illustrating this fact.

Table 1. Annualized sectorial TFP growth rates over 5-years intervals

Sector	65/70	70/75	75/80	80/85	85/90	90/95	Mean	Std.Dev.
C1	2,07	1,12	1,38	5,21	5,28	2,44	2,98	1,86
C2	3,00	-5,97	2,28	-5,19	4,85	-1,68	-0,11	4,51
C3	5,98	19,46	-3,98	3,56	-2,68	3,56	5,50	8,38
C4	12,27	7,14	1,12	-1,69	1,60	3,94	4,47	4,99
C5	6,65	3,48	-1,02	2,90	6,65	3,52	3,83	2,84
C6	3,83	6,74	-1,70	3,39	1,37	3,95	3,06	2,84
C7	5,46	9,11	1,68	-0,06	8,58	-0,19	4,38	4,21
C8	6,04	2,65	8,62	2,77	2,90	0,81	4,10	2,84
C9	3,33	0,64	2,44	1,89	2,84	0,26	1,92	1,22
C10	7,63	5,49	3,16	1,51	-2,62	1,58	2,99	3,56
C11	4,73	0,63	0,70	-0,11	1,30	-2,13	0,94	2,24
C12	-4,12	3,88	-1,12	1,20	3,58	1,01	0,89	3,01
C13	4,22	2,24	1,70	4,96	0,91	0,86	2,53	1,73
C14	-7,59	-10,82	0,85	3,65	5,41	-2,49	-1,16	6,39
C16	2,59	1,08	-2,82	-1,13	0,27	-1,99	-0,27	2,03
Cum.TFP	2,07	1,69	-0,47	0,93	2,22	-0,18	1,04	1,15
Priv.Prod.	3,10	2,77	-0,03	1,39	3,13	0,32	1,81	1,42

[13] Appendix I reports biannual growth rates of TFP, sector by sector for 1965-1995.

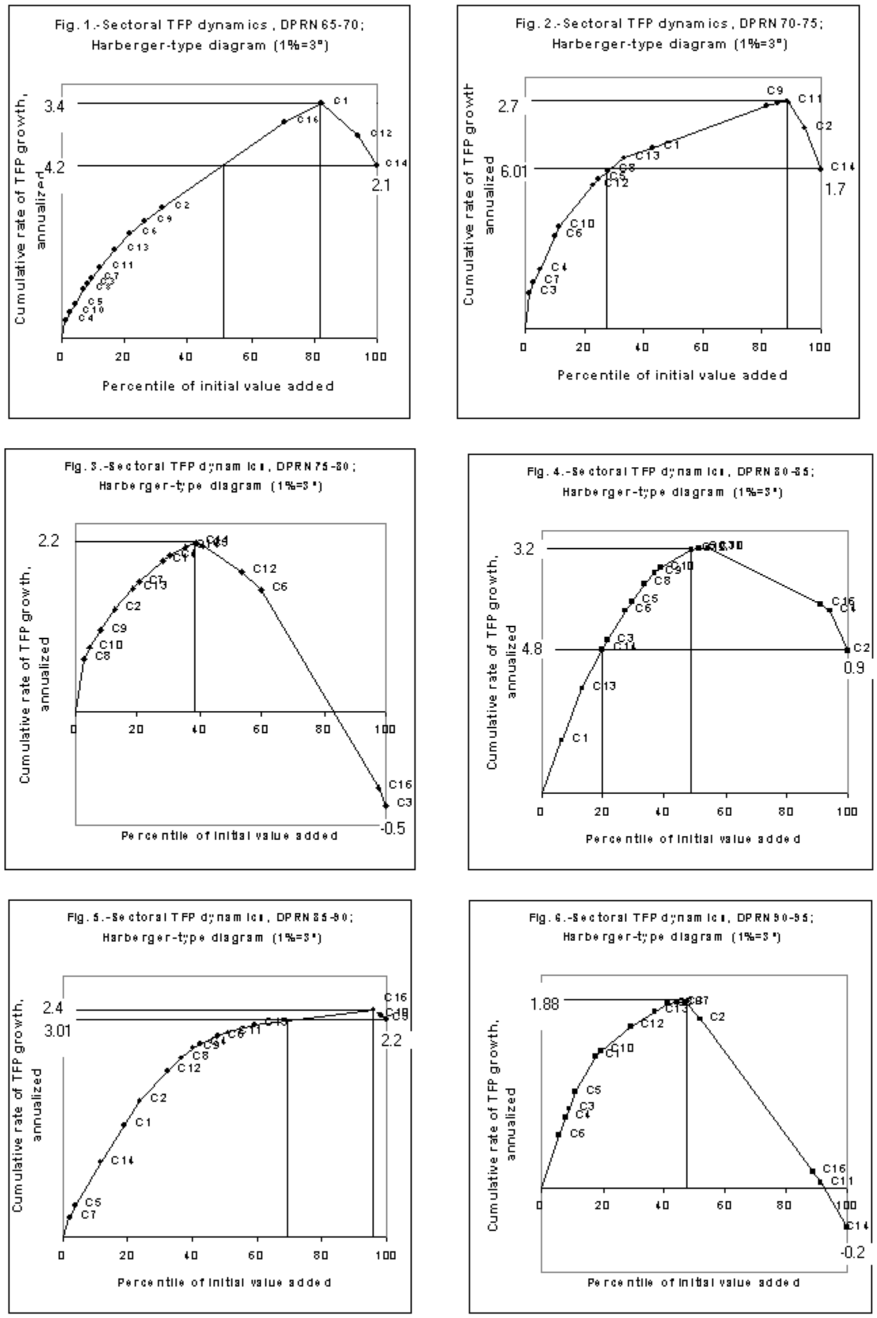
Sectorial TFP dynamics are best visualized using sunrise-sunset diagrams. Sunrise-sunset diagrams plot percentile of total initial output in the x-axis against cumulated TFP growth rates in the y-axis. Following the suggestion by Harberger, we establish a metric convention, converting percentage points of TFP growth[14] into degrees of an angle starting from the origin. For concreteness, we use 1%=3^o. Hence, the value of the y-axis ordinate is equal to the product of the percentile of initial output (value of the x-axis ordinate) times cumulated TFP growth rate measured in radians.

For any given time interval, if the sectors displaying TFP increases overcome the contribution to overall TFP performance of those experiencing TFP losses, the graph has an ordinate at value 100% of the x-axis, above zero. On the contrary, if the negative contributions outperform the positive contributions to overall TFP growth, the ordinate at value 100% of the x-axis is below zero. Also, the closer the plotted line is to a straight line, the more homogeneous sectorial TFP growth rates are. On the contrary, when very few sectors account for total estimated TFP improvements in the private productive sector, the remaining sectors display positive as well as negative contributions to overall TFP performance, that exactly offset each other.

According to the aggregate model of "K,L, and exogenous TFP", we should observe relatively constant overall TFP growth rates across time periods. In addition, sectorial contributions to overall TFP growth rates are expected to be proportional to the share in initial output[15]. Actually, total TFP growth is far from constant, and is highly variable as shown by the standard deviation. And typically, the diagrams will show "overshooting", which is represented by the piece of the curve that goes above the horizontal line drawn at the ordinate that corresponds to total TFP improvement.

[14] Instead of using estimated 5-years TFP growth rates, we plot their annual equivalents.

[15] Standard growth theory has ignored the relationship between structural change and growth. If we assume that each sector's TFP may grow at different rates, and we allow for structural change, then the growth rate of aggregate output will not be constant. Echevarría (1997) develops a multisector model, where the rate of exogenous technical change is different in each sector and preferences are non homothetic. Changes in the sectorial composition of output affect the growth rate.



Sunrise-sunset diagrams, using DPRN (Fundación BBVA)

Figures 1 to 6 clearly show the high variability of aggregate TFP performance across time periods. Accordingly, sectors' contributions to overall TFP growth are also highly variable. For instance, period 1980-85 is characterized by total TFP growth at an annual rate equal to 0.9%. Three sectors alone, agriculture and fishing (C1), transport and communication services (C13) and financial and insurance services (C14), which together represent 20% of initial value added, account for total TFP gains in the private productive sector. The remaining sectors display both positive and negative contributions, which exactly offset each other. Sectors C3, C5, C6, C8, C9, C10 and C12 have positive TFP growth rates. Sectors C7, C11, C16, C4 and C2, which together represent almost half of initial output, have negative TFP growth rates. Period 1985-90, on the contrary, is characterized by generalized positive TFP growth. More than half of initial output (60%) accounts for overall TFP growth. 96% of initial output positively contributes to total TFP growth. And only two sectors (C10 and C3, which together represent 4% of initial output) experience negative TFP growth rates. At the other extreme, periods 1975-80 and 1990-95 are characterized by overall negative TFP growth, at annual rates equal -0.5% and -0.2%, respectively. Notwithstanding, in both periods there are sectors displaying positive contributions to overall TFP performance. Almost half of initial output presents positive contributions to TFP growth, which are more than compensated by the negative contributions.

To summarize, sunrise-sunset diagrams show some interesting features of the growth process: The first striking finding is the *"steady" presence of negative contributions to overall TFP growth.* Period after period, there always are some sectors displaying negative TFP growth rates. In other words, and in line with the results obtained by Harberger for the US manufacturing sectors (1958-1967), a very small fraction of total initial value added typically accounts for 100% of overall TFP improvements in any given period. The remaining sectors show both positive and negative TFP growth rates, which exactly compensate each other. The most striking examples of this "overshooting" take place during 1970-1975: around 25% of initial output (6 industrial sectors together with the building sector) account for 100% of total TFP increases, and during 1980-1985: 20% of initial output (only 3 industrial sectors) account for 100% of total TFP increases. On the contrary, during 1985-1990, around 60% of initial output (consisting of 10 industrial sectors, the building sector and one sector belonging to the private productive services) account for 100% of total TFP improvement. The difference, of course, rests on overall TFP performance during each of these periods. That is, positive as well as negative TFP growth rates are present in any given time period. In some periods though, negative contributions are so large (in terms of the number of sectors affected, measured by their participation in total initial real value added) that overall TFP performance is negative, even though there are still some sectors experiencing positive TFP growth.

This first observation obviously questions that technical progress accrues homogeneously to all sectors. Sectorial diversity in any given period is so huge that it compensates for generalized underperformance during some periods, according to factor analyses' results. Also, the traditional view that technical change should be mainly positive is challenged probably to a more dramatic extent than the "productivity slowdown" has done.

The second finding is that winners (defined as sectors which experience positive TFP growth rates) are different in different time periods. There are neither permanent losers nor permanent winners. In general, TFP performance varies a lot for a given sector from one time interval to the next. However, contrary to Harberger's results for the US manufacturing sectors, our data show some degree of persistence. There are some sectors which are winners for two consecutive time intervals (C4 and C3, during 1965-1970 and 1970-1975; C13, during 1975-1980 and 1980-1985; C14, during 1980-1985 and 1985-1990) or even three time intervals (C10, from 1965 until 1980; and C1 from 1980-1985 to 1990-1995). Also, some sectors exhibit a particularly persistent negative TFP behaviour, for instance, C16 and C14 appear three times among the losers. In parallel, there are some sectors whose behaviour is especially oscillating, as is the case for C3 and C12. As shown in the appendix, Jorgenson's sectorial classification, which is partly used by Harberger (Harberger's focus is on industrial sectors' dynamics), is much finer than our own, which probably explains the difference.

This second observation, together with the first observation, questions the traditional assumption that TFP grows at a more or less constant growth rate. Additionally, it casts doubts on the hypothesis that growth may be driven by some kind of economies of scale, either at the industry or at the national level. If scale economies were to play a role as an engine of growth, one would expect TFP growth rates to show some sign of persistence, i.e., permanently higher TFP growth rates in those industries whose technologies were characterized by internal increasing returns to scale or enjoying some kind of externalities. Previous results rather point to an oscillating behaviour of the growth process when inspected at the industry level.

A third interesting observation is that the contribution of the losers is quite variable, contrary to what happens with the winners: if the losers had contributed zero during each time interval, the range of overall annualized TFP improvements would have been [1.9;3.4]. Instead, we observe

TFP dynamics in the range [-0.5;2.2]. That is, the presence of bad TFP performers doubles TFP variability. This result coincides with Harberger's results though to a lesser extent in our data (for the US manufacturing sectors TFP variability increases by a factor of 4). It appears that *positive TFP behaviour is more steady than negative TFP behaviour*: Across time intervals positive TFP contributions to overall TFP growth are "predictable" while negative contributions to overall TFP performance are highly variable. Apart from the information that this observation may contain about the origin and nature of observed cyclical oscillations, the asymmetric behaviour of the positive versus negative contributions to overall TFP dynamics already says something about the assumption underlying the standard RBC model: It cannot be that a single random process, with zero mean and constant variance as usually assumed, drives the cycle since this would imply positive and negative shocks share the same characteristics, in terms of likelihood and persistence. Linear and Gaussian models cannot generate asymmetric fluctuations[16].

Sunrise-sunset diagrams representing sectorial TFP dynamics using the data set provided by the Spanish Ministry of Economics and Finance (MORES) are shown in appendix G. They help check the generality of the results obtained using our benchmark data set, DPRN provided by FBBVA. Aside from the specific differences commented in the appendix, two standing features are common to both data sources and replicate the regularities observed by Harberger for the

[16] Assume, as in the introduction, that TFP is modeled as:

$$\ln A_t = \overline{A} + gt + \widetilde{\varepsilon}_t$$

$$\widetilde{\varepsilon}_t = \rho_\varepsilon \widetilde{\varepsilon}_{t-1} + u_t$$

with u_t i.i.d. Gaussian disturbance. Then

$$\ln A_t - \left(\overline{A} + gt\right) = \widetilde{\varepsilon}_t$$

and $\widetilde{\varepsilon}_t$ admits a moving average representation:

$$\widetilde{\varepsilon}_t = \frac{1}{1 - \rho_\varepsilon L} u_t$$

with L the lag operator. Since u_t has a symmetric distribution, then the process $\widetilde{\varepsilon}_t$, which is a linear combination of these disturbances, is also symmetric. Hence, a linear and Gaussian ARMA model (here we focus on an AR(1) model) cannot asymptotically sustain asymmetric behaviour.

US economy. First, TFP growth shows high variation across industries in any given interval, with positive and negative TFP growth rates coexisting. The finding confirms that technical change is at least sector-specific. Second, TFP growth rates within any given industry exhibit high variability across time periods. This suggests that growth is not caused by some kind of economies of scale that would generate sustained growth. On the contrary, the engine of growth, far from being a smooth process seems to be a cyclical process.

6 Embodied technical progress and the externalities hypothesis

The aim of the paper is to check the validity of the basic assumption of the model of "*K*apital, *L*abour, and *A*ggregate TFP" that technical change is well characterized as an exogenous aggregate stochastic process, growing at a more or less constant rate. At the other extreme, the alternative hypothesis would be: “It’s a jungle out there”. Firms are created to maximize profits, some of them are successful, some others fail. So the shocks are in fact firm-specific and cannot be modeled as an aggregate shock.

Available data at the industry level have been used to test the hypothesis that technical change is well characterized as an aggregate process. We looked for the common factor underlying sectorial TFPs, and we also checked for the common factor underlying regional TFPs. We were able to identify nation-wide sectorial technical shocks. Moreover, sector-specific TFP dynamics prove to be oscillating, rejecting the assumption that TFP growth proceeds at a more or less constant growth rate, be it of the exogenous or the endogenous type.

Hence, we have to focus on *at least* sector-specific sources of TFP growth. And look for "factors" that could explain observed differences in sectorial TFP growth rates. These may include: different savings rates, differences in the substitutability between factor inputs, differences in adjustment costs if any, differences in the "availability" of technological improvements, differences in the market structure...

In this section, we focus on the role of capital accumulation on TFP growth. More precisely, our first candidate to explain why technical improvement does not accrue to each and every sector simultaneously, and why its growth process shows a rather cyclical pattern is that technical change be investment-specific. Unless firms invest in better-quality machines or more highly qualified workers, the ratio of output to inputs will remain unchanged.

We try a simple test of the hypothesis that technical progress is embodied, using sector-level data. We report some key statistics for the 5 fastest-growing sectors and the 5 slowest-growing sectors during 1965-1995. These are: output growth rate, the Solow residual, labour productivity growth rate, capital growth rate, profits growth rate and the capital contribution to output growth in each sector.

5 fastest-growing sectors over 1965-1995
Key variables' growth rates

	Y	Solow Residual	Y/L	K	Profits	K contr.
C4	4,99%	3,16%	5,99%	3,42%	4,95%	1,78%
C5	5,13%	3,07%	4,75%	2,74%	3,47%	1,44%
C7	5,43%	3,28%	4,54%	3,52%	3,47%	1,22%
C8	4,72%	3,63%	5,10%	2,34%	4,23%	1,04%
C13	4,99%	2,31%	4,12%	6,04%	3,34%	1,85%
Mean	5,05%	3,09%	4,90%	3,61%	3,89%	1,47%

5 slowest-growing sectors over 1965-1995
Key variables' growth rates

	Y	Solow Residual	Y/L	K	Profits	K contr.
C1	1,08%	3,24%	5,37%	2,64%	2,30%	0,72%
C2	2,16%	-0,64%	3,37%	3,94%	2,23%	2,72%
C9	1,50%	1,87%	3,21%	1,07%	-0,59%	0,46%
C11	2,63%	0,58%	2,49%	4,69%	0,61%	1,73%
C12	2,77%	0,91%	2,27%	5,24%	1,91%	1,29%
Mean	2,03%	1,19%	3,34%	3,52%	1,29%	1,38%

From reported statistics, there is no substantive difference in capital contribution to output growth between the fastest-growing sectors and the slowest-growing sectors. On the contrary, the Solow residual "explains" high growth rates of output in the fastest-growing sectors. Hence, one would have to conclude that technical progress does not seem to be embodied in new capital goods insofar as slow-growing sectors have accumulated as much physical capital as the fastest-growing sectors. Upon reflection, though, it is clear that one *should not expect* to uncover any relationship between aggregate investment data and sectorial TFP growth rates at the industry level. If TFP improvements accrue only to the firms investing in new and more efficient capital, but do not accrue to the firms that invest in capital goods of the same quality, then aggregate investments at the industry level may be huge while at the same time TFP growth is small. This will happen provided that capital accumulation consists mainly of same-quality capital goods. On the contrary, at the firm level, upgrading investments are perfectly identified and so are TFP improvements. Hence, correlation of both variables is expected to be positive and strong. Results by Castiglionesi and Ornaghi (2003) using a panel of Spanish firms during 1990-1999 show that a great fraction of technical change is embodied in new and better-quality capital. Together, the variables they use to measure the effect of investment-specific technical change[17] explain 55% of TFP growth.

On the contrary, one may choose to ignore the findings of sections 3, 4 and 5. And, assuming that all capital is of the same quality, use the data to put formally to a test the hypothesis that growth is generated by "broad externalities" as postulated by some of the models of the "new" endogenous growth literature[18]. In particular, one should find a strong and positive relationship between aggregate (industry-level) investments and industry-level TFP growth in the presence of "Marshall-Arrow-Romer" type externalities[19]. In this sense, the absence of any

[17] These are: research expenditures successfully embodied in new capital goods, weighted average age of the capital stock acquired in the market, and technology usage, which is a variable measuring if in period t the firm has adopted at least one new advanced technology among computer automated designs, robotics and numerically controlled machines.

[18] The model in Romer (1986) belongs to this class of models, with knowledge being privately accumulated and contributing not only to production at a particular firm but to production of all firms.

[19] The simplest model assumes the representative firm has production function:

$$Y_h = K_h^{\alpha} \left[A_h L_h\right]^{1-\alpha}$$

where

$$A_h = BK^{\phi},\ B > 0, \phi > 0$$

B is a shift parameter, and ϕ measures the elasticity of the technological level to increases in the aggregate capital stock. That is, workers become more efficient as a side-effect of the accumulation of new capital at the aggregate level. The most widely-known version of this model, the AK model, sets $\phi = 1$.

A_h grows at the same rate as the stock of aggregate physical capital, K.

$$\frac{\dot{A}_h}{A_h} = \frac{\dot{K}}{K}$$

In equilibrium, consumption, output and the stock of physical capital all grow at the same constant growth rate. Hence, this simple model predicts:

$$\frac{dA}{A} = \frac{dK}{K}$$

That is, technical progress should be higher in those industries whose aggregate stock of physical capital grows faster.

correlation between capital accumulation and TFP growth, using cross-industry evidence, is a further though very preliminary proof that externalities are not the force underlying TFP growth. There is a large empirical literature on the existence and magnitude of "knowledge spillovers". We are in the process of carrying out a more careful investigation, in line with this literature, of the "externalities hypothesis", using data disaggregated by sector and region taken from both DPRN and MORES data sets.

7 Concluding remarks

Most commonly used model of RBC assumes the economy is hit by an aggregate technological shock, modeled as a stationary autoregressive process, with constant mean and variance. It is further assumed that TFP grows at a more or less constant rate. We have proven that this basic assumption is not supported by the data in a number of ways. First, when we look at the joint behaviour of sectorial TFPs, it is not possible to identify an "aggregate" or common shock to the 15 private productive sectors. Technical shocks are mainly sector-specific. Second, detailed examination of TPF growth rates at the industry-level over the "medium-run" shows that negative growth rates are a pervasive feature of TFP dynamics. During any given time interval, there are sectors experiencing TFP decreases. More generally, sectors alternate periods of technical improvement with periods of technical "regress". Thus, growth would seem to be best characterized as an oscillating/cyclical process. Finally, the data also show an asymmetry in the behaviour of positive and negative TFP growth rates. More precisely, the contribution of sectorial negative TFP growth rates to overall TFP growth is quite variable across time periods. This has of course implications for the most appropriate way to model technology shocks. Or put differently, if we assume a model with growth "coming in cycles", this uncovered asymmetry could be reflecting intrinsic features of the growth process that determine cyclical phases of different lengths and strengths.

The regional dimension of TFP dynamics confirms the specificity of sectorial TFP shocks by highlighting regional relationships basically determined by similarities in the sectorial composition of output. We also learn that there is no spatial dimension to the growth process, according to the results obtained using DPRN data.

Also, empirically identifying potential determinants of the highly variable TFP dynamics requires the use of detailed firm-level data sets. The hypothesis that technical progress is embodied in new capital goods has received attention recently[20] with successful results. We use industry-level evidence to prove that "broad externalities" are not the driving force underlying growth.

Further research may try to check the hypothesis that technical change is induced by changes in factors' relative price. Assessing the extent to which observed technical change in the short-run may be induced by changes in factors' relative price requires, on the one hand, the development of a model where the firm is allowed to move to a different technology (or to a different sector) when expected profits are higher than the profits it would obtain by keeping the same technology. On the other hand, detailed information at the firm-level is also required to empirically test such an hypothesis. Further research may also try to verify what kind of market structure is more conducive to technical innovations.

[20] Castiglionesi and Ornaghi (2003).

References

[1] Baily et al., "Labour productivity: Structural change and cyclical dynamics", *Review of Economics and Statistics*, 2001, 83 (3), 420-433.

[2] Castiglionesi, F. and C. Ornaghi, "An Empirical Assessment of the Determinants of Total Factor Productivity Growth", Paper presented at the annual congress of the European Economic Association, Stockholm, 2003.

[3] Ciccone, A. and R. Hall , "Productivity and the Density of Economic Activity", *American Economic Review*,1996, 86 (1), 54-70.

[4] Escribá F.J. and M.J. Murgui, "La productividad total de los factores entre sectores y regiones en la economía española (1980-1993)", Dirección General de Análisis y Programación Presupuestaria, Ministerio de Economía y Hacienda, Documento de Trabajo 98005, 1998.

[5] Fundación BBVA, *Renta nacional de España y su distribución provincial, Serie homogénea, 1955-1993 y avances 1994-1997*. Bilbao,1999.

[6] Glaeser et al., "Growth in cities", *Journal of Political Economy*, 1992, 100 (6), 1126-1152.

[7] Harberger, A., "A Vision of the Growth Process", *American Economic Review*, 1998, 88 (1), 1-32.

[8] Henderson et al., "Industrial development in cities", *Journal of Political Economy*, 1995, 103 (5), 1067-1090.

[9] Hodrick, R and E. Prescott, "Postwar U.S. Business Cycles: An Empirical Investigation", Carnegie Mellon University Discussion Paper 451, 1980.

[10] Hodrick, R and E. Prescott, "Postwar U.S. Business Cycles: An Empirical Investigation", *Journal of Money, Credit and Banking*, 1997, 29 (1), 1-16.

[11] Instituto Nacional de Estadística, *Encuesta de Poblacion Activa*. Madrid, 1965.

[12] Instituto Nacional de Estadística, *Encuesta de Población Activa*, Principales Resultados Nacionales, autonómicos y provinciales, desde trimestre 3/1976 hasta 4/2004. <www.ine.es>

[13] Lores Ínsua F.J., "Crecimiento y ciclo económico en la economía española", Tesis Doctoral, Universidad Carlos III de Madrid, 2000.

[14] Más, M., F. Pérez and E. Uriel, *El stock de capital en España y su distribución territorial*, Fundación BBVA e IVIE. Bilbao,1998.

[15] Más, M., F. Pérez, E. Uriel and L. Serrano, *Capital humano y actividad económica, 1964-2001.* Bancaja e IVIE. Valencia, 2001. Online resource available at <http://obrasocial.bancaja.es/capital/informe_actividad_economica.htm>

[16] Ministerio de Economía y Hacienda, Dirección General de Análisis y Programación Presupuestaria, *Base de Datos BD.MORES*. Madrid,1998. Online resource, available at <www.igae.minhac.es>

[17] Organisation pour la Coopération et le Développement Économique, *Labour Force Statistics.* Paris, 1997.

[18] Peneder, M., "Industrial Structure and Aggregate Growth", *Structural Change and Economic Dynamics*, 2003, 14 (4), 427-448.

[19] Romer, D., "Increasing returns and Long Run Growth", *Journal of Political Economy*, 1986, 94 (October), 1002-1037.

[20] Siotis, G., Market Power, "Total factor productivity growth, and structural change. An illustration for Spain, 1983-1996". Banco de España. Documento de Trabajo 2001, 2003.

[21] Solow, R., "Technical Change and the Aggregate Production Function", *Review of Economics and Statistics*, 1957, 39, 312-320.

[22] Torre, L., "Concentration Patterns of the contribution of TFP to Output Growth: Evidence from the Mexican Manufacturing sector". Paper presented at the Meeting of the Western Economic Association, 1997.

A Data sources and variables

A.1 Description of DPRN (FBBVA)

Our main data source is *Renta Nacional de España y su Distribución Provincial. Serie Homogénea, 1955-1995*, edited by Fundación BBVA (1999), and which we shall call DPRN from now on.

This is a study of the regional distribution of income that started in 1955 and has been carried on to our days with successive updatings of the data to take into account changes in the sectorial classification and in the variables' definitions according to official statistics at the national and lately at the European level. The latest such modifications (1999 hardcopy edition) used all the data contained in previous editions of DPRN to build a homogeneous sectorial and regional data set (biannual data), which is presented under the name *Serie Homogénea 1955-1995*, and constitutes the most extensive data set for the study of the Spanish economy, under the combined sectorial and regional perspectives.

The methodology used to elaborate such a homogeneous data set follows quite closely SEC-REG79 except for one important respect, regarding the magnitude *Imputed production of financial intermediation services,* to which we shall return later. SEC-REG79 is the methodology Eurostat suggests to EU members to build their regional accounts. Recently, Eurostat substituted the new methodology SEC-REG95 for the old one, and for one important respect, precisely related to the magnitude *Imputed production of financial intermediation services,* this will bring closer together the "new" estimations provided by the INE (Spanish Statistics Institute), following SEC-REG95, and those provided by DPRN.

In fact, it seems as if FBBVA had abandoned the detailed estimation of sectorial and regional magnitudes as provided in their 1999 edition, probably due, on the one hand, to the progressive loss of raw information at NUTS-III level ever since the materialization of the new administrative organization of the Spanish territory introduced by the 1978 Constitution. On the other hand, may be due to the consolidation of the *Regional Accounts* elaborated by the INE since 1980. Initially, there were important discrepancies between the official estimates (at NUTS-II level) provided by INE in its *Regional Accounts*, and the estimates provided by FBBVA (DPRN). These discrepancies had nearly disappeared by 1995. Moreover, the task of estimating regional and sectorial homogeneous data series has been undertaken by the Spanish Ministry of Economics (Dirección General de Planificación y Programación Presupuestaria), under the name *Base de Datos del Modelo Regionalizado de España*, in short MORES, which builds on official statistics, mainly the Regional Accounts issued by INE. Section A2 in this appendix describes the MORES data set, since some of the analyses performed using the main data set, DPRN, are replicated using MORES to check the generality of the results.

Let us mention that the main methodological difference between the data provided by INE and the data provided by FBBVA had to do with the aggregate *Imputed production of financial intermediation services* (*Producción Imputada de Servicios Bancarios, PISB*). This aggregate measures the difference between the amount received by financial institutions from their customers and the interest they pay to their creditors. FBBVA assumes that only a fraction of this magnitude should be attributed to the sectors, with the remaining fraction being attributed to the final demand and the public sector. Moreover, FBBVA considers that the fraction of *PISB* attributable to the sectors belongs to each sector's gross value added at factors costs. Instead, the INE, following SEC-REG79, and by extension the data contained in MORES, both assumed that the full amount of *PISB* belonged to each sectors' intermediate consumption and should therefore be subtracted from total output together with the remaining materials' costs to compute gross value added at factors' costs. This operation cannot be realized for each particular sector since the required disaggregation at the sectorial level of *PISB* is not known. The methodology SEC-REG95 corrects SEC-REG79: It considers, as already did FBBVA, that only a fraction of *PISB* should be attributed to the sectors.

Another important source of differences between INE estimates and FBBVA estimates up to 1993 has to do with estimated sectorial employment and sectorial output. In many cases, FBBVA estimations of the number of jobs exceed INE estimations. This is mostly due to INE using data from official sources that are known to underestimate the number of jobs in given sectors (for instance, small firms are underrepresented in the Spanish Labour Market Survey (EPA) sample, used by the official statistics to provide employment data). Several DPRN studies previous to the 1999 edition contain detailed information on the origins of the differences between FBBVA estimates and INE estimates of gross value added and the number of workers at the aggregate level. Since MORES data set builds mostly on INE statistics, it necessarily inherits from described differences. Section A3 explores the main differences between DPRN and MORES data.

Next, we describe the sectorial and regional classifications used by FBBVA as well as the list of variables provided by DPRN. FBBVA provides data on all variables disaggregated to the NUTS-III level, which is the finest level of regional disaggregation considered by Eurostat. It corresponds to the 50 Spanish provinces and the cities of Ceuta and Melilla in the African continent. Aggregation across provinces belonging to the same region yields the corresponding estimates at the NUTS-II level. There are 17 regions in Spain, called Comunidades Autonómas, and two autonomous cities, Ceuta and Melilla. The sizes of the regions are quite variable: the biggest, Castilla y León (94224 km^2) represents one fifth of the Spanish territory and is the largest region in the EU, the smallest, La Rioja, is 5045 km^2 large.

As for the sectorial disaggregation, FBBVA adapted the SEC-REG79 methodology to the Spanish accounts, and thus provides data on 24 sectors, instead of 17 as suggested by Eurostat. The sectors are listed below together with the correspondence between both sectorial classifications. We also show the correspondence between DPRN classification and the sectors for which IVIE (Instituto Valenciano de Investigaciones Económicas) provides data on the stock of capital and investment, a data set called *Stock de Capital y su Distribución Territorial* (SCDT), edited by FBBVA (1998). Section A4 describes SCDT.

Sectorial Classification: Equivalences

	NACE-R17 EUROSTAT	DPRN FBBVA	SCDT IVIE
AGRICULTURE, FORESTRY AND FISHERIES	01	1+2	1+2
Agriculture		1	1
Fishing		2	2
INDUSTRIAL PRODUCTS		3-13	3-16
Fuel and power products	06	3	3
Ferrous and non-ferrous ores and metals	13	4	4
Non metallic minerals and their products	15	5	5
Chemical products	17	6	6
Metallic products not elsewhere classified	24	7	7
Agricultural and industrial machinery	24	7	8
Office equipment	24	7	9
Electronic and other electric equipment	24	7	10
Transportation equipment	28	8	11
Food, beverages and tobacco	36	9	12
Textiles and clothing, leather and footwear	42	10	13
Paper, paper products and printing	47	11	14
Wood and cork products, and furniture	50	12	16
Rubber and miscellaneous plastic products	50	13	15
Miscellaneous manufacturing industries	50	13	16
CONSTRUCTION	53	14	17
SERVICES		15-24	18-22
Recovery and repair services	58	15	22
Retail services	58	16	22
Lodging and catering services	58	17	18
Interior transportation services	60	18	19
Water transportation and transportation by air	60	18	19
Transportation services	60	18	19
Communications	60	18	20
Finance and insurance	69	19	21
Housing	74	20	Housing
Educational and health private services	74	21	22
Other private services not elsewhere classified	74	22	22
House cleaning services	86	23	-
Public administration	86	24	Public

DPRN contains data on a number of variables, which we shall call *Production-Side Variables*, for every sector (up to 24) and region (up to 50 Spanish provinces, and 17 Comunidades Autónomas). And it contains data on a complementary set of variables, which we shall call *Income-Side Variables*, focusing on the functional distribution of income, at the aggregate level, with regional disaggregation (NUTS-III and NUTS-II). Next, we describe each of these sets of variables.

Production-side variables

TOTAL OUTPUT, valued in nominal terms (current million Pesetas), includes all production costs -materials, energy, purchased services-, all indirect taxes except for IVA (value added tax), the labour costs and profits gross of tax, including financial charges that do not belong to intermediate consumption, and depreciation.

GROSS VALUE ADDED, AT FACTOR COST, valued in nominal terms, is the sum of the labour costs and the profits, as previously defined.

LABOUR COSTS, valued in nominal terms, are the gross earnings paid to the wage-earners, which include the net salary, deductions on account of the income tax, plus the worker's and the employer's payments to the Social Security system.

NUMBER OF WAGE-EARNING JOBS, includes all jobs filled by wage-earners, including temporary jobs and jobs filled by the same worker.

NUMBER OF SELF-EMPLOYED, includes entrepreneurs, and all workers working on their own account plus the family members that help in production and do not earn a wage.

TOTAL NUMBER OF JOBS, sum of wage-earning jobs and the number of self-employed.

Income-side variables

DEPRECIATION, measures depreciation of the capital stock in each of four big sectors: Agriculture and fishing, Industry, Construction and Services.

LABOUR INCOME is the sum over all sectors operating in the regional economy of the labour costs as previously defined plus a new aggregate, OTHER LABOUR INCOME, including earnings of workers other than salaries. This aggregate is not disaggregated by sectors. Labour income is computed following the criterion of the place where this income was generated. To transform this aggregate into another magnitude measuring the labour income of the residents in a given region, we would have to use the series REGIONAL TRANSFERS OF LABOUR INCOME.

MIXED INCOME, includes income accruing to the self-employed, as a result of both their labour and their stock of capital. Only the mixed income generated by farmers is separated from the mixed income generated by the self-employed working in any other sector.

CAPITAL INCOME, net of depreciation and gross of any direct taxes, is divided into NET INTEREST AND DIVIDENDS EARNED BY FAMILIES, INCOME FROM HOUSING SERVICES, and CORPORATE SAVINGS.

Both mixed income and capital income refer to income earned by residents in their respective regions.

PUBLIC INCOME mainly measures the amount of taxes levied on firms' profits. It is computed using fiscal data and therefore public income is higher in those regions where headquarters are highly concentrated, independently of the place where output was produced. Net profits from publicly owned firms net of debt interests are also included.

Aside from previously described variables, FBBVA also provides information on a number of macroeconomic magnitudes, such as regional GNP at factor cost and regional GNP at market prices, both of them valued in nominal terms.

Finally, FBBVA provides implicit price deflator series for each of the sectorial Gross Value Added series at the national level. These series may be used to compute Gross Value Added series in constant terms (1986 Pesetas). FBBVA also provides an implicit price deflator series for the GNP series, which is common to all regions.

To compute the Solow residual at the sectorial and regional level, we require information contained in two distinct data sets. In particular, we need data on capital stocks and investments as well as data on labour inputs, outputs, factors costs and output prices. All variables have to be expressed in common terms, and sectorial classifications must be homogeneous. To express all variables in terms of a common monetary unit, we rescale the price deflator series for sectorial gross value added, provided by FBBVA (DPRN), taking 1990 as the base year, in accordance to the base year used by *Stock de Capital y su Distribución Territorial.* Next, the number of sectors we consider in our analyses is reduced to 15 private productive sectors plus the housing sector and the public sector. The resulting sectorial classification unifies all data sets used in the present paper and related papers[21]. Next table presents the correspondence between the classifications used by each different data set and the classification adopted here.

[21] This implied unifying the classification with Jorgenson's 35-KLEM data set for the US.

Sectorial classifications Different sources: Equivalences

Ours	DPRN FBBVA	MORES Ministerio Eco	SCDT IVIE-FBBVA	Jorgenson Jorgenson's web
C1. Agriculture and Fishing	1+2	1	1+2	1
C2. Fuel and power products	3	2	3	3+4+16
C3. Ferrous and non-ferrous ores and metals	4	3	4	2
C4. Non-metallic minerals and mineral products	5	4	5	5+19
C5. Chemical products	6	5	6	15
C6. Metallic products and machinery*	7	6	7+8+9+10	20-24+26
C7. Transport equipment	8	7	11	25
C8. Food, beverages and tobacco	9	8	12	7+8
C9. Textiles and clothing, leather and footwear	10	9	13	9+10+18
C10. Paper and printing products	11	10	14	13+14
C11. Rubber and plastic products and other manufacturing products	12+13	11	15+16	11+12+17+27
C12. Building and construction	14	12	17	6
C13. Transport and communication services	18	14	19+20	28-31
C14. Financial institutions	19	15	21	33
C16. Residual of private productive products**	15+16+21+22	13+16	18+22	32+34

* includes: Metal products, Agricultural and industrial machinery, Office and data processing machines, precision and optical instruments, Electrical goods

** includes: Recovery and repair services, Wholesale and repair, Lodging and catering services, Other private services.

Next, we provide a detailed description of the variables we construct, using DPRN data set and the capital stocks series and investment series provided by IVIE-FBBVA.

All series are computed for every region ($j = 1...17$) and every sector ($i = 1...15$), for the longest period available, i.e., there are 255 time series of any given variable. Data series contained in DPRN (FBBVA) start in 1955 and are available until 1995 (biannual observations), while the data provided by IVIE-FBBVA start in 1964 and are available until 1996 (annual observations).

OUTPUT, Y: We use data on gross value added, expressed in constant terms (i.e., 1990-10^6 Pesetas), computed dividing gross value added in nominal terms by the sectorial price deflator.

TOTAL NUMBER OF WORKERS, L: Sum of the wage-earners and the self-employed.

STOCK OF CAPITAL, K: We use the data on the stock of capital in each region and sector, expressed in 1990-10^6 Pesetas, as contained in SCDT (IVIE-FBBVA). The data provided are already expressed in constant terms.

LABOUR SHARE OF INCOME, $(1-\alpha)$: The details on the various procedures that may be used to compute the factors shares of income are fully explained in the corresponding paper[22]. Here, we briefly mention the procedure finally used to compute sectorial labour share time series using data from DPRN (FBBVA). We compute sectorial labour income (for any sector except for C1) by imputing to self-employed workers a wage equal to the wage earned by the wage-earners employed in their sector. We obtain the labour share of income dividing the total labour

[22] Garrido Ruiz, What if factor shares are not constant? Implications for Growth and Business Cycle Theories, in progress.

income by total sectorial output, both magnitudes in nominal terms. We compute the labour share in Agriculture, $(1-\alpha)^A$, using data on farmer's mixed income, $MI^{Farmers}$, and assuming the fraction of this mixed income attributable to farmer's labour services is the same as in the corporate sector. That is,

$$(1-\alpha)^A = \frac{Wages^A}{GVA^A - MI^{Farmers}}$$

where GVA^A measures gross value added in Agriculture, both corporate and non-corporate. To compute the labour share in C1 (Agriculture and Fishing), we mix both procedures:

$$(1-\alpha)^{C1} = \frac{\frac{Wages^F \frac{TotalNumberWor^F}{WageEarners^F}}{GVA^F} + (1-\alpha)^A\, GVA^A}{GVA^{C1}}$$

REAL RATE OF RETURN ON CAPITAL, r: Computed as the ratio of profits to the capital stock. We compute profits as a residual magnitude once we have estimated the labour income. And we express the stock of capital in nominal terms, $K^{current}$, using the appropriate price deflator for investment goods issued from SCDT (IVIE-FBBVA). Then,

$$r = \frac{\alpha \cdot GVA}{K^{current}}$$

REAL WAGE RATE, w: We first compute the wage bill in constant terms, deflating the wage bill in nominal terms by the corresponding sectorial GVA implicit price deflator. Next, we divide through by the number of wage earners.

$$w = \frac{Wages^{const}}{WageEarners}$$

The equivalent concept in C1 is computed as:

$$w^{C1} = \frac{(1-\alpha)^{C1} \cdot GVA^{C1,const}}{TotalNumberWor^{C1}}$$

SOLOW RESIDUAL: The discrete time approximation to the Solow residual is given by:

$$SR_t = \Delta Y_t - \left(\frac{(1-\alpha)_{t-1} + (1-\alpha)_t}{2}\right)\Delta L_t - \left(\frac{\alpha_{t-1}+\alpha_t}{2}\right)\Delta K_t$$

where $\Delta Y_t = (\ln Y_t - \ln Y_{t-1})$, $\Delta L_t = (\ln L_t - \ln L_{t-1})$, and $\Delta K_t = (\ln K_t - \ln K_{t-1})$.

If one assumes that technical progress is labour augmenting, the correct formula is:

$$SR_t^{LAug} = \frac{1}{\left(\frac{(1-\alpha)_{t-1}+(1-\alpha)_t}{2}\right)} \left[\Delta Y_t - \left(\frac{(1-\alpha)_{t-1}+(1-\alpha)_t}{2}\right)\Delta L_t - \left(\frac{\alpha_{t-1}+\alpha_t}{2}\right)\Delta K_t\right]$$

We construct some additional variables: labour productivity, Y/L, stock of capital per worker, K/L, factors' relative price, w/r. And we compute previous variables in efficiency units of labour: output per efficiency unit of labour, Y/LE, stock of capital per efficiency unit, K/LE, and factors' relative price, expressing the wage rate per efficiency unit of labour, $(w/E)/r$, where $E = SR^{LAug}$.

A.2 Description of MORES

MORES data set provides information on output, employment and labour costs for the period 1980-1995 (annual data), by region (17 Spanish Comunidades Autónomas, the data for Ceuta and Melilla are merged with those of Andalucía), and sector (17 sectors defined by the Eurostat classification). The main source of raw data for MORES is the Spanish *Regional Accounts* elaborated by INE, starting in 1980. MORES data set introduces some corrections to the official data, which are mostly related to the procedure used to compute value added previous to 1986. MORES data set follows the methodology proposed by Díaz and Taguas (1995), on which MOISEES data set (a data set consisting of key macroeconomic magnitudes for the Spanish economy, starting in 1958) was built. Dabán et al. (1998) provides a detailed comment on this issue.

Section A1 mentions the sources of the main differences between the data provided by FBBVA and those provided by INE, as the closest antecedent of MORES data set. Section A3 offers a detailed examination of actual discrepancies between DPRN and MORES. Let us for now describe the data contained in MORES, and how we use these data to compute factor shares, indices of technical progress, and some other relevant economic variables.

Based on the *Regional Accounts*, MORES contains series of Gross Value Added at factor cost and Gross Value Added at market prices, both in nominal terms and in constant terms (using 1980 as the base year). Gross Value Added in constant terms is measured using the corresponding implicit price deflators (price deflator of Gross value added at factor cost and price deflator of Gross value added at market prices). Both implicit price deflators are national, i.e., it is assumed that the price of output in any given sector evolves identically across regions. MORES also contains data on the total number of workers, and the total number of wage earners. Finally, it contains data on labour income, which can be directly used to compute the factors' shares of income, since these labour income series already take into account the labour income of the self-employed. Boscá, Escribá and Murgui (2001) provide a detailed description of the adjustments performed to compute the labour income. Briefly stated, in all sectors except for agriculture and fishing, they impute labour earnings for self-employed equal to the average wage earned by the employees in the sector. In agriculture and fishing, where a large number of family members are involved in production, and they contribute less than a wage-earner, average wage is weighted by a coefficient less than one (see Dabán et al. (1998) for details).

We take the series of gross value added at factors' costs to represent sectorial output, Y. And we use sectorial GVA f.c. implicit price deflators, previously rescaled to make 1990 the base year, to express sectorial GVA at factors' costs in constant terms. This magnitude is directly comparable to the data from DPRN. There may be a little difference between both series of GVA, because of the original base year adopted by each price deflator series (1980 or 1986), but this difference should be small. The largest differences may come from true differences in the estimation of the value generated by each sector. The number of workers is used to measure N, and the ratio of labour income in constant terms over total number of workers is used to measure the real wage rate, w. The labour share of income, $(1-\alpha)$, is computed as labour income over gross value added at factor cost, both expressed in nominal terms. The rest of the variables follow immediately, using the formulae stated in section A1.

A.3 Actual divergence DPRN-MORES

We provide two sets of tables to compare the data contained in DPRN with those contained in MORES.

Set 1. Divergence in raw estimations

Divergence in estimates: DPRN vs MORES, Spain-PPS. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	88.884,0	115.037,4	144.006,3	184.972,2	232.582,2	281.079,6	303.904,6	354.431,4
VAB f.c. real**	192.247,3	196.552,5	202.001,1	224.567,6	249.120,6	262.274,4	252.031,7	269.563,1
Pride defl.	46,2	58,5	71,3	82,4	93,4	107,2	120,6	131,5
Workers***	10.867,8	10.628,5	10.559,7	10.678,9	10.883,9	10.910,2	10.345,3	10.564,2
Labour income*	58.119,5	76.024,4	93.657,6	118.044,2	145.970,8	175.334,7	197.948,8	219.668,2
Gross Profits*	30.764,4	39.013,0	50.348,7	66.928,0	86.611,4	105.745,0	105.955,8	134.763,2
Labour share	0,65	0,66	0,65	0,64	0,63	0,62	0,65	0,62
MORES								
VAB f.c. nom*	83.535,2	108.789,8	136.974,8	174.504,3	220.311,3	268.269,8	294.262,0	335.233,7
VAB f.c. real**	184.783,5	189.873,7	197.708,3	215.521,8	237.180,0	249.911,3	246.924,0	257.860,7
Pride defl.	45,2	57,3	69,3	81,0	92,9	107,3	119,2	130,0
Workers***	9.701,4	9.448,3	9.257,5	9.750,4	10.330,4	10.690,1	10.030,8	10.155,2
Labour income*	55.664,3	70.332,1	80.450,6	105.821,1	129.883,7	163.504,9	182.406,4	196.465,2
Gross Profits*	27.870,9	38.457,7	56.524,2	68.683,2	90.427,6	104.765,0	111.855,5	138.768,6
Labour share	0,67	0,65	0,59	0,61	0,59	0,61	0,62	0,59
DIVERGENCES (%)								
VAB f.c. nom	6,4	5,7	5,1	6,0	5,6	4,8	3,3	5,7
VAB f.c. real	4,0	3,5	2,2	4,2	5,0	4,9	2,1	4,5
Pride defl.	2,3	2,1	2,9	1,7	0,5	-0,2	1,2	1,1
Workers	12,0	12,5	14,1	9,5	5,4	2,1	3,1	4,0
Labour income	4,4	8,1	16,4	11,6	12,4	7,2	8,5	11,8
Gross Profits	10,4	1,4	-10,9	-2,6	-4,2	0,9	-5,3	-2,9
Labour share	-1,9	2,2	10,7	5,2	6,5	2,3	5,1	5,8

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C1. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	6.804,2	9.166,0	11.320,9	12.830,5	15.690,9	17.307,2	19.202,7	20.819,3
VAB f.c. real**	11.501,6	12.872,9	14.347,2	14.653,2	15.781,3	17.214,3	17.541,3	15.963,4
Pride defl.	59,2	71,2	78,9	87,6	99,4	100,5	109,5	130,4
Workers***	2.329,5	2.099,9	1.970,8	1.823,9	1.648,7	1.441,0	1.276,3	1.223,9
Labour income*	4.569,7	6.198,8	7.612,3	8.612,6	10.883,5	12.134,9	13.861,6	15.330,5
Gross Profits*	2.234,6	2.967,2	3.708,6	4.217,9	4.807,4	5.172,3	5.341,1	5.488,8
Labour share	0,67	0,68	0,67	0,67	0,69	0,70	0,72	0,74
MORES								
VAB f.c. nom*	6.449,6	8.508,8	10.786,1	12.771,8	14.483,7	15.815,0	16.320,2	17.199,4
VAB f.c. real**	13.323,9	13.939,2	15.609,4	15.743,8	15.131,0	15.525,7	15.517,3	13.868,8
Pride defl.	48,4	61,0	69,1	81,1	95,7	101,9	105,2	124,0
Workers***	2.009,2	1.952,6	1.827,7	1.608,8	1.488,2	1.302,3	1.150,2	1.051,1
Labour income*	4.607,3	5.621,6	6.744,3	8.222,0	9.100,6	10.451,5	10.863,4	11.951,0
Gross Profits*	1.842,2	2.887,1	4.041,8	4.549,8	5.383,2	5.363,5	5.456,8	5.248,4
Labour share	0,71	0,66	0,63	0,64	0,63	0,66	0,67	0,69
DIVERGENCES (%)								
VAB f.c. nom	5,5	7,7	5,0	0,5	8,3	9,4	17,7	21,0
VAB f.c. real	-13,7	-7,6	-8,1	-6,9	4,3	10,9	13,0	15,1
Pride defl.	22,2	16,6	14,2	7,9	3,9	-1,3	4,1	5,2
Workers	15,9	7,5	7,8	13,4	10,8	10,6	11,0	16,4
Labour income	-0,8	10,3	12,9	4,8	19,6	16,1	27,6	28,3
Gross Profits	21,3	2,8	-8,2	-7,3	-10,7	-3,6	-2,1	4,6
Labour share	-6,0	2,4	7,5	4,3	10,4	6,1	8,4	6,0

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C2. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	3.910,9	5.291,0	6.672,5	9.371,0	11.577,1	13.351,3	14.753,5	15.831,3
VAB f.c. real**	11.660,6	10.081,9	9.941,2	11.063,0	13.016,3	11.875,1	11.469,6	10.626,9
Pride defl.	33,5	52,5	67,1	84,7	88,9	112,4	128,6	149,0
Workers***	160,4	163,9	164,5	158,4	153,1	145,0	130,7	125,6
Labour income*	1.418,9	1.969,9	2.357,1	2.845,8	3.260,6	4.059,5	4.236,5	4.384,6
Gross Profits*	2.492,0	3.321,1	4.315,4	6.525,2	8.316,5	9.291,8	10.517,1	11.446,7
Labour share	0,36	0,37	0,35	0,30	0,28	0,30	0,29	0,28
MORES								
VAB f.c. nom*	3.504,1	5.134,4	6.298,2	8.322,5	9.886,0	12.260,1	13.405,6	14.097,4
VAB f.c. real**	8.746,2	8.637,5	9.367,0	9.604,8	10.563,1	11.041,5	10.949,6	11.124,6
Pride defl.	40,1	59,4	67,2	86,6	93,6	111,0	122,4	126,7
Workers***	149,0	157,3	159,9	153,9	148,6	140,4	127,6	123,3
Labour income*	1.577,5	2.170,5	2.451,6	2.845,3	3.264,4	3.947,6	4.184,6	4.266,1
Gross Profits*	1.926,6	2.963,9	3.846,7	5.477,2	6.621,7	8.312,5	9.221,0	9.831,3
Labour share	0,45	0,42	0,39	0,34	0,33	0,32	0,31	0,30
DIVERGENCES (%)								
VAB f.c. nom	11,6	3,0	5,9	12,6	17,1	8,9	10,1	12,3
VAB f.c. real	33,3	16,7	6,1	15,2	23,2	7,5	4,7	-4,5
Pride defl.	-16,3	-11,7	-0,2	-2,2	-5,0	1,3	5,1	17,6
Workers	7,7	4,2	2,9	2,9	3,0	3,3	2,4	1,8
Labour income	-10,1	-9,2	-3,9	0,0	-0,1	2,8	1,2	2,8
Gross Profits	29,3	12,1	12,2	19,1	25,6	11,8	14,1	16,4
Labour share	-19,4	-11,9	-9,2	-11,2	-14,7	-5,6	-8,0	-8,5

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C3. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	1.699,1	2.179,9	2.628,0	2.471,5	2.705,9	2.461,6	2.253,1	2.793,2
VAB f.c. real**	3.381,2	3.389,2	3.513,9	2.733,2	2.579,4	2.582,3	2.393,9	2.659,5
Pride defl.	50,3	64,3	74,8	90,4	104,9	95,3	94,1	105,0
Workers***	138,1	124,0	111,4	98,0	87,4	83,9	73,9	68,0
Labour income*	952,1	1.229,1	1.399,7	1.485,6	1.580,5	1.765,2	1.801,2	2.198,4
Gross Profits*	747,0	950,8	1.228,3	986,0	1.125,5	696,4	451,9	594,8
Labour share	0,56	0,56	0,53	0,60	0,58	0,72	0,80	0,79
MORES								
VAB f.c. nom*	1.834,6	2.461,8	3.049,5	2.889,8	3.770,8	3.164,3	2.739,6	3.379,3
VAB f.c. real**	3.607,5	3.735,6	3.794,9	3.229,8	3.609,2	3.344,9	2.852,3	3.271,8
Pride defl.	50,9	65,9	80,4	89,5	104,5	94,6	96,0	103,3
Workers***	105,9	98,1	102,1	89,0	84,1	85,0	82,6	79,1
Labour income*	1.037,5	1.239,2	1.474,8	1.592,6	1.726,4	2.115,0	2.326,8	2.293,6
Gross Profits*	797,2	1.222,6	1.574,8	1.297,2	2.044,4	1.049,3	412,8	1.085,7
Labour share	0,57	0,50	0,48	0,55	0,46	0,67	0,85	0,68
DIVERGENCES (%)								
VAB f.c. nom	-7,4	-11,5	-13,8	-14,5	-28,2	-22,2	-17,8	-17,3
VAB f.c. real	-6,3	-9,3	-7,4	-15,4	-28,5	-22,8	-16,1	-18,7
Pride defl.	-1,2	-2,4	-6,9	1,1	0,4	0,8	-2,0	1,7
Workers	30,5	26,3	9,1	10,1	4,0	-1,4	-10,6	-14,0
Labour income	-8,2	-0,8	-5,1	-6,7	-8,4	-16,5	-22,6	-4,2
Gross Profits	-6,3	-22,2	-22,0	-24,0	-44,9	-33,6	9,5	-45,2
Labour share	-0,9	12,0	10,1	9,1	27,6	7,3	-5,9	16,0

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C4. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	2.315,7	2.754,9	3.075,6	3.910,1	4.921,4	5.745,2	5.284,3	6.848,7
VAB f.c. real**	4.871,8	4.912,7	4.612,7	4.693,5	5.110,4	5.532,7	5.003,6	6.258,2
Pride defl.	47,5	56,1	66,7	83,3	96,3	103,8	105,6	109,4
Workers***	228,2	222,4	207,9	203,4	192,8	178,9	161,6	163,4
Labour income*	1.185,8	1.482,4	1.690,6	2.058,3	2.311,7	2.669,2	3.023,8	3.454,5
Gross Profits*	1.129,9	1.272,5	1.385,0	1.851,8	2.609,7	3.076,0	2.260,5	3.394,2
Labour share	0,51	0,54	0,55	0,53	0,47	0,46	0,57	0,50
MORES								
VAB f.c. nom*	2.287,6	2.604,8	2.891,8	3.698,4	4.849,9	5.667,1	5.460,3	6.376,1
VAB f.c. real**	4.913,0	4.855,7	4.428,4	4.503,7	5.078,1	5.485,7	5.057,1	5.470,1
Pride defl.	46,6	53,6	65,3	82,1	95,5	103,3	108,0	116,6
Workers***	201,0	173,0	159,0	165,6	182,9	188,5	166,5	163,3
Labour income*	1.344,8	1.494,1	1.569,2	1.909,5	2.385,2	3.070,4	3.265,1	3.419,5
Gross Profits*	942,7	1.110,7	1.322,6	1.788,9	2.464,7	2.596,6	2.195,2	2.956,6
Labour share	0,59	0,57	0,54	0,52	0,49	0,54	0,60	0,54
DIVERGENCES (%)								
VAB f.c. nom	1,2	5,8	6,4	5,7	1,5	1,4	-3,2	7,4
VAB f.c. real	-0,8	1,2	4,2	4,2	0,6	0,9	-1,1	14,4
Pride defl.	2,1	4,5	2,1	1,5	0,8	0,5	-2,2	-6,1
Workers	13,6	28,5	30,8	22,8	5,4	-5,1	-3,0	0,0
Labour income	-11,8	-0,8	7,7	7,8	-3,1	-13,1	-7,4	1,0
Gross Profits	19,9	14,6	4,7	3,5	5,9	18,5	3,0	14,8
Labour share	-12,9	-6,2	1,3	2,0	-4,5	-14,2	-4,3	-5,9

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C5. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	2.254,5	2.868,2	3.675,8	4.671,2	5.430,3	5.607,5	5.442,6	7.424,5
VAB f.c. real**	3.538,0	3.407,4	3.774,2	4.874,7	5.558,7	5.477,8	5.269,0	6.511,9
Pride defl.	63,7	84,2	97,4	95,8	97,7	102,4	103,3	114,0
Workers***	174,0	163,3	160,7	166,1	176,7	168,9	159,6	163,2
Labour income*	1.200,1	1.450,0	1.730,1	2.200,2	2.660,2	3.247,0	3.595,0	4.437,7
Gross Profits*	1.054,5	1.418,2	1.945,7	2.471,0	2.770,1	2.360,4	1.847,5	2.986,9
Labour share	0,53	0,51	0,47	0,47	0,49	0,58	0,66	0,60
MORES								
VAB f.c. nom*	2.322,5	2.939,7	3.725,8	4.226,3	4.728,8	4.910,1	4.948,8	6.204,9
VAB f.c. real**	3.553,2	3.485,3	3.885,6	4.417,8	4.831,3	4.767,6	4.672,3	5.465,6
Pride defl.	65,4	84,3	95,9	95,7	97,9	103,0	105,9	113,5
Workers***	144,7	137,5	143,3	140,1	144,0	145,0	113,7	139,6
Labour income*	1.162,2	1.420,5	1.746,6	1.988,1	2.305,4	2.810,0	3.239,3	3.450,8
Gross Profits*	1.160,3	1.519,2	1.979,2	2.238,1	2.423,3	2.100,1	1.709,5	2.754,1
Labour share	0,50	0,48	0,47	0,47	0,49	0,57	0,65	0,56
DIVERGENCES (%)								
VAB f.c. nom	-2,9	-2,4	-1,3	10,5	14,8	14,2	10,0	19,7
VAB f.c. real	-0,4	-2,2	-2,9	10,3	15,1	14,9	12,8	19,1
Pride defl.	-2,5	-0,2	1,6	0,2	-0,2	-0,6	-2,5	0,4
Workers	20,2	18,8	12,2	18,6	22,7	16,4	40,4	16,9
Labour income	3,3	2,1	-0,9	10,7	15,4	15,6	11,0	28,6
Gross Profits	-9,1	-6,6	-1,7	10,4	14,3	12,4	8,1	8,5
Labour share	6,4	4,6	0,4	0,1	0,5	1,2	0,9	7,5

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C6. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	5.708,6	7.311,9	9.210,0	11.254,8	13.725,1	16.283,2	15.767,2	19.757,6
VAB f.c. real**	10.167,0	10.875,3	11.648,7	12.781,0	14.234,0	15.701,0	14.759,9	17.268,6
Pride defl.	56,1	67,2	79,1	88,1	96,4	103,7	106,8	114,4
Workers***	602,9	564,1	558,6	570,3	629,7	662,3	603,6	570,9
Labour income*	4.102,8	5.048,0	6.113,6	7.163,9	9.137,2	11.261,5	11.982,7	13.879,8
Gross Profits*	1.605,9	2.263,9	3.096,3	4.091,0	4.587,9	5.021,7	3.784,5	5.877,8
Labour share	0,72	0,69	0,66	0,64	0,67	0,69	0,76	0,70
MORES								
VAB f.c. nom*	5.638,6	6.577,4	8.329,3	10.565,3	13.246,0	14.998,9	14.473,0	17.908,4
VAB f.c. real**	9.539,1	9.270,4	10.059,3	12.095,2	13.771,4	14.432,0	13.223,3	15.191,0
Pride defl.	59,1	71,0	82,8	87,4	96,2	103,9	109,5	117,9
Workers***	563,6	521,0	527,8	572,7	630,7	644,6	592,5	605,5
Labour income*	4.052,5	4.713,6	5.474,6	7.197,1	8.975,8	11.011,9	12.206,6	13.164,4
Gross Profits*	1.586,1	1.863,7	2.854,6	3.368,3	4.270,3	3.986,9	2.266,5	4.744,0
Labour share	0,72	0,72	0,66	0,68	0,68	0,73	0,84	0,74
DIVERGENCES (%)								
VAB f.c. nom	1,2	11,2	10,6	6,5	3,6	8,6	8,9	10,3
VAB f.c. real	6,6	17,3	15,8	5,7	3,4	8,8	11,6	13,7
Pride defl.	-5,0	-5,2	-4,5	0,8	0,2	-0,2	-2,4	-2,9
Workers	7,0	8,3	5,8	-0,4	-0,2	2,8	1,9	-5,7
Labour income	1,2	7,1	11,7	-0,5	1,8	2,3	-1,8	5,4
Gross Profits	1,2	21,5	8,5	21,5	7,4	26,0	67,0	23,9
Labour share	0,0	-3,7	1,0	-6,6	-1,8	-5,8	-9,9	-4,4

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C7. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	2.874,8	3.405,1	4.005,6	5.544,1	6.671,4	7.396,1	6.944,2	6.906,1
VAB f.c. real**	4.897,7	4.517,7	4.411,5	6.418,6	7.005,6	7.043,3	6.280,2	6.126,6
Pride defl.	58,7	75,4	90,8	86,4	95,2	105,0	110,6	112,7
Workers***	247,3	237,7	238,8	255,7	269,1	263,8	233,7	184,3
Labour income*	2.096,1	2.456,2	3.040,0	3.907,1	4.629,0	5.388,1	5.819,3	4.943,3
Gross Profits*	778,7	948,9	965,6	1.637,0	2.042,4	2.008,1	1.125,0	1.962,8
Labour share	0,73	0,72	0,76	0,70	0,69	0,73	0,84	0,72
MORES								
VAB f.c. nom*	2.333,1	3.418,8	4.343,3	5.705,1	6.939,0	7.928,9	7.568,2	9.617,4
VAB f.c. real**	4.802,3	5.236,8	5.111,5	6.636,9	7.234,2	7.434,3	7.527,1	8.691,0
Pride defl.	48,6	65,3	85,0	86,0	95,9	106,7	100,5	110,7
Workers***	263,2	253,6	242,5	257,0	268,9	270,2	230,9	232,0
Labour income*	1.932,2	2.385,0	2.503,0	4.720,6	5.699,5	6.828,3	6.800,8	7.322,5
Gross Profits*	400,9	1.033,7	1.840,3	984,5	1.239,5	1.100,6	767,5	2.294,9
Labour share	0,83	0,70	0,58	0,83	0,82	0,86	0,90	0,76
DIVERGENCES (%)								
VAB f.c. nom	23,2	-0,4	-7,8	-2,8	-3,9	-6,7	-8,2	-28,2
VAB f.c. real	2,0	-13,7	-13,7	-3,3	-3,2	-5,3	-16,6	-29,5
Pride defl.	20,8	15,5	6,9	0,5	-0,7	-1,5	10,0	1,9
Workers	-6,0	-6,2	-1,5	-0,5	0,1	-2,4	1,2	-20,6
Labour income	8,5	3,0	21,5	-17,2	-18,8	-21,1	-14,4	-32,5
Gross Profits	94,2	-8,2	-47,5	66,3	64,8	82,5	46,6	-14,5
Labour share	-12,0	3,4	31,7	-14,8	-15,5	-15,4	-6,7	-6,0

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C8. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	4.263,5	5.533,5	6.618,0	8.146,1	10.228,5	11.753,4	13.472,2	14.708,8
VAB f.c. real**	8.658,0	9.089,8	8.832,4	9.108,3	10.484,3	11.466,6	11.954,8	11.823,5
Pride defl.	49,2	60,9	74,9	89,4	97,6	102,5	112,7	124,4
Workers***	448,9	442,7	439,4	438,8	438,2	433,1	424,4	416,0
Labour income*	2.333,4	3.013,3	3.864,3	4.758,5	5.444,2	6.337,1	7.437,8	8.584,4
Gross Profits*	1.930,1	2.520,2	2.753,7	3.387,5	4.784,3	5.416,3	6.034,3	6.124,4
Labour share	0,55	0,54	0,58	0,58	0,53	0,54	0,55	0,58
MORES								
VAB f.c. nom*	4.190,3	5.360,9	6.645,8	8.756,0	10.013,0	11.691,6	12.922,0	13.456,2
VAB f.c. real**	8.768,3	9.156,7	9.581,7	10.064,5	10.550,4	11.171,3	11.493,5	12.019,3
Pride defl.	47,8	58,5	69,4	87,0	94,9	104,7	112,4	112,0
Workers***	377,2	360,3	395,8	405,4	424,2	429,5	428,6	409,6
Labour income*	2.386,9	3.037,2	3.681,8	4.302,9	4.981,9	6.157,5	7.409,2	7.594,1
Gross Profits*	1.803,3	2.323,7	2.963,9	4.453,1	5.031,1	5.534,1	5.512,8	5.862,2
Labour share	0,57	0,57	0,55	0,49	0,50	0,53	0,57	0,56
DIVERGENCES (%)								
VAB f.c. nom	1,7	3,2	-0,4	-7,0	2,2	0,5	4,3	9,3
VAB f.c. real	-1,3	-0,7	-7,8	-9,5	-0,6	2,6	4,0	-1,6
Pride defl.	3,0	4,0	8,0	2,8	2,8	-2,1	0,2	11,1
Workers	19,0	22,9	11,0	8,2	3,3	0,8	-1,0	1,6
Labour income	-2,2	-0,8	5,0	10,6	9,3	2,9	0,4	13,0
Gross Profits	7,0	8,5	-7,1	-23,9	-4,9	-2,1	9,5	4,5
Labour share	-3,9	-3,9	5,4	18,9	7,0	2,4	-3,7	3,4

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C9. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	3.732,7	4.832,9	5.347,4	6.596,0	7.716,9	8.153,5	7.361,8	8.355,9
VAB f.c. real**	6.973,6	7.665,7	6.847,7	7.372,1	7.953,4	7.911,0	6.911,2	7.186,4
Pride defl.	53,5	63,0	78,1	89,5	97,0	103,1	106,5	116,3
Workers***	546,1	526,2	507,7	503,6	485,1	467,1	422,2	400,2
Labour income*	2.361,0	2.858,0	3.183,5	3.876,6	4.435,4	4.986,4	5.596,0	5.854,9
Gross Profits*	1.371,6	1.974,8	2.163,9	2.719,5	3.281,5	3.167,1	1.765,8	2.501,0
Labour share	0,63	0,59	0,60	0,59	0,57	0,61	0,76	0,70
MORES								
VAB f.c. nom*	2.705,2	3.331,8	3.932,1	4.541,6	4.800,0	5.029,5	4.963,1	5.340,6
VAB f.c. real**	4.949,4	5.000,9	4.892,1	5.149,3	5.028,1	4.942,4	4.618,1	4.619,9
Pride defl.	54,7	66,6	80,4	88,2	95,5	101,8	107,5	115,6
Workers***	469,6	440,9	434,4	450,5	431,1	430,2	363,2	368,3
Labour income*	1.870,4	2.197,3	2.430,1	3.280,0	3.474,1	4.165,8	4.288,0	4.605,4
Gross Profits*	834,7	1.134,5	1.502,0	1.261,7	1.325,9	863,7	675,1	735,2
Labour share	0,69	0,66	0,62	0,72	0,72	0,83	0,86	0,86
DIVERGENCES (%)								
VAB f.c. nom	38,0	45,1	36,0	45,2	60,8	62,1	48,3	56,5
VAB f.c. real	40,9	53,3	40,0	43,2	58,2	60,1	49,7	55,6
Pride defl.	-2,1	-5,4	-2,8	1,4	1,6	1,3	-0,9	0,6
Workers	16,3	19,4	16,9	11,8	12,5	8,6	16,2	8,7
Labour income	26,2	30,1	31,0	18,2	27,7	19,7	30,5	27,1
Gross Profits	64,3	74,1	44,1	115,5	147,5	266,7	161,6	240,2
Labour share	-8,5	-10,3	-3,7	-18,6	-20,6	-26,2	-12,0	-18,7

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C10. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	1.664,0	2.223,1	2.785,4	3.524,3	3.968,5	4.681,8	4.721,5	6.109,7
VAB f.c. real**	3.767,4	4.110,1	4.056,1	4.286,1	4.172,2	4.453,3	4.001,7	4.806,3
Pride defl.	44,2	54,1	68,7	82,2	95,1	105,1	118,0	127,1
Workers***	166,2	164,4	164,3	165,6	168,6	174,3	166,6	163,5
Labour income*	1.179,8	1.429,3	1.814,1	2.261,3	2.661,0	3.182,3	3.666,4	3.618,4
Gross Profits*	484,2	793,8	971,4	1.263,0	1.307,5	1.499,5	1.055,0	2.491,3
Labour share	0,71	0,64	0,65	0,64	0,67	0,68	0,78	0,59
MORES								
VAB f.c. nom*	1.349,1	1.728,5	2.212,2	2.989,9	3.592,8	4.093,8	4.275,2	4.865,7
VAB f.c. real**	3.022,9	3.119,6	3.229,6	3.696,9	3.822,9	3.922,3	3.699,3	3.893,9
Pride defl.	44,6	55,4	68,5	80,9	94,0	104,4	115,6	125,0
Workers***	141,2	133,5	118,6	146,1	166,1	181,6	168,6	158,5
Labour income*	829,4	1.028,7	1.069,0	1.746,9	2.242,0	2.912,1	3.187,3	3.097,2
Gross Profits*	519,7	699,8	1.143,2	1.243,0	1.350,7	1.181,7	1.087,9	1.768,6
Labour share	0,61	0,60	0,48	0,58	0,62	0,71	0,75	0,64
DIVERGENCES (%)								
VAB f.c. nom	23,3	28,6	25,9	17,9	10,5	14,4	10,4	25,6
VAB f.c. real	24,6	31,8	25,6	15,9	9,1	13,5	8,2	23,4
Pride defl.	-1,0	-2,4	0,3	1,7	1,2	0,7	2,1	1,7
Workers	17,8	23,1	38,6	13,4	1,5	-4,0	-1,2	3,1
Labour income	42,3	38,9	69,7	29,4	18,7	9,3	15,0	16,8
Gross Profits	-6,8	13,4	-15,0	1,6	-3,2	26,9	-3,0	40,9
Labour share	15,3	8,0	34,8	9,8	7,4	-4,4	4,2	-7,0

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C11. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	2.834,3	3.746,2	4.405,5	5.702,5	6.256,3	7.236,0	6.724,2	6.838,1
VAB f.c. real**	5.637,6	6.173,7	5.877,0	6.737,4	6.427,4	7.046,9	6.302,7	5.828,3
Pride defl.	50,3	60,7	75,0	84,6	97,3	102,7	106,7	117,3
Workers***	391,0	387,3	382,6	381,5	376,5	367,4	338,9	333,2
Labour income*	1.832,9	2.592,8	3.046,5	3.790,3	4.333,1	4.965,8	5.594,9	5.156,2
Gross Profits*	1.001,4	1.153,4	1.358,9	1.912,2	1.923,2	2.270,2	1.129,3	1.681,8
Labour share	0,65	0,69	0,69	0,66	0,69	0,69	0,83	0,75
MORES								
VAB f.c. nom*	2.369,8	2.911,5	3.520,4	4.514,8	5.476,2	6.161,9	6.235,7	7.025,7
VAB f.c. real**	4.756,8	4.765,8	4.727,8	5.419,0	5.661,0	6.002,8	5.780,4	6.033,6
Pride defl.	49,8	61,1	74,5	83,3	96,7	102,7	107,9	116,4
Workers***	364,8	332,0	332,6	356,7	386,6	402,2	375,1	377,3
Labour income*	1.776,4	2.097,2	2.386,9	3.397,4	4.108,4	5.047,3	5.762,7	6.280,4
Gross Profits*	593,4	814,3	1.133,5	1.117,4	1.367,8	1.114,6	473,0	745,3
Labour share	0,75	0,72	0,68	0,75	0,75	0,82	0,92	0,89
DIVERGENCES (%)								
VAB f.c. nom	19,6	28,7	25,1	26,3	14,2	17,4	7,8	-2,7
VAB f.c. real	18,5	29,5	24,3	24,3	13,5	17,4	9,0	-3,4
Pride defl.	0,9	-0,7	0,7	1,6	0,6	0,0	-1,1	0,8
Workers	7,2	16,6	15,0	7,0	-2,6	-8,6	-9,6	-11,7
Labour income	3,2	23,6	27,6	11,6	5,5	-1,6	-2,9	-17,9
Gross Profits	68,8	41,6	19,9	71,1	40,6	103,7	138,8	125,7
Labour share	-13,7	-3,9	2,0	-11,7	-7,7	-16,2	-10,0	-15,6

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-Ind. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
<u>DPRN</u>								
VAB f.c. nom*	31.258,3	40.146,7	48.423,7	61.191,5	73.201,3	82.669,6	82.724,6	95.573,9
VAB f.c. real**	63.553,1	64.223,5	63.515,5	70.067,9	76.541,7	79.090,0	74.346,7	79.096,2
Pride defl.	49,2	62,5	76,2	87,3	95,6	104,5	111,3	120,8
Workers***	3.103,3	2.995,9	2.936,0	2.941,6	2.977,3	2.944,6	2.715,2	2.588,2
Labour income*	18.980,8	23.914,3	28.710,4	34.878,8	41.054,1	48.627,9	53.597,2	57.507,3
Gross Profits*	12.277,5	16.232,5	19.713,3	26.312,7	32.147,2	34.041,7	29.127,4	38.066,5
Labour share	0,61	0,60	0,59	0,57	0,56	0,59	0,65	0,60
<u>MORES</u>								
VAB f.c. nom*	28.534,9	36.469,5	44.948,5	56.209,8	67.302,4	75.906,2	76.991,7	88.271,8
VAB f.c. real**	56.658,7	57.264,2	59.077,9	64.818,0	70.149,6	72.544,7	69.873,1	75.780,7
Pride defl.	50,4	63,7	76,1	86,7	95,9	104,6	110,2	116,5
Workers***	2.780,1	2.607,2	2.616,0	2.737,0	2.867,2	2.917,2	2.649,3	2.656,5
Labour income*	17.969,9	21.783,4	24.787,6	32.980,5	39.163,2	48.066,0	52.670,5	55.494,0
Gross Profits*	10.565,0	14.686,2	20.160,8	23.229,2	28.139,3	27.840,2	24.321,2	32.777,8
Labour share	0,63	0,60	0,55	0,59	0,58	0,63	0,68	0,63
<u>DIVERGENCES (%)</u>								
VAB f.c. nom	9,5	10,1	7,7	8,9	8,8	8,9	7,4	8,3
VAB f.c. real	12,2	12,2	7,5	8,1	9,1	9,0	6,4	4,4
Pride defl.	-2,3	-1,8	0,2	0,7	-0,3	-0,1	1,0	3,7
Workers	11,6	14,9	12,2	7,5	3,8	0,9	2,5	-2,6
Labour income	5,6	9,8	15,8	5,8	4,8	1,2	1,8	3,6
Gross Profits	16,2	10,5	-2,2	13,3	14,2	22,3	19,8	16,1
Labour share	-3,6	-0,3	7,5	-2,9	-3,6	-7,1	-5,3	-4,3

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C12. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
<u>DPRN</u>								
VAB f.c. nom*	7.836,0	9.780,0	11.607,1	14.447,5	21.900,6	30.020,6	28.962,9	35.100,7
VAB f.c. real**	16.815,2	17.618,5	17.204,1	19.073,2	23.843,3	27.574,6	24.665,5	26.973,7
Pride defl.	46,6	55,5	67,5	75,7	91,9	108,9	117,4	130,1
Workers***	987,5	968,8	936,8	990,4	1.168,3	1.279,6	1.137,6	1.171,8
Labour income*	6.764,3	8.570,7	9.893,9	11.946,8	16.438,5	21.068,0	22.838,7	26.121,7
Gross Profits*	1.071,8	1.209,3	1.713,1	2.500,6	5.462,0	8.952,6	6.124,2	8.979,0
Labour share	0,86	0,88	0,85	0,83	0,75	0,70	0,79	0,74
<u>MORES</u>								
VAB f.c. nom*	7.697,5	9.296,2	10.082,8	13.820,1	21.000,0	27.868,7	26.999,0	30.871,9
VAB f.c. real**	16.325,8	16.778,7	16.098,4	18.368,7	22.886,0	26.003,6	23.233,7	24.502,2
Pride defl.	47,1	55,4	62,6	75,2	91,8	107,2	116,2	126,0
Workers***	903,4	853,1	766,4	930,2	1.139,4	1.284,0	1.098,5	1.112,9
Labour income*	6.927,8	8.425,4	8.285,0	10.782,8	15.504,7	21.112,8	22.159,1	23.710,5
Gross Profits*	769,7	870,9	1.797,8	3.037,3	5.495,3	6.755,8	4.839,9	7.161,4
Labour share	0,90	0,91	0,82	0,78	0,74	0,76	0,82	0,77
<u>DIVERGENCES (%)</u>								
VAB f.c. nom	1,8	5,2	15,1	4,5	4,3	7,7	7,3	13,7
VAB f.c. real	3,0	5,0	6,9	3,8	4,2	6,0	6,2	10,1
Pride defl.	-1,2	0,2	7,7	0,7	0,1	1,6	1,0	3,3
Workers	9,3	13,6	22,2	6,5	2,5	-0,3	3,6	5,3
Labour income	-2,4	1,7	19,4	10,8	6,0	-0,2	3,1	10,2
Gross Profits	39,3	38,9	-4,7	-17,7	-0,6	32,5	26,5	25,4
Labour share	-4,1	-3,3	3,7	6,0	1,7	-7,4	-3,9	-3,1

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C13. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	6.931,4	9.389,8	11.747,5	14.653,5	17.893,9	21.542,4	23.877,7	27.181,1
VAB f.c. real**	13.388,1	14.823,3	16.557,6	16.911,3	18.909,1	20.385,8	20.446,9	21.368,3
Pride defl.	51,8	63,3	70,9	86,6	94,6	105,7	116,8	127,2
Workers***	678,4	692,6	699,5	725,0	753,2	771,0	747,9	769,4
Labour income*	5.048,1	7.004,9	8.537,8	10.720,0	13.173,8	16.274,3	18.860,9	20.815,7
Gross Profits*	1.883,2	2.384,9	3.209,7	3.933,5	4.720,1	5.268,0	5.016,8	6.365,4
Labour share	0,73	0,75	0,73	0,73	0,74	0,76	0,79	0,77
MORES								
VAB f.c. nom*	6.780,0	9.360,9	11.330,4	14.036,5	16.928,4	20.213,1	23.459,4	27.842,8
VAB f.c. real**	13.910,0	14.319,4	15.220,1	16.226,3	17.721,0	19.176,1	20.360,4	22.296,5
Pride defl.	48,7	65,4	74,4	86,5	95,5	105,4	115,2	124,9
Workers***	685,0	698,6	689,6	685,2	698,9	727,9	717,1	740,0
Labour income*	5.108,4	6.615,0	7.784,5	10.659,5	12.308,6	15.452,7	18.168,5	19.998,5
Gross Profits*	1.671,6	2.746,0	3.545,8	3.377,0	4.619,8	4.760,4	5.290,8	7.844,3
Labour share	0,75	0,71	0,69	0,76	0,73	0,76	0,77	0,72
DIVERGENCES (%)								
VAB f.c. nom	2,2	0,3	3,7	4,4	5,7	6,6	1,8	-2,4
VAB f.c. real	-3,8	3,5	8,8	4,2	6,7	6,3	0,4	-4,2
Pride defl.	6,2	-3,1	-4,7	0,2	-0,9	0,3	1,4	1,9
Workers	-1,0	-0,9	1,4	5,8	7,8	5,9	4,3	4,0
Labour income	-1,2	5,9	9,7	0,6	7,0	5,3	3,8	4,1
Gross Profits	12,7	-13,1	-9,5	16,5	2,2	10,7	-5,2	-18,9
Labour share	-3,3	5,6	5,8	-3,7	1,3	-1,2	2,0	6,6

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C14. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	6.231,2	6.719,3	10.512,5	14.067,4	19.261,6	24.222,0	25.480,2	29.363,5
VAB f.c. real**	15.306,3	14.676,8	15.780,3	18.529,4	21.337,5	21.865,5	18.747,5	20.524,7
Pride defl.	40,7	45,8	66,6	75,9	90,3	110,8	135,9	143,1
Workers***	322,2	325,6	327,3	325,0	333,9	352,8	347,0	344,0
Labour income*	3.454,7	4.212,2	5.842,3	7.774,1	9.632,4	11.957,7	12.873,1	13.484,0
Gross Profits*	2.776,5	2.507,1	4.670,2	6.293,3	9.629,2	12.264,3	12.607,1	15.879,5
Labour share	0,55	0,63	0,56	0,55	0,50	0,49	0,51	0,46
MORES								
VAB f.c. nom*	6.047,0	6.465,6	10.053,1	13.496,4	18.531,2	23.491,3	24.836,0	25.860,1
VAB f.c. real**	14.988,2	15.003,4	16.172,9	17.664,0	20.397,9	21.079,1	18.797,5	17.633,4
Pride defl.	40,3	43,1	62,2	76,4	90,8	111,4	132,1	146,7
Workers***	292,0	292,6	289,2	288,1	303,1	321,3	315,1	307,3
Labour income*	3.152,6	4.211,1	5.223,2	6.977,4	8.833,2	11.038,1	11.853,0	11.871,4
Gross Profits*	2.894,4	2.254,6	4.829,9	6.519,0	9.698,0	12.453,2	12.983,0	13.988,7
Labour share	0,52	0,65	0,52	0,52	0,48	0,47	0,48	0,46
DIVERGENCES (%)								
VAB f.c. nom	3,0	3,9	4,6	4,2	3,9	3,1	2,6	13,5
VAB f.c. real	2,1	-2,2	-2,4	4,9	4,6	3,7	-0,3	16,4
Pride defl.	0,9	6,2	7,2	-0,6	-0,6	-0,6	2,9	-2,4
Workers	10,4	11,3	13,2	12,8	10,1	9,8	10,1	11,9
Labour income	9,6	0,0	11,9	11,4	9,0	8,3	8,6	13,6
Gross Profits	-4,1	11,2	-3,3	-3,5	-0,7	-1,5	-2,9	13,5
Labour share	6,3	-3,7	7,0	6,9	4,9	5,1	5,9	0,0

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-C16. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	29.822,9	39.835,7	50.394,6	67.781,8	84.633,9	105.317,8	123.656,4	146.393,0
VAB f.c. real**	71.683,0	72.337,5	74.596,5	85.332,7	92.707,7	96.144,1	96.283,9	105.636,8
Pride defl.	41,6	55,1	67,6	79,4	91,3	109,5	128,4	138,6
Workers***	3.446,9	3.545,6	3.689,3	3.873,0	4.002,5	4.121,2	4.121,5	4.466,9
Labour income*	18.236,9	24.908,3	31.246,6	41.700,9	51.985,8	61.883,7	72.518,1	83.959,3
Gross Profits*	11.586,0	14.927,4	19.147,9	26.081,0	32.648,2	43.434,1	51.138,3	62.433,7
Labour share	0,61	0,63	0,62	0,62	0,61	0,59	0,59	0,57
MORES								
VAB f.c. nom*	28.026,2	38.688,7	49.774,0	64.169,8	82.065,5	104.975,6	125.655,8	145.187,8
VAB f.c. real**	69.576,9	72.568,8	75.529,5	82.701,0	90.894,5	95.582,1	99.141,9	103.779,0
Pride defl.	40,3	53,3	65,9	77,6	90,3	109,8	126,7	139,9
Workers***	3.031,7	3.044,1	3.068,6	3.501,1	3.833,6	4.137,4	4.100,6	4.287,4
Labour income*	17.898,3	23.675,7	27.626,0	36.198,8	44.973,5	57.383,7	66.691,9	73.439,8
Gross Profits*	10.127,9	15.013,0	22.148,1	27.970,9	37.092,0	47.591,9	58.963,9	71.747,9
Labour share	0,64	0,61	0,56	0,56	0,55	0,55	0,53	0,51
DIVERGENCES (%)								
VAB f.c. nom	6,4	3,0	1,2	5,6	3,1	0,3	-1,6	0,8
VAB f.c. real	3,0	-0,3	-1,2	3,2	2,0	0,6	-2,9	1,8
Pride defl.	3,3	3,3	2,5	2,4	1,1	-0,3	1,3	-0,9
Workers	13,7	16,5	20,2	10,6	4,4	-0,4	0,5	4,2
Labour income	1,9	5,2	13,1	15,2	15,6	7,8	8,7	14,3
Gross Profits	14,4	-0,6	-13,5	-6,8	-12,0	-8,7	-13,3	-13,0
Labour share	-4,2	2,2	11,7	9,1	12,1	7,5	10,5	13,4

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

Divergence in estimates: DPRN vs MORES, Spain-PPServ. Selected years

	1981	1983	1985	1987	1989	1991	1993	1995
DPRN								
VAB f.c. nom*	42.985,4	55.944,8	72.654,6	96.502,7	121.789,4	151.082,2	173.014,4	202.937,5
VAB f.c. real**	100.377,4	101.837,6	106.934,4	120.773,4	132.954,2	138.395,4	135.478,2	147.529,7
Pride defl.	42,8	54,9	67,9	79,9	91,6	109,2	127,7	137,6
Workers***	4.447,6	4.563,8	4.716,1	4.923,0	5.089,5	5.245,0	5.216,3	5.580,3
Labour income*	27.804,9	37.340,7	47.441,0	62.606,1	77.594,6	93.503,8	107.651,2	120.708,6
Gross Profits*	15.180,6	18.604,1	25.213,6	33.896,6	44.194,8	57.578,4	65.363,1	82.228,9
Labour share	0,65	0,67	0,65	0,65	0,64	0,62	0,62	0,59
MORES								
VAB f.c. nom*	40.853,2	54.515,3	71.157,5	91.702,6	117.525,1	148.680,0	173.951,2	198.890,7
VAB f.c. real**	98.475,0	101.891,6	106.922,5	116.591,3	129.013,4	135.837,3	138.299,9	143.708,9
Pride defl.	41,5	53,5	66,6	78,7	91,1	109,5	125,8	138,4
Workers***	4.008,7	4.035,4	4.047,4	4.474,4	4.835,6	5.186,6	5.132,8	5.334,7
Labour income*	26.159,3	34.501,7	40.633,7	53.835,7	66.115,3	83.874,5	96.713,5	105.309,7
Gross Profits*	14.694,0	20.013,6	30.523,8	37.866,9	51.409,9	64.805,5	77.237,7	93.580,9
Labour share	0,64	0,63	0,57	0,59	0,56	0,56	0,56	0,53
DIVERGENCES (%)								
VAB f.c. nom	5,2	2,6	2,1	5,2	3,6	1,6	-0,5	2,0
VAB f.c. real	1,9	-0,1	0,0	3,6	3,1	1,9	-2,0	2,7
Pride defl.	3,2	2,7	2,1	1,6	0,6	-0,3	1,5	-0,6
Workers	10,9	13,1	16,5	10,0	5,3	1,1	1,6	4,6
Labour income	6,3	8,2	16,8	16,3	17,4	11,5	11,3	14,6
Gross Profits	3,3	-7,0	-17,4	-10,5	-14,0	-11,2	-15,4	-12,1
Labour share	1,0	5,5	14,3	10,5	13,3	9,7	11,9	12,3

* Variables expressed in Million Euros, from values expressed in current Million Pesetas

** Variables expressed in Million Euros, from values expressed in constant Million Pesetas (base year: 1990)

*** Variable expressed in thousands

In general, measured real output is higher in DPRN than in MORES (C3 and C7 are exceptions to this observation), as are the number of workers. Sometimes, the previous differences favour labour productivity in DPRN, sometimes they favour labour productivity in MORES, and sometimes the evolution of labour productivity within a given sector may even change sign over time. There is no clear evolution of the output differences across time, on the contrary, observed differences in employment decrease after 1987. There is an increase in the number of jobs reported by MORES. In turn, this will affect the results of the growth accounting exercise, as shown below. With respect to the share of each factor in income, results are mixed. There are great divergences in reported profits in sectors C6, C7, C9, C11, where DPRN clearly overcomes MORES estimations of capital income. With respect to the evolution of the labour share of income, there is a common downturn in 1983, higher as reported by MORES.

Set 2. Divergence in growth accounting exercise

Growth Accounting Exercise, Spain-PPS, DPRN

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	1,32	4,82	1,07	2,39
Contri L (%)	-0,66	0,40	-0,40	-0,22
Contri K (%)	0,55	1,43	1,10	1,03
TFP (%)	1,43	2,98	0,37	1,58

Growth Accounting Exercise, Spain-PPS, MORES

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	1,24	4,44	0,98	2,20
Contri L (%)	-1,01	1,76	-0,59	0,04
Contri K (%)	0,59	1,54	1,16	1,10
TFP (%)	1,66	1,14	0,40	1,07

Growth Accounting Exercise, Spain-C1, DPRN

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	3,36	2,81	-0,64	1,83
Contri L (%)	-3,05	-3,32	-3,12	-3,17
Contri K (%)	0,58	0,11	-0,34	0,11
TFP (%)	5,83	6,03	2,83	4,88

Growth Accounting Exercise, Spain-C1, MORES

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	1,18	-0,05	-2,29	-0,40
Contri L (%)	-2,04	-3,09	-4,01	-3,05
Contri K (%)	0,64	0,14	-0,39	0,13
TFP (%)	2,59	2,91	2,11	2,53

Growth Accounting Exercise, Spain-C2, DPRN

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	-2,02	4,57	-3,09	-0,23
Contri L (%)	0,20	-0,62	-1,07	-0,50
Contri K (%)	2,37	0,26	-0,27	0,78
TFP (%)	-4,59	4,93	-1,75	-0,51

Growth Accounting Exercise, Spain-C2, MORES

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	1,97	2,71	0,77	1,81
Contri L (%)	0,50	-0,77	-1,06	-0,45
Contri K (%)	2,24	0,26	-0,26	0,74
TFP (%)	-0,77	3,22	2,09	1,53

Growth Accounting Exercise, Spain-C3, DPRN

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	0,23	-5,99	0,60	-1,77
Contri L (%)	-3,39	-3,30	-2,89	-3,19
Contri K (%)	-0,59	0,21	-0,66	-0,35
TFP (%)	4,20	-2,90	4,15	1,77

Growth Accounting Exercise, Spain-C3, MORES

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	0,61	-2,54	-0,40	-0,78
Contri L (%)	-1,15	-2,12	-0,86	-1,38
Contri K (%)	-0,67	0,19	-0,70	-0,40
TFP (%)	2,43	-0,60	1,16	0,99

Growth Accounting Exercise, Spain-C4, DPRN

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	-2,93	2,88	3,31	1,05
Contri L (%)	-1,11	-1,16	-1,31	-1,19
Contri K (%)	-0,07	2,38	0,40	0,89
TFP (%)	-1,75	1,66	4,22	1,35

Growth Accounting Exercise, Spain-C4, MORES

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	-2,84	3,94	0,36	0,45
Contri L (%)	-3,13	1,88	-1,53	-0,97
Contri K (%)	-0,07	2,10	0,47	0,82
TFP (%)	0,36	-0,04	1,43	0,59

Growth Accounting Exercise, Spain-C5, DPRN

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	0,48	7,89	3,37	3,87
Contri L (%)	-1,18	0,78	-0,61	-0,34
Contri K (%)	-1,56	0,80	0,41	-0,13
TFP (%)	3,22	6,31	3,56	4,34

Growth Accounting Exercise, Spain-C5, MORES

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	2,30	3,97	2,98	3,08
Contri L (%)	-0,50	0,17	-0,44	-0,26
Contri K (%)	-1,62	0,84	0,42	-0,13
TFP (%)	4,42	2,95	3,00	3,47

Growth Accounting Exercise, Spain-C6, DPRN

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	2,11	5,12	2,93	3,38
Contri L (%)	-1,21	2,04	-1,68	-0,31
Contri K (%)	-0,26	1,86	0,42	0,66
TFP (%)	3,58	1,22	4,19	3,02

Growth Accounting Exercise, Spain-C6, MORES

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	1,09	7,50	1,01	3,16
Contri L (%)	-1,85	3,21	-1,14	0,04
Contri K (%)	-0,24	1,68	0,38	0,60
TFP (%)	3,18	2,62	1,78	2,53

Growth Accounting Exercise, Spain-C7, DPRN

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	-0,26	9,75	-2,70	2,12
Contri L (%)	-0,05	1,63	-5,23	-1,28
Contri K (%)	-0,15	0,06	1,78	0,55
TFP (%)	-0,06	8,06	0,75	2,85

Growth Accounting Exercise, Spain-C7, MORES

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	0,39	6,88	4,04	3,74
Contri L (%)	-2,20	1,97	-2,61	-0,97
Contri K (%)	-0,12	-0,03	1,44	0,42
TFP (%)	2,70	4,95	5,21	4,29

Growth Accounting Exercise, Spain-C8, DPRN

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	2,30	4,42	1,52	2,74
Contri L (%)	-0,29	-0,09	-0,51	-0,30
Contri K (%)	-0,23	1,72	1,16	0,88
TFP (%)	2,82	2,79	0,87	2,16

Growth Accounting Exercise, Spain-C8, MORES

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	2,03	2,66	1,93	2,21
Contri L (%)	0,08	1,12	-0,74	0,15
Contri K (%)	-0,24	1,77	1,22	0,91
TFP (%)	2,19	-0,24	1,44	1,14

Growth Accounting Exercise, Spain-C9, DPRN

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	0,22	2,98	-1,96	0,40
Contri L (%)	-1,37	-0,81	-2,15	-1,45
Contri K (%)	-0,44	1,03	-0,27	0,10
TFP (%)	2,03	2,77	0,47	1,74

Growth Accounting Exercise, Spain-C9, MORES

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	-1,58	0,58	-1,71	-0,91
Contri L (%)	-2,56	0,40	-2,79	-1,67
Contri K (%)	-0,31	0,62	-0,10	0,07
TFP (%)	1,29	-0,44	1,18	0,69

Growth Accounting Exercise, Spain-C10, DPRN

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	1,26	1,22	2,20	1,56
Contri L (%)	-0,17	0,57	-0,63	-0,08
Contri K (%)	-0,09	2,68	1,22	1,25
TFP (%)	1,52	-2,03	1,62	0,39

Growth Accounting Exercise, Spain-C10, MORES

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	1,33	3,43	0,37	1,70
Contri L (%)	-2,38	4,91	-1,07	0,41
Contri K (%)	-0,10	3,02	1,36	1,40
TFP (%)	3,81	-4,50	0,08	-0,11

Growth Accounting Exercise, Spain-C11, DPRN

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	-0,71	2,75	-2,84	-0,29
Contri L (%)	-0,39	-0,40	-1,54	-0,78
Contri K (%)	-0,21	1,64	0,84	0,75
TFP (%)	-0,12	1,51	-2,14	-0,26

Growth Accounting Exercise, Spain-C11, MORES

	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	-0,59	4,83	0,16	1,44
Contri L (%)	-2,63	3,18	-1,13	-0,23
Contri K (%)	-0,15	1,25	0,56	0,55
TFP (%)	2,19	0,40	0,73	1,12

Growth Accounting Exercise, Spain-Ind, DPRN				
	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	0,11	4,14	0,33	1,51
Contri L (%)	-0,81	0,10	-1,58	-0,77
Contri K (%)	0,28	0,94	0,40	0,54
TFP (%)	0,64	3,10	1,51	1,74

Growth Accounting Exercise, Spain-Ind, MORES				
	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	0,66	3,88	1,18	1,90
Contri L (%)	-1,47	1,51	-1,29	-0,43
Contri K (%)	0,27	0,88	0,40	0,52
TFP (%)	1,86	1,49	2,07	1,81

Growth Accounting Exercise, Spain-C12, DPRN				
	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	-1,59	8,31	1,02	2,50
Contri L (%)	-2,09	4,38	-0,68	0,49
Contri K (%)	-0,86	0,93	0,69	0,24
TFP (%)	1,36	3,00	1,01	1,77

Growth Accounting Exercise, Spain-C12, MORES				
	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	-0,32	9,37	-0,55	2,73
Contri L (%)	-3,84	8,07	-1,62	0,72
Contri K (%)	-0,81	0,92	0,60	0,22
TFP (%)	4,32	0,38	0,46	1,79

Growth Accounting Exercise, Spain-C13, DPRN				
	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	5,37	3,47	1,71	3,50
Contri L (%)	0,25	1,29	0,14	0,56
Contri K (%)	0,24	1,21	0,79	0,74
TFP (%)	4,88	0,97	0,77	2,20

Growth Accounting Exercise, Spain-C13, MORES				
	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	2,33	3,99	3,80	3,37
Contri L (%)	0,19	0,55	0,49	0,41
Contri K (%)	0,25	1,35	0,73	0,77
TFP (%)	1,88	2,08	2,58	2,18

Growth Accounting Exercise, Spain-C14, DPRN				
	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	4,50	6,48	-1,02	3,27
Contri L (%)	0,20	0,51	0,03	0,24
Contri K (%)	0,78	0,72	1,38	0,96
TFP (%)	3,52	5,26	-2,42	2,07

Growth Accounting Exercise, Spain-C14, MORES				
	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	1,88	5,90	-3,93	1,20
Contri L (%)	0,19	0,86	-0,23	0,27
Contri K (%)	0,82	0,84	1,34	1,00
TFP (%)	0,87	4,21	-5,04	-0,07

Growth Accounting Exercise, Spain-C16, DPRN				
	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	1,44	4,82	2,27	2,84
Contri L (%)	0,90	1,17	1,16	1,08
Contri K (%)	1,54	3,28	2,67	2,49
TFP (%)	-1,00	0,38	-1,55	-0,73

Growth Accounting Exercise, Spain-C16, MORES				
	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	1,71	4,32	2,15	2,72
Contri L (%)	0,18	3,09	0,79	1,34
Contri K (%)	1,68	3,55	2,95	2,72
TFP (%)	-0,14	-2,32	-1,59	-1,34

Growth Accounting Exercise, Spain-PPSer, DPRN				
	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	2,40	4,87	1,69	2,98
Contri L (%)	0,79	1,17	0,99	0,98
Contri K (%)	0,91	2,24	1,89	1,68
TFP (%)	0,70	1,46	-1,18	0,32

Growth Accounting Exercise, Spain-PPSer,MORES				
	1980-1985	1985-1990	1990-1995	1980-1995
VAB c.f. (%)	1,82	4,52	1,50	2,61
Contri L (%)	0,18	2,60	0,69	1,15
Contri K (%)	1,04	2,60	2,12	1,92
TFP (%)	0,60	-0,67	-1,31	-0,46

The growth accounting exercise displays an overall unified picture for the private productive sector of the Spanish economy, despite the slightly higher TFP performance in the middle period reported by DPRN. This does not help important differences within specific sectors: C1, C4, C8, C9 and C14 perform much better as reported by DPRN. On the contrary, C2, C3 and

C7 are better performers as reported by MORES. The difference usually reflects differences in TFP performance except for C3, where the main difference lies on the labour contribution. In general, in both data sets, the overall picture results from an extraordinary performance during the intermediate period, a modest performance during the first period, and a bad performance during the last period (C4, C5 and C16 display the reverse evolution with respect to the first and the last time periods). There is a noticeable difference regarding the process driving the good output performance during the period 1985-1990, attending to each data source. MORES shows a remarkable labour contribution in the more dynamic sectors, C4, C10, C11, C12 and C16. Instead, good performers are mostly characterized by high TFP improvements according to DPRN. For instance, C1, C7, C8, C9, C11, C12. To sum up, the main contributor to output performance in the industrial sector are TFP improvements according to DPRN. According to MORES, TFP improvements and labour input increases contribute the same. With respect to the private productive services, DPRN enhances the labour contribution to output growth as well as TFP improvements while MORES highlights the labour contribution to output growth, since TFP actually declines.

A.4 Description of the capital stock series and investment series

The series of stock of capital are taken from Fundación BBVA-IVIE[23]. This data set contains series on investment and stock of capital for 22 private productive branches, the residential sector and the public sector, for the overall economy and each of the 17 Spanish Comunidades Autónomas, for the period 1964-1998[24]. To guarantee compatibility with the series of output, and employment from Fundación BBVA (1999), we aggregate these 22 sectors into 15 private productive sectors.

We summarize the main features of the procedure used to estimate investment series and capital stock series.

The main statistical sources used to estimate the national series of sectorial investments are described in full detail in Más, Pérez and Uriel (1998), Vol I, Methodology. All the sectors have specific information sources except for the residual of private productive services (i.e., Lodging

[23] Más, Pérez and Uriel, 1998.

[24] The series for the public sector go back to 1955.

and catering services, Communication services, Transport services, and Financial and insurance institutions all have specific data sources). The sector Rest of private productive services, which we denote by C16, agglomerates the subset of activities for which it is impossible to estimate specific investment series because of the lack of information. Their joint investment series is computed as a residual, subtracting from estimated aggregate investment sectorial investments, in Agriculture and fishing, all industrial branches, services sectors other than the residual, the public sector and the residential sector.

Next, we describe the procedure used to construct investment deflators (base year is 1990). Overall investments, Residential building, Other constructions, Transport material, and Machinery and equipment are the only sectors with homogenous deflator series for the whole period, 1964-1996. These are constructed using information from *Contabilidad Nacional de España* (INE), for 1964 onwards, and *Contabilidad Nacional de España* (Instituto de Estudios Fiscales), for 1954-1964. Fishing investment series is deflated using the Transport material deflator series, since the stock of capital in Fishing consists mainly of fishing boats. Residential building investment series is deflated according to its specific deflator. Investments in transport means undertaken by the Transport services sector are deflated according to its specific deflator. Each public investment series is deflated according to the characteristics of the goods being accumulated, i.e. roads, urban structures of local corporations or ports investment series are deflated using Other type of constructions specific deflator. Investments in Education and Health are deflated using the deflator of Overall investments. Investments of the private productive industries that do not have specific investment deflators are deflated using a common deflator. This common deflator is computed such that overall investment series, in 1990 pesetas, exactly equals overall investment series as estimated by Instituto Nacional de Estadística. More precisely, the private productive sector investment series (excluding Fishing and Transport services) in constant terms is computed by subtracting from the overall investment series in constant terms, the public sector investment, the residential investment, the Fishing investments, and transport services investment, all expressed in 1990 pesetas. Next, dividing this investment series (in constant terms) by the same series in current terms, one obtains the deflator which is used for each of the industries that do not have specific deflators: Agriculture, all industrial branches, and all private productive services except for Transport services.

The stock of capital in all private sectors of the economy, except for Communication services, is estimated applying the Perpetual Inventory Method from an initial stock of capital. Since depreciation is assumed to be a fraction of the stock of capital in the previous period, the expression used to compute the stock of capital in period t is:

$$K_{it} = (1 - \delta_{it}) \cdot K_{it-1} + I_{it},\ \forall i = 1...14$$

where I_{it} is investment in period t, and δ_{it} is the depreciation rate, which has to be estimated.

Initial sectorial stocks of capital are those estimated by Universidad Comercial de Deusto (1968) in *Riqueza Nacional de España*. Initial stock of capital of the Building and Construction sector is taken from Gómez Villegas (1987). Initial stock of capital of Lodging and Catering services are specifically constructed using additional information on these sectors. Initial stock of capital of Financial and Insurance institutions as estimated by Universidad Comercial de Deusto (1968) has been corrected to take into account the posterior evolution of the network of bank offices. All of them are deflated using the correponding investment deflator. Transport services and Communication services investment series, as well as public sector investment series are long enough to apply the Perpetual Inventory Method directly to the investment series using a particular survival function (Winfrey S-3) and depreciation scheme (linear).

Sectorial depreciation rates are computed whenever possible using both international evidence and Spanish evidence. In Agriculture, depreciation rates are adapted from the implicit rates for a set of countries[25], as reported by the OECD[26]. Depreciation rates for each of the industrial branches are computed using implicit depreciation rates for a set of countries as reported by the OECD[27] and information on depreciation rates for 13 Spanish industrial branches, for the period 1984-1988, provided by Martin y Moreno (1991). Depreciation rates for the Building and construction sector are estimated using information on Transport services depreciation rates, and the relationship between average life of the stock of capital in the building sector and the transport services sector, as reported by Gómez Villegas (1987). Lodging and catering services depreciation rates are taken from Ministerio de Transportes, Turismo y Comunicaciones (1986).

[25] The countries are: Germany, Belgium, Finland, France, Greece, Italy, Norway, United Kingdom.

[26] OECD, Economic accounts for agriculture 1976-1989. Paris, 1991.

[27] OECD (various years) Flows and stocks of fixed capital, Paris.

Financial and insurance institutions sector has an official depreciation series, estimated by INE. The rest of the private productive services sectors, whose stocks of capital are computed using the Perpetual Inventory Method from initial stocks of capital, share a common depreciation rate, which is computed using average private productive services sector implicit depreciation rates, as reported by the OECD for a set of countries.

Aggregate sectorial investment and capital stock series have been disaggregated to the level of the 17 Spanish Comunidades Autónomas (CC.AA.). Most of the raw data sources used to estimate the series at the aggregate level contain detailed information by region, in which case the regional distribution is almost automatic. There are though a few sectors that require further efforts to distribute estimated investments and capital stocks by region. In particular, additional information on regional employment is used to distribute aggregate investments in the Building and construction sector. Regional distribution of the investment series for the period 1966-1979 in the Industry is estimated using regional initial stocks of capital (from *Riqueza Nacional de España)* and the average distribution of the investment series during 1981-1991 (*Encuesta Industrial* and *Registro de Establecimientos Industriales*). Additional sources of information are required to distribute aggregate investment series and aggregate capital stocks series in nearly all of the services sectors.

References

[1] Fundación BBVA, *Renta nacional de España y su distribución provincial, Serie homogénea, 1955-1993 y avances 1994-1997*. Bilbao,1999.

[2] Gómez Villegas, J., "Cambio técnico en la economía española: un análisis desagregado para el período 1964-1981", Tesis Doctoral, Universidad Complutense. Madrid, 1987.

[3] Gómez Villegas, J., "La industria española según su stock de capital: 1964-1981", *Investigaciones Económicas (2ª época)*, 1988, 12(2), Madrid.

[4] Instituto de Estudios Fiscales, *Contabilidad Nacional*.

[5] Instituto Nacional de Estadística, *Encuesta Industrial*. Madrid, various years

[6] Instituto Nacional de Estadística, *Contabilidad Nacional de España.* Madrid, various years.

[7] Más, M., F. Pérez and E. Uriel, *El stock de capital en España y su distribución territorial*, Fundación BBVA, vols. I, II, III, and IV. Madrid, 1998.

[8] Martín, A. and L. Moreno, "Medidas del stock de capital a partir de datos contables", in *Valoración económica del beneficio y del capital*, FEDEA, Madrid, 1991.

[9] Ministerio de Industria y Energía, *Registro de Establecimientos Industriales*, non published information made available by this institution.

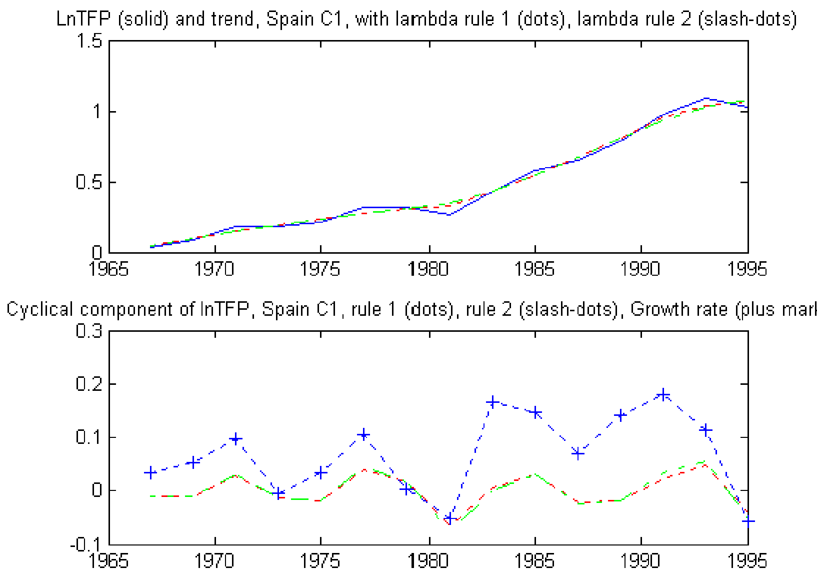
[10] Ministerio de Transporte, Turismo y Comunicaciones, *Estimación del capital y de la inversión turísticos*, Secretaría General de Turismo, Dirección General de Política Turística. Madrid, 1986.

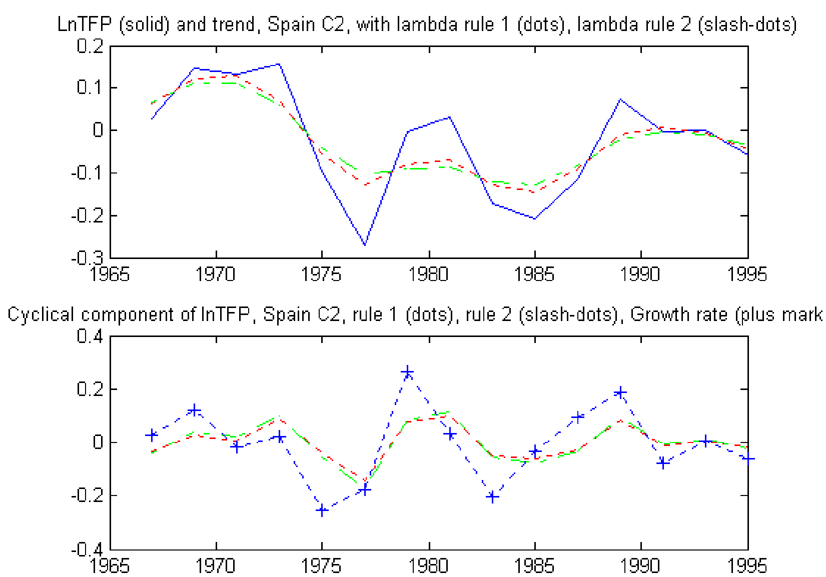
[11] OECD, *Economic accounts for agriculture 1976-1989.* Paris, 1991.

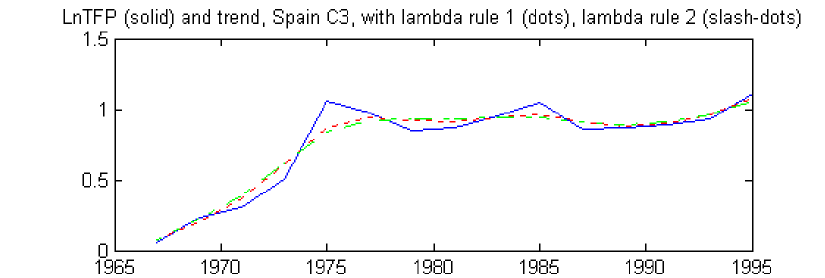
[12] OECD, *Flows and stocks of fixed capital.* Paris, various years.

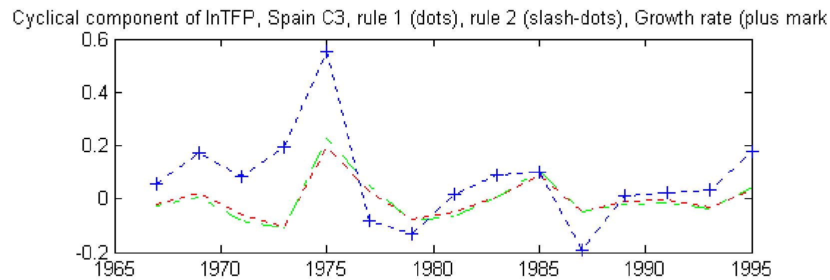
[13] Universidad Comercial de Deusto, *Riqueza nacional de España.* Bilbao, 1968.

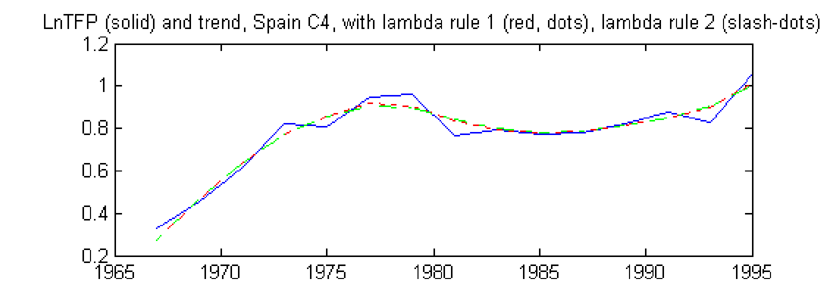
B Trend and cyclical component of sectorial TFPs for different values of lambda

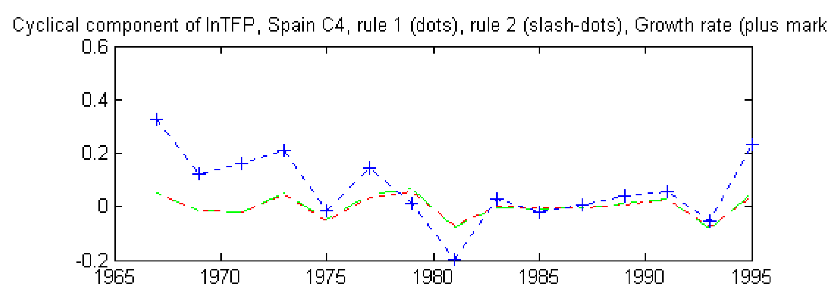


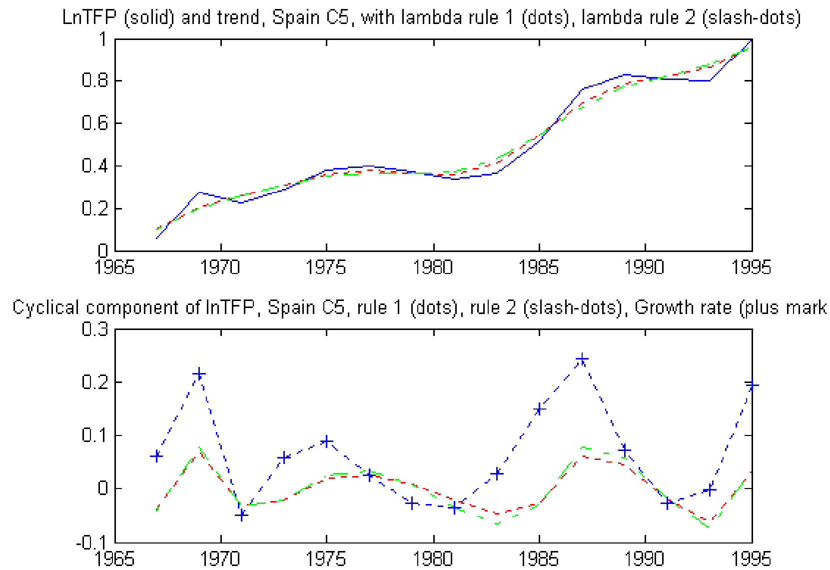


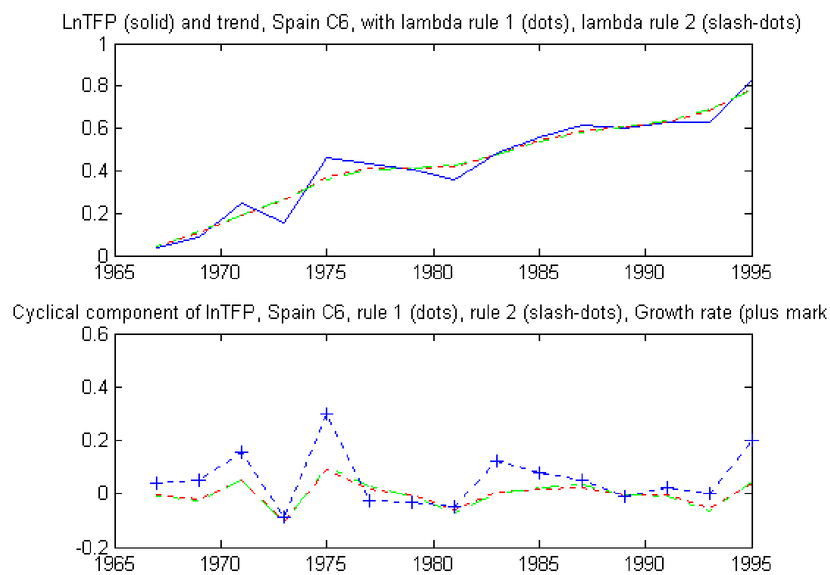

LnTFP (solid) and trend, Spain C3, with lambda rule 1 (dots), lambda rule 2 (slash-dots)
1.5
1
0.5
0
1965
1970
1975
1980
1985
1990
1995

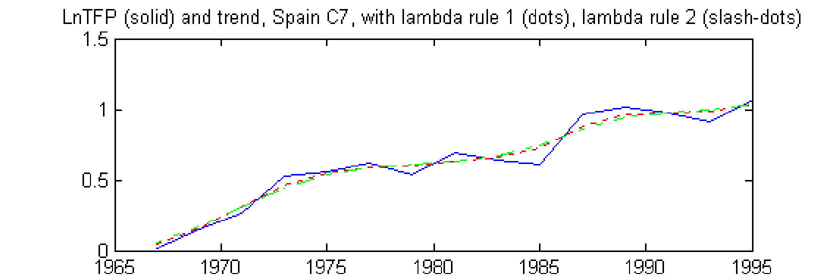

Cyclical component of lnTFP, Spain C3, rule 1 (dots), rule 2 (slash-dots), Growth rate (plus mark
0.6
0.4
0.2
0
-0.2
1965
1970
1975
1980
1985
1990
1995

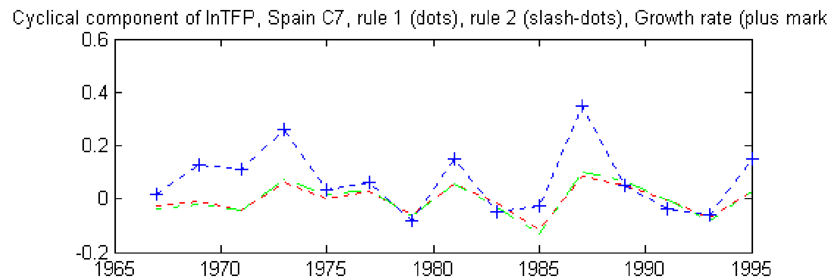

LnTFP (solid) and trend, Spain C4, with lambda rule 1 (red, dots), lambda rule 2 (slash-dots)
1.2
1
0.8
0.6
0.4
0.2
1965
1970
1975
1980
1985
1990
1995

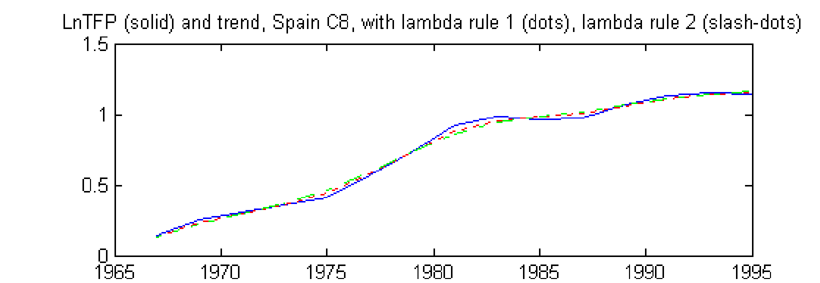

Cyclical component of lnTFP, Spain C4, rule 1 (dots), rule 2 (slash-dots), Growth rate (plus mark
0.6
0.4
0.2
0
-0.2
1965
1970
1975
1980
1985
1990
1995

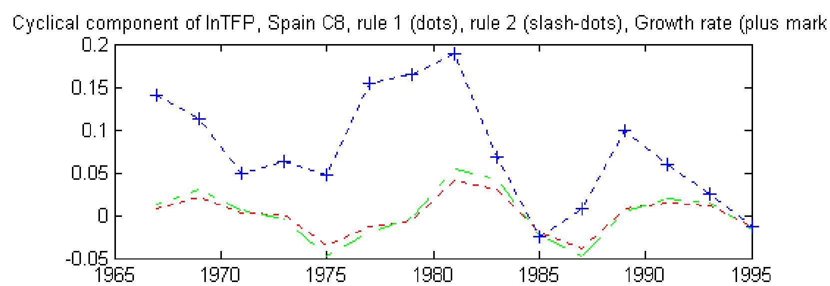

LnTFP (solid) and trend, Spain C5, with lambda rule 1 (dots), lambda rule 2 (slash-dots)
Cyclical component of lnTFP, Spain C5, rule 1 (dots), rule 2 (slash-dots), Growth rate (plus mark
1965
1970
1975
1980
1985
1990
1995


LnTFP (solid) and trend, Spain C6, with lambda rule 1 (dots), lambda rule 2 (slash-dots)
Cyclical component of lnTFP, Spain C6, rule 1 (dots), rule 2 (slash-dots), Growth rate (plus mark
1965
1970
1975
1980
1985
1990
1995

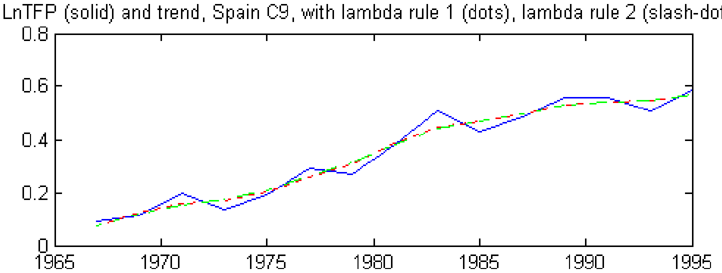

LnTFP (solid) and trend, Spain C7, with lambda rule 1 (dots), lambda rule 2 (slash-dots)
1.5
1
0.5
0
1965
1970
1975
1980
1985
1990
1995


Cyclical component of lnTFP, Spain C7, rule 1 (dots), rule 2 (slash-dots), Growth rate (plus mark
0.6
0.4
0.2
0
-0.2
1965
1970
1975
1980
1985
1990
1995

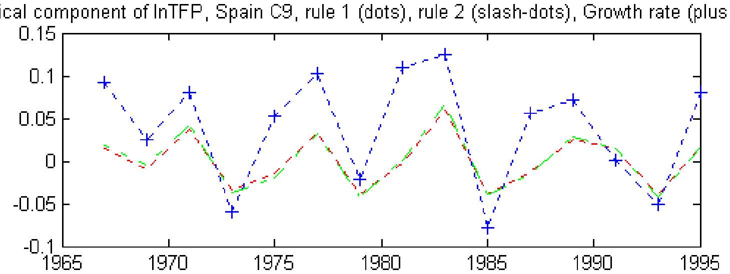

LnTFP (solid) and trend, Spain C8, with lambda rule 1 (dots), lambda rule 2 (slash-dots)
1.5
1
0.5
0
1965
1970
1975
1980
1985
1990
1995


Cyclical component of lnTFP, Spain C8, rule 1 (dots), rule 2 (slash-dots), Growth rate (plus mark
0.2
0.15
0.1
0.05
0
-0.05
1965
1970
1975
1980
1985
1990
1995

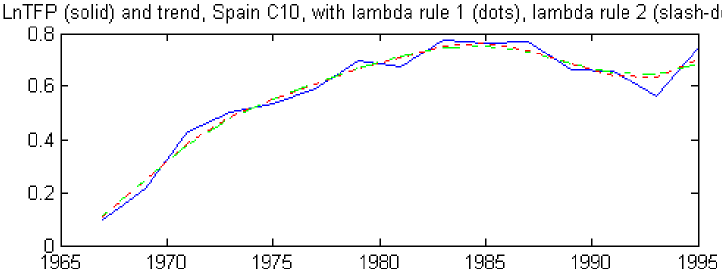
LnTFP (solid) and trend, Spain C9, with lambda rule 1 (dots), lambda rule 2 (slash-dots)



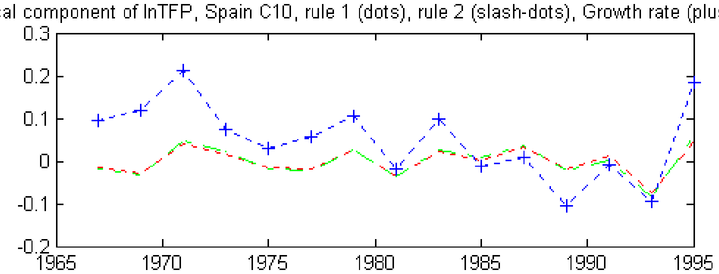
Cyclical component of lnTFP, Spain C9, rule 1 (dots), rule 2 (slash-dots), Growth rate (plus mark

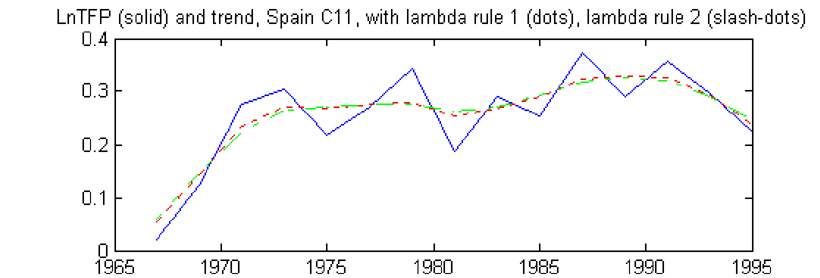


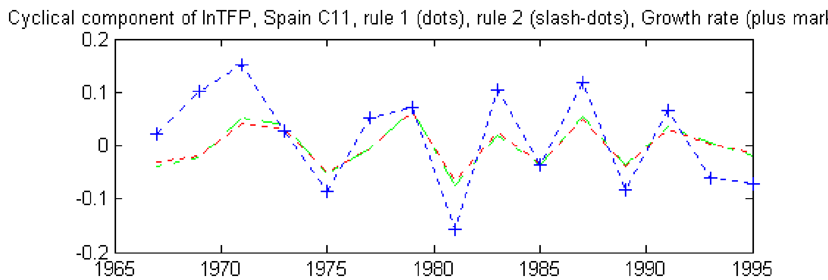
LnTFP (solid) and trend, Spain C10, with lambda rule 1 (dots), lambda rule 2 (slash-dots)

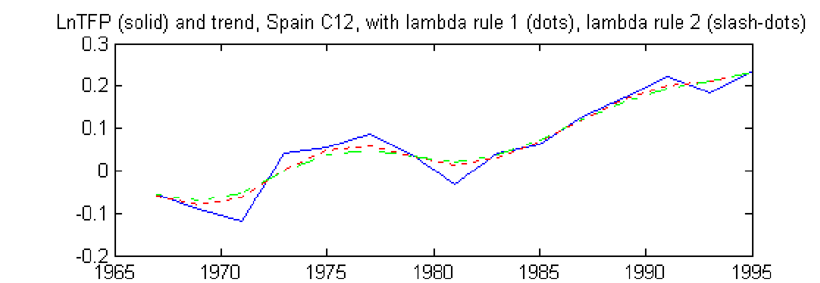


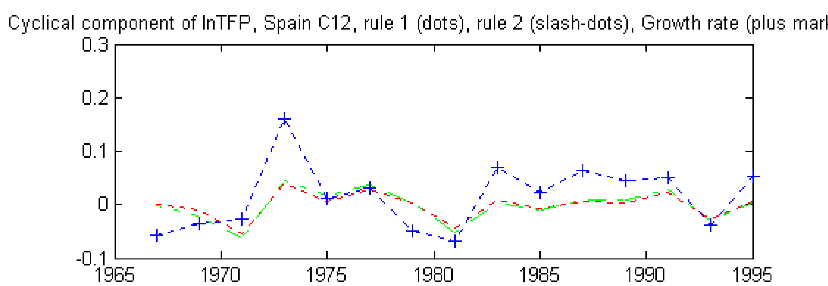
Cyclical component of lnTFP, Spain C10, rule 1 (dots), rule 2 (slash-dots), Growth rate (plus mark

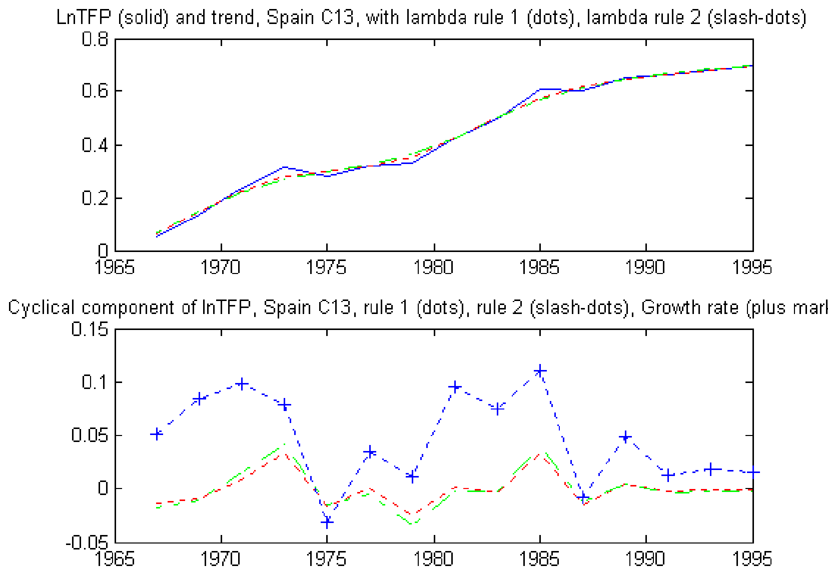


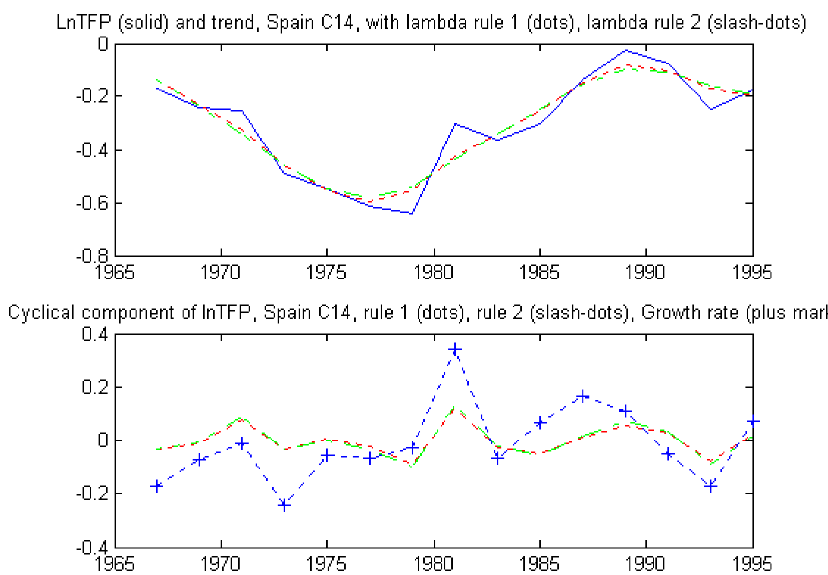

LnTFP (solid) and trend, Spain C11, with lambda rule 1 (dots), lambda rule 2 (slash-dots)
0.4
0.3
0.2
0.1
0
1965
1970
1975
1980
1985
1990
1995

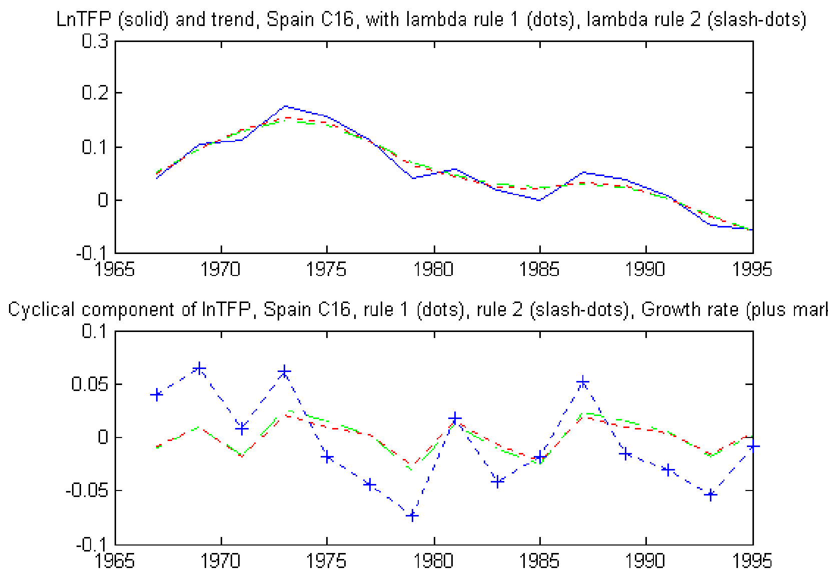

Cyclical component of lnTFP, Spain C11, rule 1 (dots), rule 2 (slash-dots), Growth rate (plus mark
0.2
0.1
0
-0.1
-0.2
1965
1970
1975
1980
1985
1990
1995

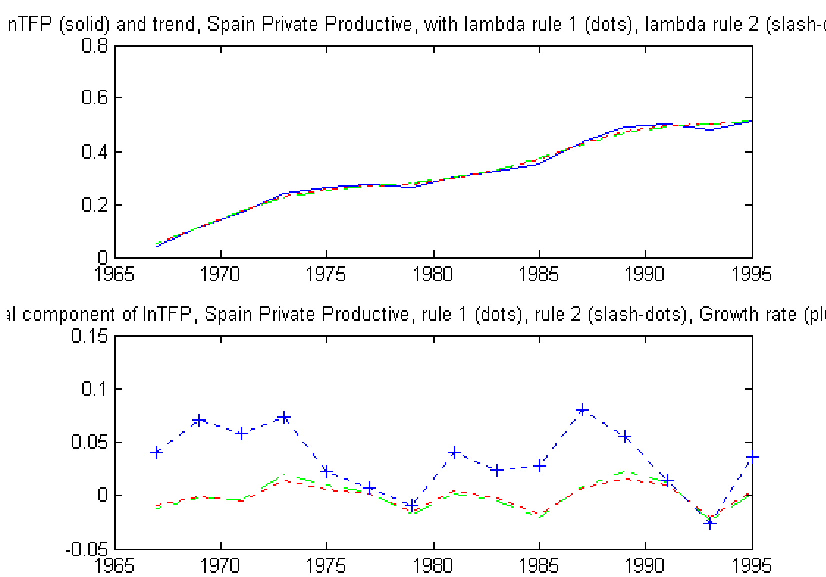

LnTFP (solid) and trend, Spain C12, with lambda rule 1 (dots), lambda rule 2 (slash-dots)
0.3
0.2
0.1
0
-0.1
-0.2
1965
1970
1975
1980
1985
1990
1995


Cyclical component of lnTFP, Spain C12, rule 1 (dots), rule 2 (slash-dots), Growth rate (plus mark
0.3
0.2
0.1
0
-0.1
1965
1970
1975
1980
1985
1990
1995


LnTFP (solid) and trend, Spain C13, with lambda rule 1 (dots), lambda rule 2 (slash-dots)
Cyclical component of lnTFP, Spain C13, rule 1 (dots), rule 2 (slash-dots), Growth rate (plus mark
1965
1970
1975
1980
1985
1990
1995


LnTFP (solid) and trend, Spain C14, with lambda rule 1 (dots), lambda rule 2 (slash-dots)
Cyclical component of lnTFP, Spain C14, rule 1 (dots), rule 2 (slash-dots), Growth rate (plus mark
1965
1970
1975
1980
1985
1990
1995


LnTFP (solid) and trend, Spain C16, with lambda rule 1 (dots), lambda rule 2 (slash-dots)
Cyclical component of lnTFP, Spain C16, rule 1 (dots), rule 2 (slash-dots), Growth rate (plus mark


nTFP (solid) and trend, Spain Private Productive, with lambda rule 1 (dots), lambda rule 2 (slash-c
l component of lnTFP, Spain Private Productive, rule 1 (dots), rule 2 (slash-dots), Growth rate (plu

C Detailed results of Factor analysis on sectorial TFP innovations (DPRN data set, FBBVA)

C.1 Sectorial TFP innovations, computed by HP detrending (rule 1)

Table 1. Explained % of Total Variance

Factor	Eigen Value	Pct of Variance	Cum Pct
1	3,54	23,62	23,62
2	3,04	20,28	43,90
3	2,58	17,19	61,09
4	1,76	11,75	72,84
5	1,28	8,53	81,37
6	1,08	7,18	88,55
7	0,73	4,88	93,43
8	0,40	2,70	96,13
9	0,27	1,79	97,92
10	0,17	1,11	99,03
11	0,10	0,64	99,67
12	0,05	0,30	99,97
13	0,00	0,03	100,00
14	0,00	0,00	100,00
15	0,00	0,00	100,00

Table 2. Factor Matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
C1	-0,87	-0,04	0,04	0,04	0,15	-0,03	0,36	0,23
C2	0,44	-0,59	0,34	-0,06	-0,41	0,09	-0,25	0,02
C3	-0,11	0,49	-0,74	-0,26	0,16	0,04	-0,18	-0,09
C4	-0,16	0,41	0,69	0,07	0,22	-0,18	-0,43	0,13
C5	0,47	0,60	0,02	-0,20	-0,33	-0,14	-0,01	0,48
C6	-0,18	0,74	-0,50	0,34	-0,19	0,11	-0,04	-0,03
C7	0,87	0,25	0,27	-0,04	0,08	-0,02	0,28	-0,08
C8	0,20	-0,73	0,06	0,36	0,28	-0,36	-0,13	0,05
C9	0,20	0,25	-0,09	0,77	0,45	-0,23	0,06	0,06
C10	-0,02	0,53	0,50	0,45	-0,13	0,41	-0,20	-0,13
C11	-0,38	0,16	0,72	0,25	-0,28	0,05	0,37	-0,06
C12	0,01	0,54	0,49	-0,44	0,42	-0,16	-0,02	-0,13
C13	-0,05	-0,28	0,13	-0,20	0,52	0,74	-0,02	0,20
C14	0,74	-0,05	-0,27	0,48	0,02	0,29	0,06	0,08
C16	0,87	0,20	0,08	-0,27	0,19	-0,02	0,22	-0,06

Table 3. Rotated Factor Matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
C1	-0,69	0,24	0,12	-0,24	0,05	0,57	0,18	-0,06
C2	0,19	-0,82	-0,24	0,14	-0,29	-0,16	-0,03	0,07
C3	-0,05	0,82	0,00	-0,15	-0,08	-0,49	-0,03	0,04
C4	-0,13	-0,15	0,80	0,45	0,18	0,05	-0,02	0,20
C5	0,42	0,18	0,11	0,08	-0,09	-0,06	-0,22	0,83
C6	-0,13	0,81	-0,20	0,37	0,17	-0,07	-0,26	0,20
C7	0,96	-0,11	0,07	0,07	0,12	0,06	-0,03	0,14
C8	-0,08	-0,68	-0,12	-0,31	0,51	-0,18	-0,02	-0,24
C9	0,13	0,15	0,00	0,15	0,95	0,01	-0,09	-0,04
C10	0,07	0,09	0,17	0,93	0,11	0,22	0,05	0,05
C11	-0,14	-0,15	0,19	0,41	-0,07	0,84	-0,12	-0,03
C12	0,31	0,20	0,88	0,03	-0,10	0,11	0,08	0,00
C13	-0,01	-0,09	0,02	0,03	-0,07	-0,04	0,98	-0,13
C14	0,54	-0,07	-0,58	0,20	0,43	-0,24	0,13	0,11
C16	0,95	-0,03	0,09	-0,13	0,02	-0,12	0,06	0,14

The factor matrices show the estimated coefficients a_{im} both from the initial extraction, and from a Varimax rotation. The Varimax rotation computes new factors, transforming the original factors, such that each of the new factors is related only with a limited number of the original variables.

Results prove there is not one common factor that could account for observed behaviour of the cyclical component of TFP in the private productive sectors. At least 6 factors are required to catch 90% total variability contained in the original series. The first 2 factors account for 44% of total variability. Together with the third, they account for 61%. The factor matrix also shows that each of the sectorial series is highly correlated with more than one factor. The rotated factor matrix solves the problem, in the sense each of the original series only loads one of the factors. The first three factors are loaded by more than one of the original series, with both positive and negative signs. To be precise, the first common factor points to high correlation between TFP shocks in C1, C7, C14 and C16. The second factor points to comovement between C2, C6, C8 and C3. Finally, the third factor points to high joint dynamics of C4, C12 and C14.

C.2 Sectorial TFP innovations, computed by first differencing

Actually, the results confirm our previous finding that there is no "aggregate" common factor underlying observed sectorial dynamics. Additionally, we find that the first few common factors single out the same relationships among the sectors as were found when examining the HP cyclical component of TFPs.

Table 1. Explained % of Total Variance

Factor	Eigen Value	Pct of Variance	Cum Pct
1	3,15	21,02	21,02
2	2,68	17,86	38,88
3	2,18	14,54	53,42
4	1,97	13,15	66,57
5	1,32	8,77	75,34
6	1,09	7,24	82,58
7	0,95	6,34	88,92
8	0,60	4,01	92,93
9	0,45	3,00	95,94
10	0,25	1,70	97,63
11	0,24	1,57	99,21
12	0,07	0,49	99,70
13	0,04	0,25	99,95
14	0,01	0,05	100,00
15	0,00	0,00	100,00

Table 2. Factor Matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
C1	-0,23	-0,49	0,39	-0,39	0,48	0,24	0,07	0,30
C2	-0,32	0,69	0,12	-0,23	-0,18	-0,32	0,31	0,03
C3	0,47	-0,50	-0,33	0,20	-0,48	0,25	0,01	0,10
C4	0,64	0,10	0,55	0,19	-0,17	-0,13	-0,12	0,16
C5	0,63	0,20	-0,33	-0,36	0,12	-0,20	0,23	0,30
C6	0,53	-0,59	-0,34	0,32	0,16	-0,10	0,30	0,02
C7	0,56	0,65	-0,29	-0,18	0,14	0,03	-0,22	-0,11
C8	-0,51	0,43	0,17	0,55	-0,13	0,01	-0,31	0,18
C9	0,10	0,12	-0,18	0,70	0,54	0,06	-0,29	0,19
C10	0,60	0,12	0,35	0,57	0,02	-0,06	0,24	-0,33
C11	0,30	0,12	0,75	0,00	0,43	-0,12	0,17	-0,03
C12	0,50	-0,11	0,09	-0,54	0,14	0,15	-0,49	-0,28
C13	-0,06	0,34	0,23	0,05	-0,05	0,82	0,32	-0,07
C14	-0,27	0,36	-0,69	0,08	0,46	0,07	0,17	-0,17
C16	0,59	0,64	-0,10	-0,10	-0,11	0,26	0,00	0,28

Table 3. Rotated Factor Matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
C1	0,01	-0,21	-0,02	0,05	-0,96	-0,07	0,10	0,06
C2	-0,74	0,23	0,04	-0,09	0,20	-0,30	-0,37	0,01
C3	0,84	0,07	-0,23	0,29	0,24	-0,09	0,00	0,09
C4	0,05	0,27	0,50	0,69	0,09	0,11	0,09	-0,02
C5	0,19	0,86	0,06	-0,08	-0,06	-0,19	0,02	-0,22
C6	0,89	0,10	0,27	-0,14	-0,04	0,03	-0,12	-0,25
C7	-0,15	0,74	0,11	-0,16	0,35	0,14	0,43	0,05
C8	-0,49	-0,28	-0,14	0,17	0,28	0,58	-0,34	0,15
C9	0,16	0,06	0,18	-0,20	0,02	0,92	-0,06	-0,05
C10	0,25	0,04	0,85	0,18	0,35	0,13	-0,04	0,14
C11	-0,24	0,08	0,78	0,23	-0,38	0,03	0,09	0,02
C12	0,07	0,20	0,03	0,15	-0,11	-0,14	0,91	-0,05
C13	-0,10	0,04	0,10	-0,06	-0,06	-0,02	-0,05	0,97
C14	-0,09	0,18	-0,14	-0,91	0,12	0,23	-0,09	0,05
C16	-0,07	0,84	0,04	0,18	0,22	0,11	0,09	0,35

As can be seen, the first factor is mainly loaded by sectors C2, C3, C6 and C8. The second factor shows high correlation between C5, C7 and C16, and the fourth factor points to joint movement of C4 and C14. Hence, factor one reproduces the relationships highlighted by the second factor in our previous analysis of HP cyclical component of TFPs; C2 and C8 load this factor with negatively signed coefficients and C3 and C6 with positively signed coefficients. The second factor reproduces the relationship pointed at by the first factor of our previous factor between C7 and C16, whose TFP dynamics are positively related. Finally, factor four reproduces the relationship between dynamics of TFP in sectors C4 and C14 (inversely related) pointed at by factor 3 in the analysis using HP cyclical components.

D Results of Factor analysis on sectorial TFP innovations, using MORES data set

D.1 Summary results

Factor Analysis Results, MORES
Sectorial TFP business cycle component
First-differencing

Sector	1F-R^2	2F-R^2
C1	0,1	0,59
C2	0,56	0,56
C3	0,07	0,39
C4	0,23	0,36
C5	0	0,28
C6	0,12	0,28
C7	0,05	0,17
C8	0,58	0,59
C9	0,28	0,32
C10	0,45	0,7
C11	0,36	0,45
C12	0,24	0,26
C13	0,01	0,14
C14	0,17	0,24
C16	0,17	0,45

D.2 Detailed results

Table 1. Explained % of Total Variance

Factor	Eigen Value	Pct of Variance	Cum Pct
1	3,39	22,58	22,58
2	2,39	15,95	38,53
3	2,12	14,14	52,68
4	1,76	11,72	64,39
5	1,50	10,03	74,42
6	1,07	7,10	81,52
7	0,95	6,36	87,89
8	0,74	4,91	92,80
9	0,53	3,50	96,30
10	0,24	1,58	97,89
11	0,15	0,99	98,87
12	0,12	0,81	99,68
13	0,04	0,26	99,94
14	0,01	0,06	100,00
15	0,00	0,00	100,00

Table 2. Factor Matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
C1	-0,32	0,70	0,09	-0,23	-0,35	-0,23
C2	-0,75	0,01	0,00	0,19	-0,05	0,38
C3	0,26	0,57	-0,25	0,57	0,12	0,25
C4	0,48	0,36	-0,49	0,34	-0,09	0,29
C5	-0,01	0,53	0,63	-0,14	0,13	0,02
C6	0,34	-0,40	0,52	0,42	0,38	0,10
C7	0,22	-0,35	0,47	-0,13	0,08	0,51
C8	0,76	0,10	-0,04	0,44	-0,36	-0,16
C9	0,53	-0,21	0,17	-0,56	-0,37	0,19
C10	0,67	0,50	0,09	-0,21	0,31	0,15
C11	0,60	-0,31	0,41	0,31	-0,19	-0,48
C12	0,49	-0,14	-0,34	-0,33	0,55	-0,04
C13	-0,10	0,35	0,72	0,22	-0,25	0,18
C14	-0,41	0,25	0,25	0,20	0,63	-0,31
C16	0,42	0,52	0,11	-0,43	0,13	-0,07

Table 3. Rotated Factor Matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
C1	0,20	0,48	-0,05	-0,13	-0,73	0,06
C2	-0,50	0,29	-0,01	-0,61	0,00	0,17
C3	0,12	0,11	0,88	-0,01	-0,02	0,23
C4	0,12	-0,17	0,85	0,06	-0,08	-0,17
C5	0,51	0,62	-0,11	-0,05	0,03	0,21
C6	-0,01	0,09	0,00	0,36	0,83	0,22
C7	0,11	0,19	-0,16	-0,10	0,69	-0,34
C8	0,07	0,04	0,54	0,75	0,01	-0,26
C9	0,34	-0,01	-0,22	0,16	0,13	-0,79
C10	0,85	0,00	0,35	0,09	0,13	-0,06
C11	0,00	0,09	-0,09	0,95	0,26	-0,06
C12	0,50	-0,70	0,03	0,02	0,21	0,01
C13	0,05	0,88	0,03	0,05	0,13	0,03
C14	0,11	0,13	-0,16	-0,12	0,03	0,87
C16	0,79	0,07	0,05	0,05	-0,18	-0,08

The results confirm the findings reported in the main text: There does not appear to be one aggregate factor causing observed sectorial TFP dynamics.

E Results of Factor analysis on regional TFP innovations, private productive sector, using DPRN (FBBVA)

Results obtained using extracted cyclical component of regional TFP series in the private productive sector (1965-1995) from DPRN data set show that TFP shocks are much more correlated in the regional dimension than in the sectorial dimension. To be precise, results reported below show that the first factor alone already explains around 61% of total variability contained in the regional series. Together with the second factor, they explain up to 76%, and the first three factors explain 83% of total variability. The correlation coefficients between each of the original variables and the first factor are all above 0.60 except for two regions (Asturias and Extremadura). These figures correspond to the factors from the initial extraction (no restriction is imposed such that each of the original variables -regional TFP cyclical component series- should load no more than one factor). We also report results of the factor analysis of regional series when the factors are rotated such that a clearer interpretation is obtained by imposing that each of the original variables should load only one factor. The results we obtain are noticeable: Rotation of the factors clearly splits the regions into two groups. The first group, according to the first rotated factor, corresponds to Aragón, Baleares, Cantabria, Cataluña, Valencia, Madrid, Navarra, and País Vasco. The second, according to the second rotated factor, gathers Canarias, Castilla-La-Mancha, Castilla y León, Extremadura and Galicia. The remaining regions, Andalucía, Asturias and La Rioja each load one additional factor (factor 7, factor 5, and factor 3, respectively). The striking thing is that this classification corresponds quite closely to the one established by Escribá and Murgui (1998) in their study of the regional levels of TFP in Spain during 1980-1993, using the data from MORES. For concreteness, they divide the regions into two groups: regions initially more efficient (above average measured level of TFP in the private productive sector) and regions initially lagging behind. Since their regional classification divides regions into three groups, Aragón, Cantabria and Valencia belong to an intermediate group of regions. These authors also relate this classification to the sectorial composition of output of the average region in each group: more productive regions are specialized in industrial sectors and services (business services) while lagging regions do not share this specialization.

Table 1. Explained % of Total Variance

Factor	Eigen Value	Pct of Variance	Cum Pct
1	10,42	61,27	61,27
2	2,52	14,82	76,09
3	1,23	7,26	83,35
4	0,89	5,21	88,56
5	0,58	3,39	91,95
6	0,49	2,87	94,81
7	0,28	1,64	96,45
8	0,21	1,25	97,70
9	0,17	1,02	98,72
10	0,12	0,68	99,40
11	0,08	0,49	99,89
12	0,01	0,08	99,97
13	0,00	0,03	100,00
14	0,00	0,00	100,00
15	0,00	0,00	100,00
16	0,00	0,00	100,00
17	0,00	0,00	100,00

Table 2. Factor Matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
And	0,83	0,20	-0,17	-0,05	-0,22	0,37	0,09	0,19
Ara	0,92	-0,23	0,03	0,10	0,11	-0,22	-0,08	-0,02
Ast	0,33	0,21	0,71	0,55	-0,09	0,08	0,03	-0,04
Bal	0,88	-0,02	0,23	-0,23	-0,18	-0,13	0,16	-0,10
Can	0,69	0,52	0,15	-0,39	-0,13	0,05	-0,04	-0,14
Cant	0,82	-0,38	0,23	-0,18	-0,11	0,11	-0,02	0,10
CLM	0,85	0,14	-0,20	0,28	0,06	0,16	0,26	-0,09
CyL	0,79	0,50	-0,21	-0,11	0,06	0,03	-0,14	0,14
Cat	0,93	-0,30	0,15	-0,03	-0,05	-0,14	-0,09	0,01
Val	0,96	-0,06	-0,11	-0,11	0,05	-0,16	0,01	-0,06
Ext	0,53	0,70	0,08	-0,03	0,21	-0,32	0,19	0,14
Gal	0,79	0,40	-0,11	0,32	-0,09	-0,09	-0,18	0,10
Mad	0,90	-0,20	0,30	-0,14	-0,05	0,08	-0,11	-0,03
Mur	0,79	0,28	-0,16	0,01	0,39	0,23	-0,09	-0,21
Nav	0,69	-0,63	-0,23	-0,02	0,00	-0,04	0,20	0,02
PV	0,64	-0,61	0,14	0,05	0,39	0,10	-0,04	0,13
Rio	0,68	-0,23	-0,49	0,32	-0,28	-0,11	-0,09	-0,09

Table 3. Rotated Factor Matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
And	0,36	0,39	0,33	0,26	0,06	0,21	0,70	0,03
Ara	0,79	0,35	0,40	0,08	0,14	0,17	-0,03	-0,02
Ast	0,14	0,15	0,00	0,06	0,97	0,03	0,03	0,01
Bal	0,67	0,39	0,17	0,52	0,16	0,00	0,13	0,17
Can	0,19	0,60	0,01	0,68	0,09	0,20	0,24	-0,05
Cant	0,87	0,07	0,12	0,27	0,12	0,03	0,28	-0,03
CLM	0,38	0,42	0,49	0,06	0,22	0,41	0,32	0,31
CyL	0,22	0,75	0,28	0,24	-0,03	0,30	0,34	-0,17
Cat	0,86	0,25	0,32	0,23	0,15	0,06	0,07	-0,06
Val	0,70	0,47	0,39	0,26	-0,04	0,21	0,09	0,07
Ext	0,02	0,96	0,00	0,12	0,17	0,07	0,01	0,12
Gal	0,21	0,64	0,54	0,10	0,30	0,18	0,22	-0,18
Mad	0,81	0,21	0,13	0,37	0,24	0,17	0,19	-0,09
Mur	0,34	0,50	0,20	0,16	0,04	0,73	0,17	-0,01
Nav	0,82	-0,06	0,40	-0,05	-0,19	0,05	0,13	0,27
PV	0,92	-0,04	0,03	-0,24	0,07	0,26	0,05	-0,01
Rio	0,39	0,08	0,88	0,03	-0,06	0,09	0,13	0,02

We next present the results we obtain when we use regional TFP growth rates to extract the common factors.

Table 1. Explained % of Total Variance

Factor	Eigen Value	Pct of Variance	Cum Pct
1	11,43	67,24	67,24
2	1,77	10,39	77,62
3	1,03	6,04	83,67
4	0,83	4,86	88,53
5	0,63	3,69	92,21
6	0,39	2,31	94,52
7	0,24	1,42	95,94
8	0,20	1,20	97,14
9	0,17	0,98	98,11
10	0,11	0,65	98,77
11	0,08	0,48	99,24
12	0,07	0,43	99,67
13	0,04	0,25	99,92
14	0,01	0,08	100,00
15	0,00	0,00	100,00
16	0,00	0,00	100,00
17	0,00	0,00	100,00

Table 2. Factor Matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
And	0,88	0,22	-0,09	0,07	-0,11	0,32	-0,06	-0,03
Ara	0,93	-0,22	0,02	-0,03	0,14	-0,17	0,03	0,05
Ast	0,40	0,24	0,80	0,03	0,32	0,16	0,03	0,07
Bal	0,85	0,01	0,05	0,46	-0,10	-0,09	0,02	0,17
Can	0,80	0,36	0,06	0,30	-0,27	0,11	-0,08	-0,06
Cant	0,88	-0,30	0,16	0,08	-0,15	-0,01	-0,10	-0,05
CLM	0,86	0,13	-0,02	-0,39	0,06	0,16	-0,13	-0,01
CyL	0,87	0,39	-0,19	-0,13	-0,07	-0,06	0,00	-0,09
Cat	0,91	-0,32	0,12	-0,01	0,03	-0,16	-0,12	-0,05
Val	0,95	-0,11	-0,08	-0,10	-0,05	-0,06	-0,12	-0,02
Ext	0,70	0,58	-0,05	-0,18	-0,07	-0,25	0,02	0,25
Gal	0,84	0,36	-0,07	-0,11	0,30	-0,10	-0,06	-0,14
Mad	0,87	-0,26	0,20	0,19	-0,07	-0,16	0,10	-0,17
Mur	0,87	0,24	-0,13	0,00	-0,08	0,11	0,35	-0,04
Nav	0,79	-0,50	-0,16	-0,03	-0,03	0,21	-0,05	0,19
PV	0,71	-0,49	0,13	-0,41	-0,12	0,03	0,18	0,02
Rio	0,66	-0,19	-0,42	0,28	0,51	0,06	0,05	0,01

Table 3. Rotated Factor Matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
And	0,36	0,59	0,50	0,23	0,12	0,40	0,13	0,00
Ara	0,74	0,42	0,25	0,37	0,15	-0,10	-0,01	0,00
Ast	0,13	0,18	0,15	-0,02	0,96	0,02	0,01	0,01
Bal	0,42	0,32	0,75	0,32	0,15	-0,11	0,00	-0,11
Can	0,20	0,54	0,74	0,06	0,16	0,17	0,05	0,07
Cant	0,77	0,24	0,47	0,14	0,14	0,08	-0,04	0,08
CLM	0,54	0,70	0,04	0,15	0,18	0,32	0,00	0,01
CyL	0,31	0,85	0,31	0,17	0,01	0,09	0,08	0,11
Cat	0,82	0,31	0,32	0,25	0,16	-0,04	-0,12	0,12
Val	0,70	0,54	0,31	0,25	0,02	0,10	-0,06	0,05
Ext	0,13	0,92	0,24	0,00	0,12	-0,15	-0,02	-0,19
Gal	0,27	0,79	0,16	0,38	0,25	0,02	-0,04	0,21
Mad	0,72	0,22	0,50	0,21	0,19	-0,14	0,10	0,22
Mur	0,36	0,65	0,39	0,24	0,08	0,08	0,44	0,01
Nav	0,80	0,13	0,24	0,37	-0,07	0,27	0,03	-0,21
PV	0,94	0,20	-0,04	0,00	0,08	0,07	0,22	-0,04
Rio	0,32	0,23	0,18	0,89	-0,03	0,04	0,04	0,01

Results obtained from regional TFP growth rates reproduce those obtained when we use the HP estimated cyclical component of regional TFPs, both in terms of magnitude of the common/national factor (in the range 61-67%) and in terms of the regional classification that we obtain when factors are rotated.

F Results of Factor analysis on regional TFP innovations, private productive sector, computed by first-differencing, using MORES data set

Table 1. Explained % of Total Variance

Factor	Eigen Value	Pct of Variance	Cum Pct
1	3,99	23,49	23,49
2	3,26	19,17	42,66
3	2,78	16,33	58,99
4	1,59	9,36	68,35
5	1,41	8,30	76,65
6	1,17	6,90	83,56
7	0,91	5,36	88,92
8	0,77	4,53	93,46
9	0,43	2,55	96,01
10	0,37	2,15	98,16
11	0,16	0,96	99,12
12	0,10	0,56	99,68
13	0,05	0,28	99,96
14	0,01	0,04	100,00
15	0,00	0,00	100,00
16	0,00	0,00	100,00
17	0,00	0,00	100,00

Table 2. Factor Matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
And	0,64	-0,27	-0,21	0,09	-0,16	-0,27
Ara	0,73	0,35	-0,20	-0,05	-0,04	0,14
Ast	-0,03	0,80	-0,09	-0,36	0,39	-0,12
Bal	0,70	-0,50	0,15	0,01	0,15	-0,05
Can	0,75	-0,01	0,46	-0,17	0,11	-0,16
Cant	0,28	0,71	-0,20	0,37	0,19	-0,24
CLM	0,00	0,54	-0,35	0,60	-0,36	-0,07
CyL	0,45	0,25	-0,13	-0,34	-0,57	0,40
Cat	0,42	0,36	0,51	-0,13	-0,35	-0,43
Val	0,72	-0,29	-0,40	-0,03	0,18	0,12
Ext	0,61	0,47	-0,34	-0,08	0,17	-0,03
Gal	-0,08	0,39	0,55	-0,13	0,04	0,61
Mad	0,66	0,11	0,63	0,07	0,08	0,22
Mur	0,19	-0,72	0,34	0,07	-0,16	-0,16
Nav	0,27	-0,07	0,20	0,85	0,02	0,33
PV	-0,16	0,19	0,73	0,21	0,47	-0,13
Rio	0,25	-0,37	-0,59	-0,02	0,51	0,21

Table 3. Rotated Factor Matrix

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
And	0,47	-0,01	0,11	0,26	-0,57	0,13
Ara	0,45	0,51	0,11	0,48	-0,03	0,13
Ast	-0,06	0,82	-0,08	-0,11	0,27	-0,42
Bal	0,77	-0,24	0,28	0,03	-0,24	0,08
Can	0,90	0,08	-0,13	0,02	0,01	-0,07
Cant	0,05	0,85	-0,13	-0,09	-0,14	0,31
CLM	-0,37	0,50	-0,28	0,21	-0,23	0,59
CyL	0,18	0,10	-0,13	0,89	0,17	-0,03
Cat	0,53	0,19	-0,74	0,10	-0,06	-0,08
Val	0,49	0,10	0,60	0,33	-0,32	0,07
Ext	0,33	0,71	0,17	0,30	-0,12	0,00
Gal	0,09	0,05	-0,17	0,07	0,90	0,07
Mad	0,82	0,05	-0,15	0,04	0,39	0,26
Mur	0,40	-0,70	-0,04	-0,11	-0,26	0,07
Nav	0,20	-0,06	0,10	-0,11	0,11	0,93
PV	0,25	0,07	-0,26	-0,74	0,42	0,09
Rio	0,07	0,06	0,89	0,03	-0,22	-0,03

G Sunrise-sunset diagrams statistics

DPRN 1965-1970	TFP growth over the period (%)	Absolute amount of TFP gains/losses in Million Euros from 1990 Pesetas	Cum sum of TFP gains/losses in Million Euros from 1990 Ptas	GVA by sector, 1965 in Million Euros from 1990 Ptas	Cum sum of GVA by sector, 1965 in Million Euros from 1990 Ptas	Cum sum of GVA by sector, 1965 (%)	Cumulated TFP growth over the period (%)	Cumulated TFP growth annualized (%)
C4	78,39	1.139	1.139	1.453	1.453	1,44	78,39	12,27
C10	44,44	558	1.697	1.257	2.709	2,69	62,64	10,22
C5	37,96	551	2.248	1.451	4.160	4,13	54,03	9,02
C8	34,10	1.011	3.259	2.965	7.125	7,07	45,74	7,82
C3	33,71	349	3.608	1.034	8.160	8,09	44,22	7,60
C7	30,42	381	3.989	1.254	9.414	9,34	42,38	7,32
C11	26,02	696	4.686	2.677	12.090	11,99	38,76	6,77
C13	22,95	1.139	5.825	4.964	17.054	16,92	34,15	6,05
C6	20,65	1.027	6.852	4.976	22.030	21,86	31,10	5,57
C9	17,77	818	7.670	4.602	26.631	26,42	28,80	5,19
C2	15,91	890	8.560	5.596	32.227	31,97	26,56	4,82
C16	13,64	5.312	13.872	38.937	71.164	70,60	19,49	3,63
C1	10,80	1.251	15.123	11.575	82.739	82,08	18,28	3,41
C12	-18,97	-2.253	12.870	11.872	94.611	93,86	13,60	2,58
C14	-32,62	-2.019	10.851	6.189	100.800	100,00	10,77	2,07

DPRN 1970-1975	TFP growth over the period (%)	Absolute amount of TFP gains/losses in Million Euros from 1990 Pesetas	Cum sum of TFP gains/losses in Million Euros from 1990 Ptas	GVA by sector, 1970 in Million Euros from 1990 Ptas	Cum sum of GVA by sector, 1970 in Million Euros from 1990 Ptas	Cum sum of GVA by sector, 1970 (%)	Cumulated TFP growth over the period (%)	Cumulated TFP growth annualized (%)
C3	143,28	2.442	2.442	1.705	1.705	1,27	143,28	19,46
C7	54,63	1.144	3.586	2.094	3.799	2,82	94,41	14,22
C4	41,14	1.168	4.754	2.839	6.637	4,93	71,63	11,41
C6	38,54	2.675	7.429	6.941	13.578	10,08	54,72	9,12
C10	30,66	634	8.063	2.069	15.647	11,62	51,53	8,67
C12	20,96	3.207	11.271	15.300	30.946	22,98	36,42	6,41
C5	18,68	464	11.735	2.484	33.430	24,82	35,10	6,20
C8	13,95	577	12.312	4.137	37.568	27,89	32,77	5,83
C13	11,72	905	13.217	7.725	45.292	33,63	29,18	5,25
C1	5,73	729	13.946	12.723	58.016	43,08	24,04	4,40
C16	5,53	2.855	16.802	51.658	109.674	81,43	15,32	2,89
C9	3,23	175	16.977	5.408	115.083	85,45	14,75	2,79
C11	3,19	134	17.110	4.188	119.271	88,56	14,35	2,72
C2	-26,48	-2.110	15.001	7.967	127.238	94,47	11,79	2,25
C14	-43,61	-3.246	11.755	7.443	134.681	100,00	8,73	1,69

DPRN 1975-1980	TFP growth over the period (%)	Absolute amount of TFP gains/losses in Million Euros from 1990 Pesetas	Cum sum of TFP gains/losses in Million Euros from 1990 Ptas	GVA by sector, 1975 in Million Euros from 1990 Ptas	Cum sum of GVA by sector, 1975 in Million Euros from 1990 Ptas	Cum sum of GVA by sector, 1975 (%)	Cumulated TFP growth over the period (%)	Cumulated TFP growth annualized (%)
C8	51,20	2.635	2.635	5.148	5.148	2,88	51,20	8,62
C10	16,85	540	3.175	3.204	8.352	4,68	38,02	6,66
C9	12,82	816	3.991	6.365	14.717	8,24	27,12	4,92
C2	11,91	967	4.959	8.121	22.838	12,79	21,71	4,01
C13	8,77	932	5.890	10.624	33.462	18,73	17,60	3,30
C7	8,69	328	6.219	3.777	37.239	20,85	16,70	3,14
C1	7,11	900	7.119	12.669	49.908	27,94	14,26	2,70
C4	5,74	274	7.392	4.766	54.674	30,61	13,52	2,57
C14	4,35	384	7.777	8.843	63.518	35,56	12,24	2,34
C11	3,54	196	7.973	5.525	69.042	38,65	11,55	2,21
C5	-5,01	-190	7.782	3.803	72.845	40,78	10,68	2,05
C12	-5,46	-1.265	6.517	23.153	95.998	53,74	6,79	1,32
C6	-8,23	-881	5.636	10.701	106.699	59,74	5,28	1,03
C16	-13,34	-9.008	-3.371	67.499	174.198	97,53	-1,94	-0,39
C3	-18,37	-812	-4.183	4.420	178.619	100,00	-2,34	-0,47

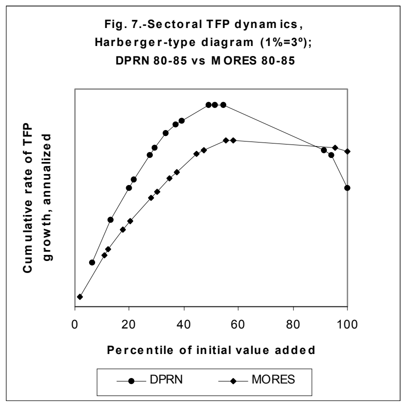
DPRN 1980-1985	TFP growth over the period (%)	Absolute amount of TFP gains/losses in Million Euros from 1990 Pesetas	Cum sum of TFP gains/losses in Million Euros from 1990 Ptas	GVA by sector, 1980 in Million Euros from 1990 Ptas	Cum sum of GVA by sector, 1980 in Million Euros from 1990 Ptas	Cum sum of GVA by sector, 1980 (%)	Cumulated TFP growth over the period (%)	Cumulated TFP growth annualized (%)
C1	28,92	3.517	3.517	12.160	12.160	6,44	28,92	5,21
C13	27,40	3.493	7.010	12.748	24.907	13,20	28,14	5,08
C14	19,63	2.486	9.495	12.661	37.568	19,91	25,28	4,61
C3	19,09	663	10.159	3.474	41.042	21,75	24,75	4,52
C6	18,13	1.902	12.061	10.494	51.536	27,31	23,40	4,30
C5	15,38	567	12.628	3.684	55.220	29,26	22,87	4,20
C8	14,62	1.153	13.781	7.885	63.105	33,44	21,84	4,03
C9	9,82	665	14.446	6.772	69.877	37,03	20,67	3,83
C10	7,77	296	14.742	3.810	73.687	39,05	20,01	3,71
C12	6,17	1.150	15.892	18.635	92.322	48,93	17,21	3,23
C7	-0,31	-14	15.878	4.470	96.792	51,30	16,40	3,08
C11	-0,56	-34	15.844	6.092	102.884	54,52	15,40	2,91
C16	-5,54	-3.847	11.997	69.453	172.337	91,33	6,96	1,36
C4	-8,16	-437	11.560	5.351	177.688	94,17	6,51	1,27
C2	-23,38	-2.574	8.986	11.009	188.697	100,00	4,76	0,93

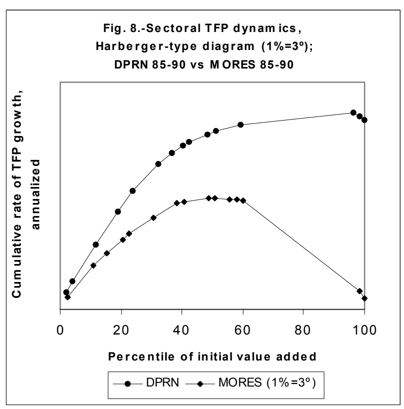
DPRN 1985-1990	TFP growth over the period (%)	Absolute amount of TFP gains/losses in Million Euros from 1990 Pesetas	Cum sum of TFP gains/losses in Million Euros from 1990 Ptas	GVA by sector, 1985 in Million Euros from 1990 Ptas	Cum sum of GVA by sector, 1985 in Million Euros from 1990 Ptas	Cum sum of GVA by sector, 1985 (%)	Cumulated TFP growth over the period (%)	Cumulated TFP growth annualized (%)
C7	50,90	2.245	2.245	4.412	4.412	2,18	50,90	8,58
C5	37,97	1.433	3.678	3.774	8.186	4,05	44,94	7,70
C14	30,15	4.758	8.436	15.780	23.966	11,86	35,20	6,22
C1	29,35	4.210	12.647	14.347	38.313	18,97	33,01	5,87
C2	26,72	2.656	15.303	9.941	48.254	23,89	31,71	5,66
C12	19,20	3.304	18.607	17.204	65.458	32,41	28,43	5,13
C8	15,37	1.358	19.964	8.832	74.291	36,78	26,87	4,88
C9	15,05	1.030	20.995	6.848	81.139	40,17	25,88	4,71
C4	8,26	381	21.376	4.613	85.751	42,45	24,93	4,55
C6	7,03	819	22.195	11.649	97.400	48,22	22,79	4,19
C11	6,65	391	22.586	5.877	103.277	51,13	21,87	4,03
C13	4,65	770	23.356	16.558	119.835	59,32	19,49	3,63
C16	1,37	1.025	24.381	74.597	194.431	96,25	12,54	2,39
C10	-12,45	-505	23.876	4.056	198.487	98,26	12,03	2,30
C3	-12,70	-446	23.430	3.514	202.001	100,00	11,60	2,22

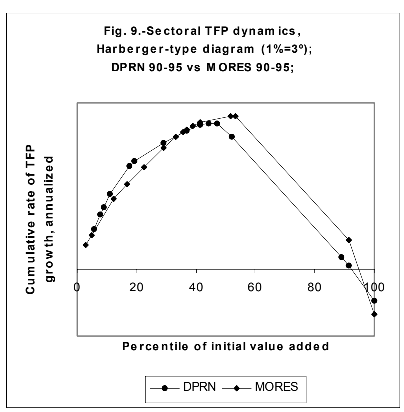
DPRN 1990-1995	TFP growth over the period (%)	Absolute amount of TFP gains/losses in Million Euros from 1990 Pesetas	Cum sum of TFP gains/losses in Million Euros from 1990 Ptas	GVA by sector, 1990 in Million Euros from 1990 Ptas	Cum sum of GVA by sector, 1990 in Million Euros from 1990 Ptas	Cum sum of GVA by sector, 1990 (%)	Cumulated TFP growth over the period (%)	Cumulated TFP growth annualized (%)
C6	21,34	3.191	3.191	14.950	14.950	5,85	21,34	3,95
C4	21,31	1.133	4.324	5.317	20.267	7,93	21,33	3,94
C3	19,09	493	4.817	2.581	22.848	8,94	21,08	3,90
C5	18,91	1.043	5.860	5.518	28.366	11,10	20,66	3,83
C1	12,84	2.116	7.976	16.482	44.848	17,55	17,78	3,33
C10	8,13	350	8.326	4.310	49.159	19,24	16,94	3,18
C12	5,15	1.321	9.647	25.641	74.800	29,27	12,90	2,46
C13	4,38	860	10.507	19.634	94.433	36,96	11,13	2,13
C8	4,12	452	10.959	10.964	105.398	41,25	10,40	2,00
C9	1,32	105	11.064	7.932	113.330	44,35	9,76	1,88
C7	-0,95	-66	10.997	7.024	120.354	47,10	9,14	1,76
C2	-8,12	-1.010	9.987	12.433	132.787	51,97	7,52	1,46
C16	-9,58	-9.042	946	94.410	227.197	88,91	0,42	0,08
C11	-10,22	-688	258	6.730	233.927	91,55	0,11	0,02
C14	-11,83	-2.556	-2.298	21.600	255.527	100,00	-0,90	-0,18

H Comparison of sunrise-sunset diagrams, using DPRN data set and MORES data set

We show below the resulting diagrams for MORES together with those for DPRN for the time intervals covered by both data sets, 1980-1985 to 1990-1995.







The following tables report the precise TFP growth rates for the 15 private productive sectors, computed using data from DPRN and from MORES. They complement the statistics presented in appendix A (Set 2. Divergence in Growth accounting exercise). The tables show the differences in the sectorial rankings for each time period.

Sectorial rankings using annualized growth rates
DPRN vs MORES, 1980-1985

DPRN		MORES	
Sector	TFP (%)	Sector	TFP (%)
C1	5,21	C5	4,42
C13	4,96	C12	4,32
C14	3,65	C10	3,81
C3	3,56	C6	3,18
C6	3,39	C7	2,70
C5	2,90	C1	2,59
C8	2,77	C3	2,43
C9	1,89	C8	2,19
C10	1,51	C11	2,19
C12	1,20	C13	1,88
C7	-0,06	C9	1,29
C11	-0,11	C14	0,87
C16	-1,13	C4	0,36
C4	-1,69	C16	-0,14
C2	-5,19	C2	-0,77

Correlation coefficient=0,56

During 1980-1985, overall performance of the private productive sector is quite similar. Total TFP improvement in the private productive sector is estimated at 1.43% per year by DPRN and 1.66% by MORES. However, the sectorial rankings are all but similar. There are only 3 sectors out of the first 6 sectors in the rankings which are the same according to both data sets, one sector whose position is quite reversed, C14, and overall the positions do not coincide. A look at the growth accounting statistics obtained using DPRN data and MORES data (see section A3 in appendix A), reveals that this difference in TFP performance derives from different output growth rates during the period. There are though some exceptions, such as sectors C7, C9, C10, C11 where the main difference between both data sets comes from the behaviour of the labour contribution to output growth. With respect to the losers, there is full coincidence.

Sectorial rankings using annualized growth rates
DPRN vs MORES, 1985-1990

DPRN		MORES	
Sector	TFP (%)	Sector	TFP (%)
C7	8,58	C7	4,95
C5	6,65	C14	4,21
C14	5,41	C2	3,22
C1	5,28	C6	2,62
C2	4,85	C5	2,95
C12	3,58	C1	2,91
C8	2,90	C13	2,08
C9	2,84	C11	0,40
C4	1,60	C12	0,38
C6	1,37	C4	-0,04
C11	1,30	C8	-0,24
C13	0,91	C9	-0,44
C16	0,27	C3	-0,60
C10	-2,62	C16	-2,32
C3	-2,68	C10	-4,50
Correlation coefficient=0,80			

During 1985-1990, overall TFP performance clearly does not coincide. According to DPRN, TFP grew by 2.98% per year, while it only increased by 1.14% per year according to MORES. The private productive output growth rates as reported by DPRN and MORES are high and similar (4.82% and 4.44%, respectively). It is the labour input contribution to output growth which makes the big difference (according to DPRN labour input increased at 0.40% per year, according to MORES, at 1.76% per year). Notwithstanding the difference in overall TFP growth, this is the time period when the sectorial rankings are closer: 5 out of 6 coincidences among the winners and 3 out of 3 among the losers, and a Pearson correlation coefficient as high as 0.8.

Sectorial rankings using annualized growth rates
DPRN vs MORES, 1990-1995

DPRN		MORES	
Sector	TFP (%)	Sector	TFP (%)
C6	3,95	C7	5,21
C4	3,94	C5	3,00
C3	3,56	C13	2,58
C5	3,52	C2	2,09
C1	2,44	C6	1,78
C10	1,58	C1	2,11
C12	1,01	C8	1,44
C13	0,86	C4	1,43
C8	0,81	C3	1,16
C9	0,26	C9	1,18
C7	-0,19	C11	0,73
C2	-1,68	C12	0,46
C16	-1,99	C10	0,08
C11	-2,13	C16	-1,59
C14	-2,49	C14	-5,04
Correlation coefficient=0,42			

During 1990-1995, overall TFP performance is quite similar. Sectorial rankings are "moderately" similar. Only three sectors out of the first 6 sectors in the rankings coincide. As for the losers, the picture is a mixed one: two sectors coincide in both classifications but two additional losers according DPRN are not, according to MORES. The position of C2 is quite disparate.

It should also be mentioned that MORES statistics show a bit more persistence than that revealed by DPRN statistics. Three industrial sectors prove to be particularly dynamic during all three time intervals as reported by MORES, C5, C6 and C7 (C5 and C6 appear also twice among the leaders according to the DPRN ranking). Among bad performers, C10 appears twice and C16 all three times, which is hopefully a common feature to both data sets, and a characteristic feature of the more recent structural evolution of the Spanish economy to which we return in detail in a related paper.

In summary, sectorial TFP dynamics computed using DPRN data set (FBBVA) and MORES data set (Spanish Ministry of Economics) do not fully reflect the same image of the Spanish economy. These differences derive from differences between both data sets in terms of both employment and output. Apart from the divergence in the levels of these variables, which is shown in appendix A, here we can focus on the rankings' correlations: The dissimilarities are higher when overall TFP performance is lower, on the contrary, the rankings are highly correlated when overall performance is positive.

I Sectorial TFP growth rates at the national level

DPRN.- TFP growth rates, annualized

	67/65	69/67	71/69	73/71	75/73	77/75	79/77	81/79	83/81	85/83	87/85	89/87	91/89	93/91	95/93
C1	1,34	2,46	4,73	-0,18	1,77	5,24	0,32	-2,70	8,12	7,16	3,50	6,87	8,65	5,45	-2,90
C2	1,50	5,99	-0,50	1,44	-13,57	-9,40	12,38	1,53	-11,05	-1,71	4,50	8,99	-3,88	0,32	-2,91
C3	2,68	7,89	3,83	9,39	24,79	-3,97	-6,78	1,35	4,48	5,26	-9,43	0,93	1,12	1,21	8,42
C4	15,07	6,06	7,73	10,12	-0,60	6,90	0,69	-10,28	1,55	-1,18	0,35	2,19	3,28	-2,81	10,97
C5	3,22	10,47	-2,32	2,92	4,37	1,06	-1,95	-1,69	1,38	7,03	11,40	3,60	-1,31	-0,31	9,30
C6	1,80	2,42	7,46	-4,44	13,99	-1,29	-1,52	-2,39	5,99	3,88	2,75	-0,46	1,23	-0,14	9,50
C7	1,75	6,59	5,51	12,23	1,70	3,37	-3,66	7,35	-2,54	-1,40	16,14	2,40	-1,60	-3,80	6,71
C8	6,78	5,48	2,49	3,04	2,13	7,37	7,88	9,02	3,37	-1,27	0,31	4,85	3,04	1,31	-0,67
C9	4,58	1,27	4,13	-2,88	2,56	4,96	-1,17	5,33	6,07	-3,96	2,92	3,73	0,17	-2,69	3,72
C10	4,65	5,83	10,17	3,76	1,67	2,81	5,13	-0,98	4,79	-0,61	0,53	-5,29	-0,40	-5,14	8,86
C11	1,03	4,96	7,46	1,59	-4,25	2,48	3,50	-8,03	5,06	-1,78	5,82	-4,03	3,43	-3,45	-3,81
C12	-2,36	-1,23	-1,21	7,82	0,63	1,49	-2,55	-3,60	3,62	1,47	3,43	2,23	2,52	-1,48	2,70
C13	2,58	4,15	4,85	4,12	-1,40	1,71	0,44	4,87	3,71	5,37	-0,44	2,46	0,65	0,84	0,76
C14	-7,83	-3,51	-0,33	-12,92	-3,08	-3,64	-1,98	15,50	-3,45	3,18	8,05	5,31	-2,37	-8,89	3,58
C16	1,96	3,22	0,44	3,09	-0,96	-2,29	-3,92	0,92	-2,10	-0,93	2,54	-0,82	-1,52	-2,64	-0,35

Table A1. Sectoral TFP growth rates, DPRN data set (1965-1995)

MORES, TFP growth rates, annual

	81/80	82/81	83/82	84/83	85/84	86/85	87/86	88/87	89/88	90/89	91/90	92/91	93/92	94/93	95/94
C1	-6,82	-0,50	5,17	10,47	4,76	-3,18	12,06	3,67	-2,74	5,09	6,30	4,02	5,12	-0,74	-3,66
C2	-0,98	-3,64	-4,87	3,37	2,39	1,89	-0,55	7,44	4,69	2,52	3,78	1,77	1,56	3,94	-0,55
C3	2,42	3,67	6,56	4,70	-5,12	-13,71	4,48	9,97	4,83	-8,56	-0,30	-6,47	-5,65	10,76	7,52
C4	-1,83	2,61	5,38	-0,95	-3,15	-3,56	0,98	1,64	-1,47	2,23	-0,94	-2,94	0,97	6,74	3,42
C5	5,81	1,60	2,39	7,24	5,08	3,11	11,21	5,39	-0,45	-4,86	-0,55	4,10	6,79	0,83	3,63
C6	4,71	2,95	0,76	5,06	2,50	11,54	-1,05	1,01	0,65	0,21	-0,57	0,69	-3,83	6,38	6,25
C7	0,80	0,77	10,99	-3,50	4,60	18,81	4,49	4,76	0,13	-4,48	2,88	3,62	6,48	4,42	8,71
C8	3,42	3,69	4,37	1,53	-2,16	-0,48	1,48	-0,47	-1,65	-0,03	1,50	2,54	-2,36	4,91	0,62
C9	0,62	2,62	3,60	-0,39	0,16	2,56	-1,51	-1,92	1,17	-2,46	-0,15	3,27	3,79	2,09	-2,89
C10	1,17	0,97	6,07	5,72	5,33	-3,63	-0,40	-6,82	-5,09	-5,36	-3,44	-5,76	1,96	5,26	2,53
C11	3,67	6,37	1,66	2,71	-3,26	5,20	1,56	-3,24	-1,72	0,10	-0,24	4,09	-3,35	1,67	1,53
C12	6,63	4,18	4,31	-0,24	7,29	0,18	-1,67	-0,26	1,45	2,12	-1,08	-1,27	1,56	2,56	0,67
C13	1,18	-0,81	1,14	5,53	2,25	2,63	3,91	1,97	1,90	-0,23	0,47	5,18	0,99	3,92	2,05
C14	-1,14	0,11	-2,26	6,23	1,35	3,37	5,98	6,17	3,78	0,97	-5,04	-8,36	-4,69	-7,80	0,37
C16	-1,71	-0,21	0,51	2,47	-1,69	-1,76	-2,51	-2,46	-1,92	-2,29	-2,35	-2,89	1,20	-1,27	-2,26

Table A2. Sectoral TFP growth rates, MORES data set (1980-1995)