THE SPANISH ECONOMIC «MIRACLE»: A DISAGGREGATED APPROACH TO PRODUCTIVITY GROWTH, 1958-1975*

M.ª TERESA SANCHÍS LLOPIS
Universidad de Valencia[a]

RESUMEN

En este trabajo se analizan las fuentes del crecimiento español durante 1958-1975 desde una perspectiva sectorial, siguiendo una metodología similar a la desarrollada por Jorgenson, Gollop y Fraumeni (1987). Para ello se mide la contribución de los inputs intermedios, el capital, el trabajo y la productividad total de los factores al crecimiento del output total para 25 ramas productivas. Los resultados atribuyen más de la mitad del crecimiento del *output* al crecimiento de la Productividad Total de los Factores. Este crecimiento de la productividad fue de alcance general aunque no estuvo uniformemente repartido y se apoyó en una potente contribución de algunas industrias manufactureras compartida con avances significativos en los transportes y en las comunicaciones.

Palabras clave: Productividad, análisis sectorial, cambio tecnológico, España, 1958-1975

---

* This work was presented and discussed at the II[nd] Iberometrics Conference held in Sigüenza (Spain) in March 2005. The author is grateful to Joan R. Rosés, and Leandro Prados for their comments and the introduction to Jorgenson_s literature, and to Antonio Cubel, Jordi Palafox and two anonymous referees for their comments on the paper. However, any errors are exclusively my own responsibility. The Spanish Ministry of Education (Grant SEC 2002-01595) supports this research.

[a] Departamento de Análisis Económico, Facultad de Economía, Avda. dels Tarongers, s/n, Edificio Departamental Oriental, 46022 Valencia (Spain) and Instituto Laureano Figuerola (Universidad Carlos III). E-mail: m.teresa.sanchis@uv.es.

ABSTRACT

This paper exploits sectorial growth accounting methodology in a similar way to Jorgenson, Gollop and Fraumeni (1987) in order to provide additional insight into the sources of Spanish economic growth. We measure the contribution of intermediate inputs, capital, labour and total factor productivity to the increase in total output for 25 productive branches. We also analyse sectorial contributions to overall productivity growth and discuss the role of pioneering sectors in the whole transformation. The findings presented attribute more than fifty per cent of output growth to improvement in TFP. This productivity growth was unevenly distributed and was fuelled by some potent manufacturing industries together with advances in transportation and communications.

Keywords: Productivity, industry level, technological change, Spain, 1958-1975

JEL classification: N64, O47, O14

1. INTRODUCTION

Looking back over the course of Spanish economic history, 1960 to 1975 was a period of exceptional rates of output and productivity growth, substantially higher than those of the preceding and subsequent decades [1]. Whether the foundations of this spectacular growth were broad or narrow has not been discussed until now [2]. For this reason, we believe it is worth going a step further in order to comprehend the great upsurge in the Spanish economy over this period by analysing the sectorial origins of productivity growth. This paper seeks to answer the question of whether the advances in productivity were related to specific technological change or were more broadly based. For this purpose a further strand of results obtained from a disaggregated approach to growth accounting methodology is added to the available evidence.

Technology is not easily measurable, partly because of the characteristics of the phenomenon itself: technological advances take many different forms, each with their own field of appliance, magnitude and diffusion speed. One traditional way of measuring them is indirect and builds upon the concept of a production function. In this case, the rate

[1] Prados de la Escosura and Rosés (2005).

[2] Industry interdependence for the years 1962-1970 has only been analyzed in the work of Martín, Romero and Segura (1981) using an input output approach as suggested by Hirschman.

of technological change is approximated by the residual of output growth after subtracting the rates of input growth weighted by their shares in income. The drawbacks of this method for measuring growth are well known [3]. With regard to the residual, it is important to underline that it not only measures technological change but also other sources of growth not taken into account by the growth rates of the conventional inputs.

For the case of Spain, there are several pioneering studies which analyse the sources of growth at an aggregate level [4]. It is worth highlighting the general consensus arising from all of them with regard to the prominent role attributed to Total Factor Productivity (TFP) in explaining output growth. In the research employing a growth accounting approach, some works have tried to reduce the residual by taking into account improvements in input quality. For example, Myro (1983) for 1965-1981 and Cebrián (2000) for 1963-1973 offer analyses based on a translog production function in which changes in capital and labour quality are distinguished from changes in capital stock and changes in hours worked. Myro (1983) considers that around half of total Value Added growth between 1965 and 1973 could be attributed to TFP growth, while Cebrián (2000) obtains a higher contribution of TFP of around 2/3 of total output growth. In both cases the contribution of the residual remains high after being purged of changes in capital and labour quality. In the same line, Prados and Rosés (2005) compute the contribution of factors and TFP to economic growth in the long run for 1850 to 2000. These authors also consider that the success in growth during the Golden Age in Spain was largely determined by TFP growth. All these results are in line with those obtained for other countries over the same period, where the measured residual quite often accounted for more than half the output growth observed, while traditional inputs typically fell well short of this share.

So where do TFP improvements come from? In the case of a backward country such as Spain, understanding where TFP growth came from seems a good way of identifying the channels of technological transfer. In general, the significant role played by the residual when it comes to explaining growth after World War II has been subsequently interpreted as reflecting a shift to a knowledge-based type of economic

[3] It depends heavily on the concepts of constant returns to scale and equilibrium factor markets.

[4] Following a «parametric» or growth accounting methodology: Myro (1983), Cebrián (2000) and Prados de la Escosura and Rosés (2005). There are other works which employ a non-parametric approach and also attribute a prominent role to productivity growth or to technological change: Perez, Goerlich and Mas (1996) for 1964-1991, Suárez Bernardo de Quirós (1992) and Raymond (1995) for 1961-1991.

development [5]. But more recently, the end of century uptick in the United States has focused attention on what caused the growth of the residual to accelerate and how much of it could be laid at the feet of specific technologies (IT). In this line, with reference to the acceleration of TFP growth during the interwar period in the United States and during the Golden Age in Europe, some authors have characterized it by advances across a broader set of sectors in the economy including some industrial branches, transportation, communication and public utilities [6].

The main aim of this article is to reconsider the role attributed to inputs and productivity in the explanation of overall output growth by taking a disaggregated growth accounting approach. We will integrate the growth of intermediate, capital and labour inputs in each individual industrial sector into an analysis of the sources of growth for the economy as a whole following the methodology developed by Jorgenson, Gollop and Fraumeni (1987). We consider this methodology essential in order to locate improvements in productivity in particular industries and to discover why the growth of the residual accelerated in the sixties and the degree to which specific technological change could have been responsible. The main reason is that the relationship between technological change in the strict sense of the expression and productivity is closer at sector level than at aggregate level, bearing in mind that technological progress has a differential impact on different sectors. At a level of individual industries it is possible to observe whether the whole span of modernizing sectors was broad or narrow and examine whether or not technological change in pioneering sectors played a prominent role in the changes experienced during these years [7].

The results of our analysis of sectorial productivity show that the so called «Spanish Economic Miracle» arose, to a great extent, from swift progress in technology in specific industries. The «leading» industries, in terms of their large contribution to overall productivity growth, were those that had fallen well behind their counterparts in advanced countries. These were the technologies developed in the United States in the first quarter of the twentieth century and which spread through Europe

[5] Abramovitz (1956); Solow (1957).

[6] Harberger (1998); Field (2006).

[7] The debate surrounding the British Industrial Revolution during the first half of the 19th century is an excellent reference point in the examination of the sectorial dynamics of economic growth, especially with regard to the role played by the modernizing sectors. Technological change and the interindustry linkages and spillover effects of modernizing sectors are at centre of this debate (Crafts and Harley (1992). O'Brian (1993) considers these effects insufficient, while in a recent paper, Oxley and Greasley (2000), adopted an intermediate position.

after World War II. However, our results go further by revealing that technical progress also had a widespread effect on most of the economy, as most of the remaining industries experienced positive and significative rates of productivity growth. This means that individual industries were influenced in a variety of ways by technological change coming from the most modern industries but also by other types of spillover effects and improvements in efficiency.

This article is organized as follows. In section 2.1 we summarise the method developed by Jorgenson *et al.* (1987) for attributing the sources of economic growth to industry level. In section 2.2 we present the statistical sources employed for measuring labour, capital and intermediate input and discuss possible problems of underestimation of inputs. In section 3.1 we present the decomposition of aggregate output growth between growth in capital, labour and intermediate inputs and changes in productivity and discuss the contribution of each input to individual industry output growth. In section 3.2 we measure aggregate productivity growth by means of explicit aggregation over the industrial sector taking a Domar approach into consideration. In section 4 we also discuss whether the group of modernizing sectors was narrow or broad and if technological change in pioneering sectors and their interindustry linkages played a prominent role in the changes experienced during these years. Section 5 offers the concluding remarks. See Appendix for data sources.

2. METHODOLOGY AND SOURCES

2.1. Methodology

This section summarises the methodology developed by Jorgenson *et al* (1987) for allocating the sources of economic growth to industry level [8].

Analysis of the sources of growth at industry level is based on the decomposition of the sectorial output growth rate into the sum of the contributions of intermediate, capital and labour inputs and productivity growth. The contribution of each input is the product of the value share of the input and its growth rate. The methodology for productivity measurement which underlies the disaggregated approach is a homogeneous production function *(F)* for each of the *n* industrial sectors. The production function for the *i*th industry gives the quantity of output, Z_i,

[8] As summarised by Jorgenson, Gollop and Fraumeni (1987) and Jorgenson (1995), chapter 1.

as a function of the primary inputs, capital services (K_i) and labour services (L_i), intermediate inputs (X_i) and the level of technology (t):

$$Z_i = f_i\,(K_i,\, L_i,\, X_i,\, t) \qquad\qquad i = 1....n \qquad [1]$$

where all inputs are measured as service flows rather than stocks. Under the assumptions of constant returns to scale and the exhaustion of the value of output by the value of inputs, the growth accounting equation for each sector is,

$$d1nA_i = d1nZ_i - v_{ki}d1nK_i - v_{li}dnL_i - v_{mi}1nX_i \qquad [2]$$

where v is the average share of the subscripted input in the i sector and A_i is industry productivity. Note that equations [1] and [2] define industry-level productivity in terms of industry gross output rather than value-added [9]. This has several advantages, as highlighted by Jorgenson. First, it provides an explicit role for intermediate goods in allocating economic growth at industry level. Second, it avoids the condition needed for the existence of an aggregate production function. As Jorgenson *et al.* (1987) show, this condition is not consistent with the empirical evidence because the share of factors is very different at an individual industry level. Finally, the sources of growth can be identified at individual industry level, thus providing a more detailed understanding of the forces driving aggregate trends.

The augmentation factor A_i represents the growth in output not explained by input growth and is conceptually analogous to the TFP concept used in aggregate accounts. It represents any kind of efficiency gains, technological progress, scale economies and measurement errors which allow more measured gross output to be produced from the same set of measured inputs. We refer to this term as «industry productivity» to distinguish it from TFP, which is estimated from the value added concept.

The shares of intermediate (v^i_X), capital (v^i_K) and labour (v^i_L) inputs in the value of the output can be defined by,

$$v^i_X = \frac{p^i_X X_i}{q_i Z_i}, \qquad v^i_K = \frac{p^i_K K_i}{q_i Z_i}, \qquad v^i_L = \frac{p^i_L L_i}{q_i Z_i} \qquad [3]$$

[9] An aggregate production function gives value-added as a function of aggregate capital and labour inputs, so that intermediate inputs are excluded. As a consequence there is a conceptual distinction between industry productivity (which takes into account intermediate inputs) and aggregate productivity (which only considers capital and labour). For this reason and because there are reallocations of factors between sectors, aggregate productivity growth can differ from the weighted sum of sectorial productivity changes.

where q_i, p^i_k, p^i_L, and p^i_X denote the prices of output, capital, labour and intermediate inputs, respectively. Under constant returns to scale the elasticities and the value shares for all three inputs add up to unity, so that the value of output is equal to the value of the inputs.

For every sector, each of the inputs is an aggregate which depends on the quantities of individual intermediate, capital and labour inputs. Where X_{ij} is the set of n intermediate inputs from the *j*th sector (j=1...n), K_{ki} the set of *p* capital inputs and L_{li} the set of *q* labour inputs. The shares of the individual intermediate (v^i_{Xj}), capital (v^i_{Kk}) and labour inputs (v^i_{Ll}) can be defined in the values of the corresponding aggregates by,

$$v^i_{Xj} = \frac{p^i_{Xj}X_{ji}}{p^i_X X_i} \qquad (i,j = 1...n)$$

$$v^i_{Kk} = \frac{p^i_{Kk}K_{Ki}}{p^i_K K_i} \qquad (i = 1...n;\ k = 1,...p) \qquad [4]$$

$$v^i_{Ll} = \frac{p^i_{Ll}L_{Li}}{p^i_L L_i} \qquad (i = 1...n;\ l = 1,...q)$$

So the increase in the quantities of services offered by each input depends on the increase in the quantities of its components and the change in the input value share of any component. The growth rate of each input between two periods is a weighted average of the growth rates of its components. Weights are given by the average share of each component in the value of the input for the two periods.

Similarly, the translog index of productivity growth is the difference between the growth rate of output and a weighted average of growth rates of intermediate, capital and labour inputs.

2.2. Input measurement

Labour input: Sources and method

The appropriate measure of labour input is the flow of services emanating from this factor which can be considered proportional to the hours of work. An accurate measure of labour services would require the taking into account of as many attributes of the labour force as possible in order to capture its heterogeneity and improvements in workers' skills. Differences in the services offered by any labour category are a consequence of their differences in marginal productivity and can be reflected in differences in labour compensation per hour in any employ-

ment category. These differences in marginal labour productivity by workers are obtained through a process of education or qualification in the workplace. Therefore, if we take into account as many attributes of the labour force as possible we can better capture the changes in labour force quality and in turn, the contribution of labour input to growth.

The first step towards developing this measure of labour input is to construct employment matrices cross-classified by sex, age, education and employment status for each year. The *Instituto Nacional de Estadística* offers a survey called *Salarios* which contains information on hours worked and average labour compensation per hour for fourteen industrial branches, construction and three service branches [10]. Data are classified in two employment categories, skilled and unskilled workers, with at least five salary levels in each category. Information on other classification categories such as sex, age or education is not available. This lack of attributes could bias the sectorial measures of labour input due to the fact that changes in labour quality are poorly considered. Changes in labour input could be undervalued, especially in those sectors which move into the group of qualified workers in favour of a greater presence of human capital [11].

Despite being the most comprehensive statistical source, with the greatest number of attributes by sector and labour categories, *Salarios* also has some drawbacks. Firstly, this source has been criticised for only including companies of a certain size thus excluding much of the activity in sectors where small companies predominate. This bias in the collection of data seriously undervalues the evolution of employment in some activities. For this reason, we decided it was appropriate to cross the survey information with total employment data collected by Alcaide and published by the *Fundación BBVA*. Consequently we proceeded in the following way. Firstly, we distributed total employment by sector from *BBVA* sources in two broad categories, skilled and non skilled labour. With this information we can break down the total employment by sector published by the *Fundación BBVA* into two large categories.

The second disadvantage of the *INE* survey is that data have only been available since 1964. So for the previous years, 1958-1962, we

[10] Industrial branches: «coal mining», «metal mining», «non-metal mining», «food and tobacco products», «textile mill industries», «clothing and footwear», «furniture and fixtures», «paper products», «printing and publishing», «rubber and plastic industries», «chemical products», «Coal and crude oil derivatives», «Manufactured metals, industrial machinery and equipment, transport equipment», «construction», «trade», «banking and finance» and «insurance».

[11] Prados and Rosés (2005) also reach this conclusion. They consider that for the last quarter of the twentieth century their labour quality index based on data from *Salarios* could have underestimated the improvement in human capital as reflected by data on education.

used the *Fundación BBVA* series on labour costs which contains data since 1955. This source has also been used for agriculture for the whole period.

The final step in constructing data on labour input for each of the sectors is to combine price and quantity data. With the data on the average labour cost for each category obtained in the *Salarios* survey, we calculate v^i for each sector in order to measure how changes in the quality of employment affected the evolution of labour input. To construct a labour input index for each sector, sectorial labour input, L_i, is expressed as a translog function of its individual components, L_{li}.

The corresponding sectorial labour input index is a translog quantity index of individual labour inputs,

$$L_i\,(t) - L_i\,(t-1) = \sum_l \overline{v^i_{Ll}}\,(L_{li}(t) - L_{li}(t-1)) \qquad [5]$$

Where weights are given by the average shares of each component in the value of sectorial labour compensation

$$\overline{v^i_{Ll}} = \frac{1}{2}\left[v^i_{Ll}(t) + v^i_{Ll}(t-1)\right] \qquad [6]$$

and

$$v^i_{Ll} = \frac{p^i_{Ll}L_{li}}{\sum_l p^i_{Ll}L_{li}} \qquad [7]$$

The value shares are computed from data on hours worked (L_{li}) and wages per hour (p^i_{Ll}) for each component of sectorial labour input cross-classified by employment category. Thus, growth in labour input reflects the increase in labour hours as well as changes in the composition of hours worked as firms substitute from heterogeneous types of labour, although we are aware of the fact that our data do not capture changes in labour quality very effectively.

Capital input: data sources and method

Jorgenson and Griliches (1967) approached the construction of capital input in the same way as that outlined in the previous section for data on labour input. This approach is based on estimates for different types of capital goods (e.g.: machinery and equipment, transport equipment, structures and so on) using the perpetual inventory method and com-

bining price and quantity data, cross-classified by type of asset into price and quantity indexes of capital input. The corresponding sectorial capital input index is a translog quantity index of individual capital inputs,

$$K_i\,(t) - K_i\,(t-1) = \sum \overline{v^i_{Kk}}\,(K_{Ki}(t) - K_{Ki}(t-1)) \qquad [8]$$

where weights are given by the average shares of each component in the value of sectorial capital property compensation

$$\overline{v^i_{Kk}} = \frac{1}{2}\left[v^i_{Kk}(t) + v^i_{Kk}(t-1)\right] \qquad [9]$$

and

$$v^i_{Kk} = \frac{p^i_{Kk}K_{Ki}}{\sum p^i_{Kk}K_{Kki}} \qquad [10]$$

where p^i_{Kk} represents the rental price of capital services. The key innovation provided by the capital input quantity indexes developed by Jorgenson and Griliches (1967) involves the aggregation of different types of capital using rental prices as weights. Rental prices are identified with the marginal product of different types of capital which give a good measure of the services of different kinds of capital. The rental price is derived by Jorgenson and Hall (1967) under profit maximisation using capital accumulation identity and the assumption of no adjustment cost for capital:

$$p_k(t) = p_i(t-1)r(t) + \delta 1 p_i(t) - \left[p_i(t) - p_i(t-1)\right] \qquad [11]$$

where $p_k(t)$ is the rental price, $p_i(t)$ is the investment price of the capital good I, $\delta 1_i$ is the depreciation rate for the capital good *i*, *r* is the nominal rate of return, and the expression in brackets represents the revaluation of the asset. Equation [11] implies that short duration capital goods, like machinery, with longer amortization rates will tend to have higher rental prices than structures and hence (see equation [10]) higher weights in capital input. Similarly, those capital goods more affected by technological change will be more sensitive to relative price declines and hence to negative revaluation [12]. The consequence will be higher rental prices for those capital goods which embody more technological change and hence greater weight in the input capital index.

[12] Hulten (1992); Greenwood, Hercowitz and Krusell (1997).

The first step towards developing sectorial measures of capital input is to construct estimates of capital stock by industry. Data on capital stock at sectorial level are taken from the *El stock de capital en España y su distribución territorial* (2005) database published by *Fundación BBVA*. The advantage of this source is that it provides estimates of both net capital stock and gross investment for different sectors and it estimates different depreciation rates for every sector [13]. The main difficulty in constructing «input capital» at a sectorial level for the Spanish economy is that we cannot break down the aggregate capital stock for each sector into its components because there are no disaggregated series of gross fixed capital formation by sector. While we can break down the sectorial capital stock into machinery and equipment and structures at a point in time, 1980, it is not possible to reconstruct the individual progress of every kind of capital by industry [14]. For this reason the growth of «capital input» is assumed to be proportional to the growth of the aggregate capital stock for every sector.

This assumption implies not taking into account differences in economic obsolescence of assets directly related with rapid technological change that could significantly influence the evolution of capital services. In the period 1959-1966 there was a rapid decline in the relative prices of machinery and equipment compared to the prices of other investment goods [15]. As a result, we suppose there was an increase in machinery rental prices which could have marked a greater presence of machinery and equipment in the capital input. For this reason we suspect that the contribution of «capital input» to growth in the most intensive sectors in terms of machinery and equipment investment, and hence more exposed to technological change, could be underestimated [16]. This

[13] Agriculture; fisheries; energy products; metal mining; primary metals; non-metallic mineral mining; chemicals and allied products; fabricated metal products; agricultural and industrial machinery; electrical machinery; transportation equipment; food and kindred products; tobacco manufactures; textile mill products; apparel and other textile products; printing, publishing and other paper products; rubber and plastic products; lumber, wood products and furniture; construction; hotels and restaurants; transportation; communications; finance and insurance; other services.

[14] A monograph published by the *Ministerio de Industria y Energía* (1980) offers information on the coefficients of capital for different branches of Spanish industry.

[15] Cubel y Sanchis (2005) present data on the relative prices of machinery and equipment for Spain and relate the sharp decline during the sixties with the increasing share of machinery imports in machinery and equipment investment. These imports came from the most advanced countries. These countries presented lower relative prices for capital than Spain.

[16] Recently, numerous works have revisited the hypothesis of technical change embodied in new capital. Although the results are not conclusive and depend to a large extent on the assumptions made and on the historical moment analysed, there seems to be some consensus on its relatively limited impact [Hulten (1992), Crafts (2004a and 2004b)].

suspicion is reinforced by the fact that Spain doubled its rate of investment in machinery and equipment in the sixties.

Intermediate inputs: method and data sources

Intermediate inputs are treated in the same way as labour inputs. Data on interindustry transactions published in the Spanish Input-Output Tables for 1958, 1962, 1970 and 1975 have been used to disaggregate intermediate input by sector of origin. In order to bring intermediate input measures into line with industry definitions from the Spanish National Accounts classification, data on input-output tables have been aggregated as described in the Appendix. Intermediate input quantity indexes by sector of origin have been constructed by deflating the value of intermediate input originating in each sector by a producer price index for each sector output. This was achieved by using the Tornqvist index, which is commonly used to measure volume changes for productivity measurement purposes [17].

An industry's intermediate input, (X_i), is expressed as a translog function of its n individual components (X_{ji}),

$$X_i\,(t) - X_i\,(t-1) = \sum_j \overline{v^i_{Xj}}\,(X_{ji}(t) - X_{ji}(t-1)) \qquad [12]$$

where weights are given by the average shares of each component in the value of sectorial intermediate outlay

$$\overline{v^i_{Xj}} = \frac{1}{2}\left[v^i_{Xj}(t) + v^i_{Xj}(t-1)\right] \qquad [13]$$

and

$$v^i_{Xj} = \frac{p^i_{Xj}X_{ji}}{\sum_j p^i_{Xj}X_{ji}} \qquad [14]$$

The value shares are computed from data on intermediate input consumption (X_{ji}) and the corresponding prices paid by the receiving sectors (p^i_{Xj}) for each component of sectorial intermediate input. Appendix A describes how intermediate inputs consumptions are deflated.

[17] The Tornqvist index is a discrete-time approximation to a Divisia index which takes into account share changes over time. When the production possibilities being analysed can be represented by a homogeneous translog function, as is the case, the Tornqvist index provides an accurate measure of the underlying theoretical volume index.

Output: Sources and coverage

Constructing data for sectorial productivity growth requires output to be correctly valued. Jorgenson suggests the concept of valuation from the producer's point of view. This concept is half-way between the national accounting concepts of valuation at market prices and valuation at factor cost. The value of output at market prices includes taxes paid by producers and excludes any subsidies they receive. Output value at factor costs excludes these taxes and includes subsidies but intermediate inputs include taxes paid by producers for each input. Thus valuation from the producers' point of view is the best way to integrate output and input data into productivity measures at sectorial level.

In general, output value has been taken from Input-Output Tables. The level of aggregation and the classification of activities are different in all the tables (1958, 1962, 1970 and 1975) and therefore correspondences between tables must be established first. In some cases it is easy to find some inconsistencies between two consecutive tables with respect to the input and output growth rates. For this reason control totals for output value are made. We checked the output growth derived from Input-Output Tables with Value Added growth by sector from the Spanish National Accounts.

We have considered most of the sectors in the National Accounts and Input-Ouput Tables and have excluded public sector and private households output. This was because their output is defined as labour input (public sector) or is set equal to a capital and labour input index (private households). In both cases, productivity growth is zero by definition. Thus, excluding these two sectors, the degree of coverage of the sectors considered in the analysis is 89 per cent of the Added-Value at factor costs for 1958, 80 per cent for 1962, 76 per cent for 1970 and 74 per cent for 1975.

3. SOURCES OF INDUSTRY GROWTH, 1958-1975

3.1. Sources of industry growth

In this section, we present the decomposition of aggregate output into capital, labour and intermediate input growth and changes in productivity (Tables I, II and III). Calculations have been made for three sub periods, 1958-1962, 1962-1970 and 1970-1975 in order to exploit information on intermediate consumption and total output from successive input-output tables (1958, 1962, 1970 and 1975) more accurately.

To explore the changing sectorial contributions to aggregate TFP advance, we need first to consider how the structure of the economy has

evolved. An examination of the sectorial distribution of the value added reveals that the shares of all goods-producing sectors of the economy, with the exception of agriculture, increased during 1958-1975. Agriculture fell from 22 per cent to 12 per cent. Meanwhile, industry increased from 22.4 per cent to 35 per cent and services remained unchanged, but with important composition changes. Within manufacturing, «machinery and equipment», «transport equipment», «chemicals and allied products» and «rubber and plastic products» recorded the largest share increases between 1958 and 1975, while the share increases in «textiles» and «clothing and leather goods» were more modest [18]. The changing composition of output is the result of rapid output and productivity growth in some sectors combined with slow rates in others.

Productivity variation rates compiled in Tables *I, II* and *III* are noticeably higher than those obtained by the same author in a previous paper [19]. These new results are more consistent with output growth and are similar to aggregate productivity growth obtained by other authors for a similar period [20]. The results show the importance of high technology industries like «machinery and equipment», «motor vehicles and transportation equipment», «chemical products» and «electric utilities» which grew rapidly in both output and productivity. It also highlights the growth of productivity witnessed by «rubber and plastic industries» after 1962. The sectors which grew slowly include most services, «food and tobacco products», «textile mills products» and «clothing and footwear», «lumber, wood and furniture» and «primary metals» which display below-average output growth and low or even negative productivity growth.

The results presented also highlight a wide variation in output and productivity growth between industries. The growth rate of total output ranges from 1.5 per cent in «railroads» to 23 per cent in «motor vehicles

[18] See Sanchis (2000), chapter 2 for more details about sectorial decomposition of output at two digit level for 1954-1975.

[19] Sanchis (2001) carried out a similar application for sectorial productivity growth, using a «dual approach», in which variations in productivity were obtained from changes in goods prices with relation to factor prices, while output and input quantities were considered fixed at a base year. The calculations presented in this research have been obtained using the «primal approach», in which input prices remain constant throughout the entire period, while changes in output and input quantities are computed. In theory, these two approaches should give similar results under the assumption of perfectly competitive markets of goods and factors. However, markets are not perfectly competitive and price changes do not usually register overall productivity increases. Therefore, the «dual approach» tends to undervalue productivity growth unlike the «primal approach».In this paper we employ the primal approach.

[20] Myro (1983), Suárez (1992), Cebrián (2000), Serrano and van Ark (2001). Gandoy (1987, 1988) carried out global productivity estimates for 28 industrial branches in the period 1964-1974 obtaining a higher result (6.5 per cent for total industry).

TABLE 1
SOURCES OF OUTPUT GROWTH BY INDUSTRY, 1958-1962

	Output growth (1)	Contributions to Total Output Growth			
		Inter-mediate (2)	Labour (3)	Capital (4)	Product. growth (5)
Agriculture	10.98	7.26	–1.07	3.64	1.15
Energy, not including electricity	18.09	9.60	0.31	3.64	4.54
Electricity, gas and water	10.27	0.09	0.36	1.52	8.30
Metal and non-metallic mining	7.46	2.30	0.52	1.61	3.03
Primary transformation of metals	17.25	13.24	0.34	2.08	1.59
Non-metallic minerals industry	14.84	3.83	1.22	0.83	8.55
Chemical industries	16.77	7.50	0.28	0.42	8.49
Industrial machinery and equipment	19.29	6.41	2.11	1.55	9.22
Transport equipment	22.93	13.27	4.76	0.84	4.06
Food and tobacco products	7.97	5.90	0.19	2.64	–0.76
Textile mills products	6.40	4.38	0.35	0.09	1.58
Clothing and footwear	12.68	8.13	0.34	0.07	4.15
Lumber, wood and furniture	3.43	2.81	0.62	0.07	–0.07
Paper products and printing	15.73	9.82	0.80	0.10	5.01
Rubber and plastic	39.50	29.26	1.32	0.52	8.40
Miscellaneous manufacturing	23.67	12.02	0.00	4.88	6.77
Construction	8.31	6.32	0.95	2.12	–1.08
Trade	6.63	1.55	2.17	1.97	0.95
Hotels, restaurants and bars	13.93	6.55	0.79	2.35	4.24
Railroad transport	1.50	2.27	1.95	2.43	–5.15
Land transport	16.6	9.59	1.73	5.36	–0.68
Sea transport	8.29	5.99	1.85	0.96	–0.51
Air transport	24.02	24.84	1.45	1.55	–3.82
Communications	13.20	1.47	2.44	1.64	7.65
Financial institutions	5.33	0.04	1.12	5.00	–0.84

Sources: Author's calculations from 1958 and 1962 Input-Output Tables (for total output, intermediate inputs and inputs shares in total output), Fundación BBVA (for labour and capital input), INE (*Contabilidad Nacional...* for Value Added and *Salarios* for classification of labour input by changes in labour quality).

Notes: (1) Annual cumulative rates of growth for total output in percentage points; (2), (3) and (4) annual cumulative rates of growth for intermediate, labour and capital weighted by their respective share in industry output; (5) TPF growth is equal to the growth of output (1) less the share-weighted growth of inputs [(2)+(3)+(4)].

and transportation equipment» in 1958-1962, from 0.5 per cent in «railroads» to 20 per cent in «rubber and plastics» during the second period and from 0.65 per cent in «textile mills products» to 16 per cent in «transport equipment industries» and 18 per cent in «miscellaneous manufacturing». This is not surprising as these industries produce different outputs, face changing consumer and business demands, and respond differently to evolving technologies. Similarly, productivity growth ranges from –5.15 per cent in «railroad transports» to 9.22 per

cent in «industrial machinery and equipment» in 1958-1962, from –2.70 per cent in «trade» to 9.78 per cent in «electricity, gas and water» in 1962-1970, and from –0.87 per cent in «construction» to 12.38 per cent in «communications» and 8.87 per cent in «air transport» in the last period.

An important feature of productivity growth at sectorial level is that some industries present negative rates. This fact could be interpreted as a decline in overall production efficiency, and may be the consequence of drastic changes in relative prices in inputs, or represent declining industries [21]. In other cases, the negative rates are found in new fast growing sectors like «air transport» and «communications services», where new firms respond differently to new challenges or are carrying over the costs of establishing the industry.

The industries with negative productivity growth include «energy, except for electricity» (which includes «petroleum and coal mining industries»), «food and tobacco», «clothing and footwear», «lumber, wood and furniture» or «railroad transportation» [22]. However, the most striking fact is that most industries and services present positive productivity growth throughout the entire period and the increase in aggregate productivity comes from almost all sectors of the economy but within a wide range of variation as a signal of the positive transformation of the Spanish economy in the sixties.

Tables I, II and III also present the analysis of the sources of growth at industry level based on decomposing the sectorial output growth rate into the sum of the contributions from intermediate, capital and labour inputs and the growth of sectorial productivity. Each input's contribution is the product of the value share of the input and its growth rate. A glance at the results seems to show that the contribution of intermediate inputs was by far the most significant source of output growth, exceeding productivity growth and the contributions of capital and labour inputs. We must interpret this result as a signal of the increasing modernization experienced by the Spanish economy during the sixties which

[21] Harberger (1998), with reference to negative TFP growth, points out the following causes: external shocks like international prices, competition within industries, firms struggling to survive while experiencing output levels below their previous peaks or below installed capacity. He recognizes that firms with negative productivity may even be innovators, firms that respond in different ways to new challenges.

[22] Jorgenson, Gollop and Fraumeni (1987) obtained negative productivity growth during the period 1948-1979 in similar industries for the United States: «coal mining», «crude petroleum and natural gas», «tobacco manufacturers», «paper and allied products», «primary metal industries», «street railways», «transportation services», «radio broadcasting and television», «gas utilities», «water transportation», «institutions» and «services, exluding private households and institutions». Similar sectors present negative productivity growth for the period 1961-1995 for the Canadian economy [Gu and Ho (2000)].

TABLE 2
SOURCES OF OUTPUT GROWTH BY INDUSTRY, 1962-1970

	Output growth (1)	Contributions to Total Output Growth			
		Inter-mediate (2)	Labour (3)	Capital (4)	Product. growth (5)
Agriculture	1.88	1.17	–0.74	0.49	0.96
Energy not including electricity	16.08	5.53	0.38	2.18	7.98
Electricity, gas and water	18.30	4.73	–0.43	4.22	9.78
Metal and non-metallic mining	8.28	0.40	0.25	1.70	5.92
Primary transformation of metals	11.21	6.90	0.25	2.10	1.96
Non-metallic minerals industry	15.84	7.79	0.16	1.54	6.35
Chemical industries	13.06	7.03	0.26	1.69	4.09
Industrial machinery and equipment	17.24	10.04	0.65	0.80	5.74
Transport equipment	14.37	10.43	0.53	1.55	1.86
Food and tobacco products	7.38	5.12	0.07	0.17	2.02
Textile mills products	3.35	1.01	–0.08	0.09	2.32
Clothing and footwear	11.02	6.50	–0.16	0.17	4.51
Lumber, wood and furniture	11.41	4.04	0.27	0.66	6.44
Paper products and printing	14.32	7.04	0.45	1.05	5.78
Rubber and plastic	20.81	8.52	0.85	4.08	7.36
Miscellaneous manufacturing	8.22	6.25	0.47	0.30	1.21
Construction	10.02	5.08	1.01	6.28	–2.34
Trade	5.76	5.00	0.57	2.88	–2.70
Hotels, restaurants and bars	14.88	13.90	1.22	1.23	–1.46
Railroad transport	0.54	0.21	1.11	1.01	–1.79
Land transport	10.05	2.12	0.61	2.02	5.30
Sea transport	10.74	6.10	0.82	0.46	3.36
Air transport	23.11	11.18	1.13	0.37	10.43
Communications	6.74	5.86	1.22	–0.92	0.57
Financial institutions	19.51	14.75	4.70	–4.77	4.82

Sources: Author's calculations from 1958 and 1962 Input-Output Tables (for total output, intermediate inputs and inputs shares in total output), Fundación BBVA (for labour and capital input), INE (*Contabilidad Nacional...* for Value Added and *Salarios* for classification of labour input by changes in labour quality).

Notes: (1) Annual cumulative rates of growth for total output in percentage points; (2), (3) and (4) annual cumulative rates of growth for intermediate, labour and capital weighted by their respective share in industry output; (5) TPF growth is equal to the growth of output (1) less the share-weighted growth of inputs [(2)+(3)+(4)].

led to a general increase in interindustry transactions and also as directly related with the high level of disaggregation of the data. But intermediate inputs are not primary sources of growth and their contribution to growth might be seen as a vehicle for transmitting self productivity increases to other parts of the economy. In the next section we discuss the contribution of intermediate inputs.

For this reason, if we discount the contribution of intermediate goods, productivity becomes the main source of growth in almost all

activities. It is significant that the industries producing intermediate goods, defined as those whose production is mainly sold to other industries for their production processes (see Table IV), are among the activities with the greatest growth in productivity. This is the case of the «energy industries», «primary mineral industries», «chemical industries», «rubber and plastic industries» and some branches of the service sector, such as «road transport», «communications» and «air transport». The same would occur with equipment goods industries, defined as those

TABLE 3
SOURCES OF OUTPUT GROWTH BY INDUSTRY, 1970-1975

	Output growth (1)	Contributions to Total Output Growth			
		Inter-mediate (2)	Labour (3)	Capital (4)	Product. growth (5)
Agriculture	3.03	1.69	–1.92	0.36	2.90
Energy not including electricity	9.99	9.89	–0.02	0.85	–0.74
Electricity, gas and water	4.91	0.68	0.24	3.13	0.86
Metal and non-metallic mining	4.95	1.68	-4.31	2.63	4.95
Primary transformation of metals	3.85	0.40	0.19	0.44	2.81
Non-metallic minerals industry	9.66	7.13	0.04	1.58	0.91
Chemical industries	8.19	4.50	0.71	1.35	1.64
Industrial machinery and equipment	10.19	6.25	0.58	0.35	3.01
Transport equipment	15.97	7.01	0.47	0.51	7.99
Food and tobacco products	4.65	3.82	–0.08	0.46	0.46
Textile mills products	0.64	–2.47	–0.24	0.66	2.70
Clothing and footwear	3.44	1.59	0.17	0.78	0.90
Lumber, wood and furniture	6.82	2.39	0.69	0.96	2.78
Paper products and printing	11.59	6.79	0.69	1.03	3.08
Rubber and plastic	10.72	3.93	0.88	1.88	4.03
Miscellaneous manufacturing	18.69	4.11	0.91	1.02	12.67
Construction	6.98	6.38	1.04	0.42	–0.87
Trade	5.16	0.80	0.82	3.36	0.18
Hotels, restaurants and bars	3.53	2.11	0.43	1.32	–0.33
Railroad transport	5.56	1.61	0.10	1.89	1.96
Land transport	11.20	5.78	0.08	2.17	3.16
Sea transport	7.73	2.45	0.08	1.06	4.14
Air transport	13.20	3.81	0.07	0.46	8.87
Communications	14.71	0.87	0.14	1.33	12.38
Financial institutions	8.62	5.68	2.12	1.32	–0.50

Sources: Author's calculations from 1970 and 1975 Input-Output Tables (for total output, intermediate inputs and inputs shares in total output), Fundación BBVA (labour and capital input), INE (*Contabilidad Nacional...* for Value Added and *Salarios* for weight of labour input categories).

Notes: (1) Annual cumulative rates of growth for total output in percentage points; (2), (3) and (4) annual cumulative rates of growth for intermediate, labour and capital weighted by their respective share in industry output; (5) TPF growth is equal to the growth of output (1) less the share-weighted growth of inputs [(2)+(3)+(4)].

whose production is preferably consumed as investment goods by other activities (like «machinery» and «transport equipment»).

Capital deepening was the second most important source of growth behind productivity growth. The relatively poor contribution of capital together with the low growth of capital quality have been interpreted by other authors as a trail in favour of the importance of disembodied technological change in the explanation of growth [23]. However, a closer look at our results shows that gains in productivity growth were larger in investment goods producing industries («machinery and equipment industries» and «transport equipment industries»). The evidence is equally clear that in the case of intermediate industries and investment goods industries high rates of productivity growth went hand in hand with high rates of productivity growth. We can suspect that technological advances in «investment goods industries» were a direct source of productivity growth in these industries as well as an indirect source of more rapid capital deepening and productivity growth in other industries. Technological progress in the investment goods industries could have had two effects on the Spanish economy in the sixties. First (directly observed in the data), as the production of investment goods improved and became more efficient, this raised overall productivity in the capital goods industries and contributed to TFP growth for the economy as a whole. Second (not directly observed in the data), the decline in the relative prices of machinery and equipment was an indirect source of more rapid capital deepening in other industries. If this last effect is not accounted as an increase in capital input it would be recorded as an increase in productivity at the level of capital consuming industries [24]. This could explain why, in general, the contribution of capital tends to be underestimated in favour of productivity in a period of high investment rates and high «catch-up» and productivity growth in investment goods industries in Spain [25].

Labour, however, appears to be the factor which least influenced growth, confirming the results obtained by other authors where the Spanish economy's lack of labour generating capacity during the period of rapid growth in the sixties is emphasized [26]. But, as mentioned in the

[23] Cebrián (2000) follows an aggregate growth accounting approach and concludes that the contribution of capital to growth was low in comparison to other European countries and considers the results as a sign that most TFP growth was due to disembodied technological change.

[24] See the discussion for measuring capital input in the previous section.

[25] For postwar productivity growth in the United States, Greenwood, Hercowitz and Krusell (1997) incorporate changes in capital input quality to estimate its contribution to output growth. Their results reveal that investment-specific technological change accounts for the majority of growth.

[26] Myro (1983), Suárez (1992), Cebrián (2000) and Prados and Rosés (2005).

previous section, the lack of attributes in the construction of the labour input could have resulted in an underestimation of the sectorial measures of labour input due to the fact that changes in labour quality have been given insufficient importance.

3.2. Aggregation of productivity across industries

We have derived growth accounting in the previous section for each industry to measure the sources of economic growth for individual industries. In order to obtain an aggregate measure of TFP growth we can aggregate over individual industries or use an aggregate model of production. The key difference between the two approaches is the use of different output concepts. At aggregate level only primary inputs are included in the industry production functions, whereas both primary and intermediate inputs are included at disaggregated level.

To aggregate over industry productivity growth and obtain results consistent with aggregate TFP growth we have followed Domar's aggregation [27]. He showed that TFP growth can be expressed as a weighted average of industry productivity growth:

$$\Delta A = \sum_i \overline{w}_i \, \Delta A, \qquad \overline{w}_i = \frac{1}{2}\left[\frac{P_{i,t}Q_{i,t}}{P_{Y,t}Y_t} + \frac{P_{i,t-1}Q_{i,t-1}}{P_{Y,t-1}Y_{t-1}}\right] \qquad [15]$$

where $\overline{w}_i$ is the «Domar weight», P_iQ_i is current gross output in sector *i*, and $P_{Yt}Y_t$ is current aggregate value added. As can be seen, Domar weights do not sum unity. With this aggregation procedure Domar tries to reflect the different output concepts used at aggregate and industry level. For any particular industry, gross output considerably exceeds value added, and therefore the sum of gross output across industries exceeds the sum of value added. Weighting as suggested by Domar implies that economy-wide TFP growth can grow faster than the sum of particular industries' productivities as productivity gains in any particular industry are magnified as they work their way through the production process when they are consumed by other industries as intermediate inputs.

For example, a substantial part of price declines in the production of electricity or electrical appliances can be traced to steep price declines in the «machinery and equipment industry» or in any industry which consumes these components as intermediate inputs. Price decreases in the industries which consume those inputs could reflect technological

[27] Domar (1961). This aggregation procedure is also followed by Jorgenson, Gollop and Fraumeni (1987) and by other authors such as Jorgenson and Stiroh (2000).

progress coming from the intermediate industries. So the impact of intermediate industries on overall productivity growth may not be well reflected in aggregate measures based only on value added.

Table IV shows the significant group of activities which can be considered as intermediate industries under the criterion that they sell more than 50 per cent of their output as intermediate inputs. These include «agriculture», «electricity», «other energies», «metal and non-metallic mining», «primary transformation of metals» and «chemical industries», «paper products», «communications» and «financial services». Other industries such as «machinery and equipment» and «transport equipment» are not included in this group because they sell most of their output as final investment goods. Any increase in productivity in intermediate industries would be transmitted to other sectors through intermediate consumption. The impact of intermediate inputs on overall growth can be seen in their large contribution to the output growth of most industries (see column 2 in Tables I, II and III). When we account for productivity in terms of total output, intermediate inputs can be considered as the first source in explaining growth in individual industries. But when we account for growth in terms of value added, the impact of intermediate inputs is diluted as part of total TFP growth because productivity increases in intermediate industries are transmitted to the rest in the form of further increases in productivity.

TABLE 4
SALES AS INTERMEDIATE INPUT OVER TOTAL OUTPUT (%)

	1958	1962	1970	1975
Agriculture	62.3	65.9	76.9	74.3
Energy, not including electricity	81.2	85.0	70.7	82.0
Electricity, gas and water	58.7	62.3	56.9	64.7
Metal and non-metallic mining	69.2	84.5	93.9	96.1
Primary transformation of metals	95.6	93.0	93.3	92.3
Non-metallic minerals industry	84.2	89.0	89.6	85.2
Chemical industries	66.7	72.8	69.4	72.0
Industrial machinery and equipment	23.0	29.1	31.3	39.7
Transport equipment	22.3	32.3	36.0	31.9
Textile mills products	42.4	69.9	83.3	64.5
Lumber and furniture	53.6	58.8	51.1	46.3
Paper products, printing and publishing	39.0	75.6	69.1	65.1
Rubber and plastics	25.4	47.1	46.4	44.8
Railroad transport	29.1	49.2	63.1	60.4
Land transport	24.2	36.0	43.1	52.2
Communications	51.6	57.1	53.4	47.6
Financial institutions	42.3	92.5	85.2	54.3

Source: Author's calculations over Spanish Input-Output Tables for 1958, 1962, 1970 and 1975.

The impact of domestic intermediate industries on overall productivity would be higher if we consider that 90 per cent of intermediate consumption was in domestic products, with the exception of «agriculture» (only 65 per cent), «energy, not including electricity» (around 80 per cent) and «chemicals» (around 70 per cent).

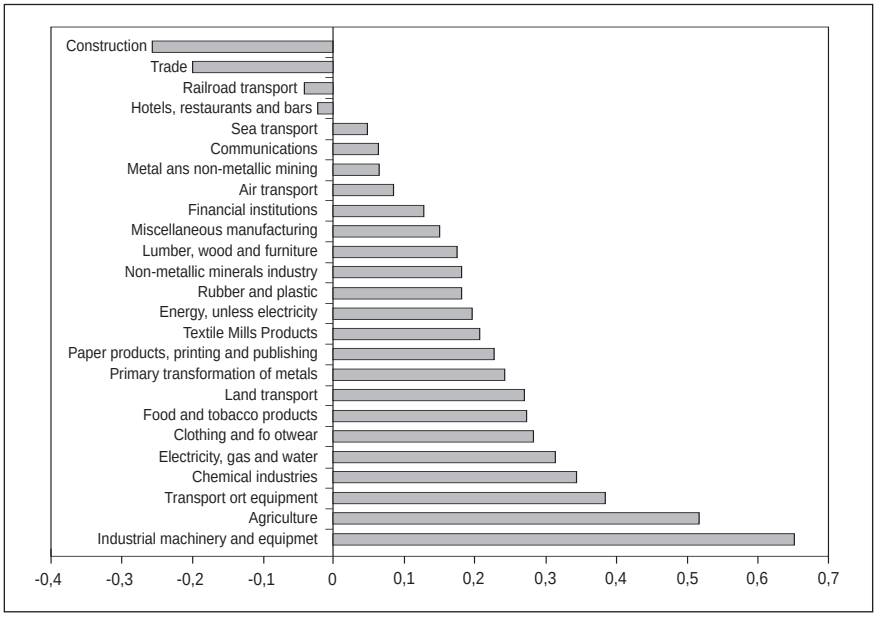
Aggregating over Domar's weight we can increase the contribution to the global productivity of any given industry by taking into account the share of their output which is not reflected in final consumption. Figure I presents our estimates of each Domar industry contribution to TFP growth for the period 1958-1975. Summing across industries gives an estimate of aggregate TFP growth of 4.46 per cent for 1958-1975, where 3.19 points came from the above considered intermediate industries and 1.03 points came from investment good industries.

The most striking feature of Figure I is the wide range of industry contributions. On the one hand, «Agriculture» and «food and tobacco products» made large Domar contributions because of their large share. Agriculture's Domar weight ran from 0.44 in 1958 to 0.23 in 1975 while its productivity increased at a moderate rate (1.57 per cent on average between 1958 and 1975). The fact that agriculture lost weight in total output over the period explains its decreasing contribution to overall productivity, although it was still very high at the end of the period. «Food and tobacco industries» made a high contribution because of high Domar's weights, between 0.33 per cent and 0.26 per cent, although productivity increases were low (0.9 per cent).

On the other hand, «industrial machinery and equipment», «transport equipment», «electricity, gas and water», «chemical industries» and «clothing and footwear» among non-agricultural industries made the largest contributions to TFP growth because of their high rates of productivity growth in spite of their relatively small size. Machinery's Domar weight ran from 0.08 in 1958 to 0.1 in 1975, but its productivity grew at 5.75 per cent per year; «chemical industry» weight ran from 0.09 to 0.16, but its productivity grew at 3.95 per cent, «electricity, gas and water» ran from 0.04 to 0.05 and its productivity increased at 6.8 per cent per year and «clothing and footwear» weight ran from 0.073 to 0.075 and its productivity increased at a 4.5 per cent per year between 1958 and 1970. An industry's contribution to aggregate productivity growth depends on both productivity performance and relative size. The Domar size of these industries is greater than their value added share and thus their contribution to productivity growth is more significant when its contribution to intermediate consumption is considered.

Figure I also highlights the impact of some industries which experienced negative productivity growth. Again, both performance and relative size matter. Construction made an important negative contribution

FIGURE 1
INDUSTRY CONTRIBUTIONS TO AGGREGATE TFP GROWTH, 1958-1975



Source: See Tables 1, 2 and 3.
Note: Average annual Domar contribution in percentage points.

because of its negative productivity growth and its large share in the economy. A similar situation occurred with «trade» which made an important negative contribution in 1962-1970 because of its relatively high share.

4. INTERPRETING ECONOMIC GROWTH: «YEAST VERSUS MUSHROOMS»

In this section we seek to answer the question of whether the growth process behaves in a balanced or unbalanced way. If the growth process is unbalanced, it is because a reduced number of sectors explain most of the transformation. In this case a set of leading sectors, those with clear opportunities for technological change, will explain most productivity growth. The rest of the overall transformation could be explained by spillover effects or by the linkages of these sectors with other parts of the economy. The main disadvantage of explaining growth in this way is that

the forward and backward linkages from the leading sectors tend to have a limited impact so the explanatory power of an interpretation based on the role of the leading sectors is usually too weak [28].

Tables V, VI and VII and Figure II show the degree of concentration of productivity improvements in industries [29]. First, the industries are classified in descending order according to their rates of productivity growth in each period [column (1)]. Column (2) shows Domar's contribution to productivity growth. Column (3) shows the share of each sector in aggregate Value Added. The last two columns show the cumulative sums of Value Added (column 4) and the cumulative sum of productivity expressed in terms of Domar's contribution (column 5).

We can observe that total productivity improvements tend to be concentrated in very few industries. For 1958-1962, half the productivity increase was explained by the top six industries (column 1) which jointly represent 12 per cent of total Value Added (column 5). For 1962-1970, fifty per cent of overall productivity growth was explained by the top nine industries which represented only 18.2 per cent of total Value Added. For the last sub period, 1970-1975, the same growth was explained by the top eight industries which represented only 17 per cent of total Value Added.

Not only were the contributions to productivity increase highly concentrated in relatively few modern industries, but also these industries tend to appear in the group of leaders throughout the entire period. «Machinery and equipment industry», «electricity, gas and water», «equipment transport» and «rubber and plastics industry» remained in the top 50 per cent of TFP increase. If one considers 75 per cent of the transformation, «miscellaneous manufactures», «chemical industry» and «communications» and «air transport» could be added to this group. The persistence of the industries in the leading group in productivity is evidence in favour of the hypothesis that specific technological change was a central element in global modernization. The external effects derived from the incorporation of new technologies were not exhausted immediately and they caused the persistence of high rates of output and productivity growth in subsequent periods and in other sectors.

During these years, technological change was linked to the diffusion of electrical machinery and appliances, to the chemical industry, the

[28] Regarding the debate over the British Industrial Revolution during the first half of the 19th century, O_Brien (1993) considers interindustry linkages of modernizing sectors to be insufficient. More recently, Crafts (2004a and 2004b) highlights the relatively small and long-delayed impact of steam on productivity growth even when capital deepening is taken into account. However he concludes that technological change alone accounted for the acceleration in labour productivity growth.

[29] These tables are based on data provided by Harberger (1998).

automobile industry and related industries and to new communications (telephone and television). These were the industries which led TFP growth in United States during the second quarter of the twentieth century [30] and the industries which offered more opportunities for catching-up in a backward country such as Spain in the sixties. Technological change in these industries had important implications for the acceleration of productivity in these sectors and other parts of the economy. The general application of electricity to production meant a significant change in the layout of factories and the renovation of capital stock. At the same time, small electric motors were also critical on the product side driving the production of new consumer products such as vacuum cleaners, refrigerators, washing machines, heaters and so on. The ascendancy of transport equipment industries was outstanding and in particular the development of the automobile industry. On the other hand, the introduction of new chemical processes affected a large number of sectors including the mining industry and the electrical power generating industries in a disembodied way. Chemistry also lengthened the life of equipment or structures and improved many of the inputs of the automobile industry.

Harberger (1998) created an analogy for describing the economic process in terms of balance or imbalance which he called the «yeast versus mushrooms process». In his own words: «This analogy comes from the fact that yeast causes bread to expand very evenly, like a balloon being filled with air, while mushrooms have the habit of popping up in a fashion that is not easy to predict». Following this analogy, he interprets the growth process as a «yeast» one within each industry and «mushrooms» between industries. Similar productivity changes tend to be experienced by firms within the same industry depending on that industry_s luck in the technological draw. Productivity changes tend to be highly diverse between different industries because technical progress is scattered and unpredictable.

In the case of the Spanish economy during the sixties, the image that could emerge from these results would be that of a «mushroom process» between industries, in which the opportunities for particular industries to experience rapid productivity growth depended on the technological deficit they had with regard to the most advanced countries [31]. In this sense, the mushroom process was not unpredictable but was guided by the steps taken by the most advanced countries.

---

[30] Field, A. (2006).

[31] Crafts and Tonniolo (1996) maintain that Europe experienced a technological «catch-up» with the United States after the Second World War based on the development of technologies linked to the consumption of electricity and petroleum which the United States had developed during the interwar years.

The «mushroom process» rapidly became a «yeast process». Although the findings here place some industries at the heart of the transformation, it does not follow that productivity improvements were located in only a few modern industries. The evidence tells us a more complex story. Nevertheless, despite the high concentration of the transformation, one can still observe that 80 per cent of total Value Added in the first sub period, 72.8 per cent in the second and 82 per cent in the last sub period experienced positive productivity increases. Domar's contribution calculations attempt to account for industry interdependence through input-output transactions or technological spillovers linked to the leading sectors. These calculations reveal that interrelationships between specific leading industries and the rest of the economy were high and hence the industries involved in productivity improvements represented an increasing share of total output. These results lead us to extend Harberger's «yeast» analogy to the economy as a whole. Technological progress took place at the same time in several specific industries and caused productivity to increase not only into these particular industries but also into other parts of the economy. Sometimes it was spread throughout new capital goods (the embodiment hypothesis). Sometimes throughout better and more efficient intermediate inputs (electricity, chemical products, new materials and so on). These changes also forced other ways of improving productivity such as organisational changes, improvements in human capital through «learning by doing» and «learning by using» or scale economies linked to the increase in demand.

The fact that such a wide variety of industries benefited in a wide variety of ways from technological progress at the same time directs our attention to the change in the direction of economic policy. In 1960 Spain started to look abroad and this change had several implications including easier access to technology transfer from more advanced countries and the injection of growing competition into the Spanish economy which stimulated modernisation. This meant that not only the industries directly linked to specific technological change, but also the more traditional sectors, such as agriculture and consumer goods industries (textile, clothing and footwear, food) experienced quite an increase in productivity from the perspective of long term economic growth.

Another striking fact observed in Tables V, VI and VII is the characteristic «overshooting», that is to say, that part of productivity growth which is «cancelled out» by the negative contribution of the «losers». Figure II tries to represent this «overshooting». For this purpose the degree of concentration of productivity growth is represented against the concentration in Value Added, in a similar way to a Lorenz curve. On the x-axis we have represented the cumulative sum of total Value Added and the y-axis shows the cumulative sum of productivity growth.

TABLE 5
CONCENTRATION OF TFP GROWTH IN SPANISH INDUSTRIES, 1958-1962

	Productivity growth (1)	Domar's contribution (2)	Share in Value Added % (3)	Cumulative Sum of Value Added (4)	Cumulative Sum of Productivity (5)
Industrial machinery and equipment	9.22	0.84	0.04	0.04	0.84
Non-metallic minerals industry	8.55	0.25	0.02	0.05	1.09
Chemical industries	8.49	0.67	0.03	0.08	1.76
Rubber and plastic	8.40	0.14	0.01	0.09	1.90
Electricity, gas and water	8.30	0.31	0.03	0.12	2.21
Communications	7.65	0.09	0.01	0.12	2.30
Miscellaneous manufacturing	6.77	0.14	0.01	0.14	2.44
Paper products and printing	5.01	0.19	0.01	0.15	2.62
Energy not including electricity	4.54	0.18	0.02	0.17	2.80
Hotels, restaurants and bars	4.24	0.22	0.03	0.20	3.03
Clothing and footwear	4.15	0.32	0.02	0.23	3.35
Transport equipment	4.06	0.30	0.03	0.26	3.65
Metal and non-metallic mining	3.03	0.04	0.01	0.26	3.69
Primary transformation of metals	1.59	0.16	0.02	0.29	3.85
Textile mills products	1.58	0.10	0.04	0.33	3.95
Agriculture	1.15	0.54	0.29	0.61	4.49
Trade	0.95	0.17	0.13	0.75	4.66
Lumber, wood and furniture	–0.07	0.00	0.02	0.76	4.66
Land transport	–0.68	–0.05	0.04	0.80	4.61
Food and tobacco products	–0.76	–0.25	0.05	0.86	4.36
Financial institutions	–0.84	–0.06	0.06	0.91	4.30
Construction	–1.08	–0.14	0.06	0.97	4.16
Sea transport	–1.84	–0.01	0.01	0.98	4.15
Air transport	–3.82	–0.01	0.00	0.98	4.14
Railroad transport	–5.15	–0.13	0.02	1.00	4.01

Sources: Author's calculation. See Table I.

The first vertical line marks the point where the rising curve crosses 100 per cent on the vertical axis. The question is «what» percentage of the output coming from the top branches in terms of productivity growth could represent the productivity growth for output as a whole. For example, in 1958-1962, the productivity growth of just 33 per cent of industries (measured by their share in Value Added) was equal to the productivity increase for the economy as a whole. After that there are other industries producing another 47 per cent of the total, but their contribution is offset by yet another 20 per cent of industries with negative productivity growth. The fraction of industries that were able to account for the full amount of productivity increases represented 43 per cent of total Value Added for 1962-1970, and 53 per cent for 1970-1975.

TABLE 6
CONCENTRATION OF TFP GROWTH IN SPANISH INDUSTRIES, 1962-1970

	Productivity growth (1)	Domar's contribution (2)	Share in Value Added % (3)	Cumulative Sum of Value Added (4)	Cumulative Sum of Productivity (5)
Air transport	10.43	0.11	0.005	0.00	0.11
Electricity, gas and water	9.78	0.48	0.033	0.038	0.59
Energy not including electricity	7.98	0.36	0.015	0.053	0.95
Rubber and plastic	7.36	0.23	0.012	0.065	1.18
Lumber, wood and furniture	6.44	0.30	0.020	0.085	1.48
Non-metallic minerals industry	6.35	0.24	0.020	0.105	1.72
Metal and non-metallic mining	5.92	0.08	0.010	0.115	1.80
Paper products and publishing	5.78	0.28	0.018	0.133	2.08
Ind. machinery and equipment	5.74	0.69	0.049	0.182	2.77
Land transport	5.30	0.44	0.052	0.233	3.21
Financial institutions	4.82	0.32	0.037	0.271	3.52
Clothing and footwear	4.51	0.39	0.031	0.302	3.92
Chemical industries	4.09	0.39	0.031	0.333	4.31
Sea transport	3.36	0.06	0.010	0.344	4.37
Textile mills products	2.32	0.29	0.036	0.380	4.65
Food and tobacco products	2.02	0.63	0.051	0.431	5.29
Primary transformation of metals	1.96	0.25	0.025	0.456	5.53
Transport equipment	1.86	0.17	0.028	0.484	5.70
Miscellaneous manufacturing	1.21	0.04	0.013	0.497	5.74
Agriculture	0.96	0.38	0.219	0.716	6.12
Communications	0.57	0.01	0.011	0.728	6.13
Hotels, restaurants and bars	–1.46	–0.14	0.050	0.777	6.00
Railroad transport	–1.79	–0.03	0.012	0.790	5.96
Construction	–2.34	–0.37	0.066	0.856	5.59
Trade	–2.70	–0.52	0.144	1.000	5.07

Sources: Author's calculation. See Table I.

If the losers had only contributed zero change in productivity, we would have had cumulative TFP growth of 4.66 per cent for 1958-1962, 6.13 per cent for 1962-1970 and 4.14 for 1970-1975. The second vertical line marks this maximum point of the curve. The interpretation is that about 75 per cent of industries enjoyed productivity increases during 1958-1962, while the remaining 25 per cent recorded negative productivity growth. For the subsequent periods, the corresponding figures were 73 per cent for 1962-1970 and 82 per cent for 1970-1975. One striking fact that emerges from this set of negative contributions is how stable the negative contribution was across periods: quantitatively (between 25 and 18 per cent of VA, and between 0.2 and 1.06 percentage points) and qualitatively (the sectors with negative contributions were almost the same throughout the entire period: «financial institutions»,

TABLE 7
CONCENTRATION OF TFP GROWTH IN SPANISH INDUSTRIES, 1970-1975

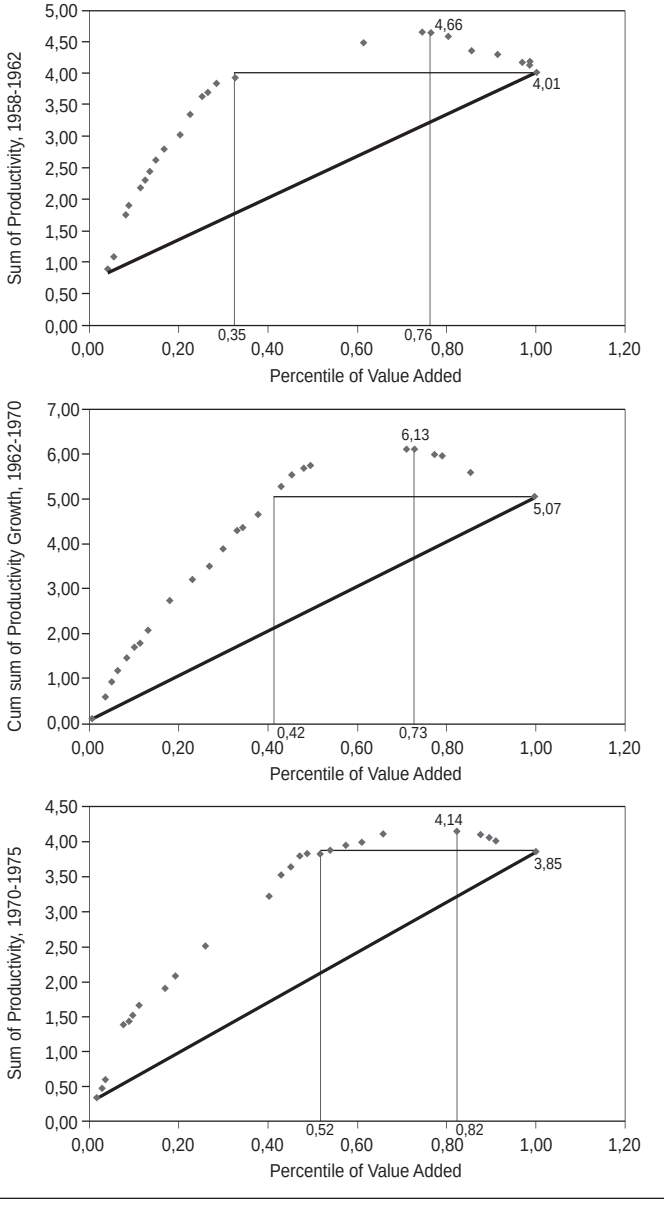
	Productivity growth (1)	Domar's contribution (2)	Share in Value Added % (3)	Cumulative Sum of Value Added (4)	Cumulative Sum of Productivity (5)
Miscellaneous manufacturing.....	12.67	0.34	0.01	0.01	0.34
Communications	12.38	0.13	0.01	0.03	0.47
Air transport	8.87	0.13	0.01	0.03	0.60
Transport equipment.....	7.99	0.79	0.04	0.08	1.39
Metal and non-metallic mining ...	4.95	0.06	0.01	0.09	1.45
Sea transport	4.14	0.07	0.01	0.10	1.52
Rubber and plastic.....	4.03	0.14	0.01	0.11	1.65
Land transport.....	3.16	0.25	0.06	0.17	1.90
Paper products and publishing....	3.08	0.18	0.02	0.19	2.08
Ind. machinery and equipment ...	3.01	0.44	0.07	0.26	2.52
Agriculture	2.90	0.71	0.14	0.40	3.23
Primary transformation of metals.....	2.81	0.30	0.03	0.43	3.53
Lumber, wood and furniture.....	2.78	0.11	0.02	0.45	3.64
Textile mills products.....	2.70	0.17	0.02	0.47	3.81
Railroad transport.....	1.96	0.02	0.01	0.48	3.83
Chemical industries	1.64	0.01	0.03	0.52	3.84
Non-metallic minerals industry...	0.91	0.04	0.02	0.54	3.88
Clothing and footwear	0.90	0.07	0.04	0.57	3.95
Electricity, gas and water	0.86	0.04	0.03	0.61	3.99
Food and tobacco products.....	0.46	0.11	0.05	0.66	4.11
Trade	0.18	0.03	0.16	0.82	4.14
Hotels, restaurants and bars.....	–0.33	–0.04	0.06	0.88	4.10
Financial institutions.....	–0.50	–0.04	0.02	0.90	4.07
Energy not including electricity...	–0.74	–0.05	0.01	0.91	4.02
Construction	–0.87	–0.17	0.09	1.00	3.85

Sources: Author's calculation. See Table I.

«hotels and restaurants», «railroad transport» and «construction»). It is difficult to accept that some of these activities, such as «financial institutions» and «construction» could have been losers during the years of rapid growth. This may be due to certain difficulties with the way these activities were measured.

The main conclusion that can be drawn from the graphs in Figure II is that the growth process was relatively balanced in the sense that most activities experienced positive growth in productivity and that despite the «overshooting» a clear, positive, slope prevailed, thus indicating a very positive transformation of productivity at aggregate level. The process was less balanced at the beginning of the period, as the differences in productivity between the leading industries and the rest were greater and there were more activities with a negative transformation.

FIGURE 2
CUMULATIVE SUM OF PRODUCTIVITY AND TOTAL VALUE ADDED OVER INDUSTRIE



5. CONCLUSIONS

This article offers new insight into the sources of Spanish economic growth during the so called «Spanish Economic Miracle» by applying a disaggregated sectorial approach. Following Jorgenson, Gollop and Fraumeni (1987) we have integrated the growth of intermediate, capital and labour inputs at individual industry level into an analysis of the sources of growth for the economy as a whole.

The results here confirm productivity as the main source of growth, with an average growth rate of 4.66 per cent over the period 1958-1975 which represents about half of overall output growth. Capital deepening appears in a distant second place, followed by relatively slow job creation. Hence, factor contributions (labour and capital) are in line with other studies at aggregate level. However, disaggregated analysis at sectorial level provides further evidence regarding the specific or general nature of the technical progress experienced by the Spanish economy over this period.

First, we want to emphasize the importance of some specific industries which recorded notably higher productivity growth than the average for the economy as a whole. During these years such industries had the chance to close the wide technological gap that had opened with regard to the most advanced countries. This was the case with «electricity», «machinery and equipment industries», «transport equipment», «chemicals», «rubber and plastic» or «communications». As can be seen, technological progress was not localized in terms of «general purpose technology» but was related with a heterogeneous group of modern industries. These results suggest that Spain incorporated and developed a wide range of technology, some of which had already been in the economy for decades, but had not been as intensely developed and disseminated throughout the economy until the 1960s.

Secondly, most of these industries were able to spread technological progress across the whole economy due to the size of their interindustry transactions or because they were investment goods industries. At this point, we would like to clarify the fact that due to problems involved in calculating capital input, this variable could be underestimated. The reason for this is that it is impossible to measure the quality improvements attributed to new machinery more accurately. This observation merely reflects our wish to highlight the need to make further progress in the measurement of capital input in the future. Notwithstanding, we do not expect this to cause a substantial change in the results derived from growth accounting in favour of capital and to the detriment of TFP. This would not only go against our results, which support a highly spectacular contribution of TFP, but also against the evidence generally obtained

in other countries by measuring the role of embodied technological change in aggregate output growth.

Thirdly, while these findings place the above mentioned industries at the heart of the transformation, it does not follow that efficiency increases were only to be found here. The main conclusion we can draw is that in general the growth process was unevenly distributed in the sense that most activities experienced positive productivity growth. Despite the «overshooting effect» provoked by the losers, a clear, positive slope prevailed, thus indicating a very positive transformation of productivity at aggregate level. This means that individual industries were influenced in a variety of ways by technological change coming from the most modern industries but also by other types of spillover effects linked to new technologies, such as changes in firm organization, improvements in human capital, economies of scale, mass production processes and different kinds of improvements in efficiency that can be identified as disembodied technological change.

REFERENCES

ABRAMOVITZ, M. (1956): «Resources and Output Trends in the United States Since 1870». *American Economic Review* 46 (May), pp. 5-23.

ARK, B. VAN, and SERRANO, L. (2001): «Productividad del sector manufacturas en España: medio siglo de crecimiento y convergencia». *Revista de Historia Industrial* 19-20, pp. 77-104.

CEBRIÁN, M. (2000): «Las fuentes del crecimiento económico español, 1964-1973», in F. COMÍN, and B. SÁNCHEZ ALONSO (eds.), *Los novísimos en la historia económica de España, Revista de Historia Económica* XIX (special issue), pp. 277-299.

— (2005): «La regulación industrial y la transferencia internacional de tecnología en España, 1959-1973». *Investigaciones en Historia Económica* 3, pp. 12-40.

CRAFTS, N. (1995): «Exogenous or Endogenous Growth? The Industrial Revolution Reconsidered». *The Journal of Economic History* 4 (December), pp. 745-771.

— (2004a): «Productivity Growth in the Industrial Revolution: A New Growth Accounting Perspective». *The Journal of Economic History* 64 (2), pp. 521-535.

— (2004b): «Steam as a General Purpose Technology: A Growth Accounting Perspective». *Economic Journal* 495, pp. 338-351.

CRAFTS, N., and HARLEY, C. K. (1992): «Output Growth and the British Industrial Revolution». *Economic History Review* 45, pp. 703-730.

CRAFTS, N., and MILLS, T. C. (2004): «Was Nineteenth Century British Growth Steam-Powered? The Climateric Revisited». *Explorations in Economic History* 41 (2), pp. 156-171.

CRAFTS, N., and TONIOLO, G. (1996): «Postwar Growth: An Overview», in N. CRAFTS, and G. TONIOLO (eds.), chap. 1, pp. 1-37.

— *Economic Growth in Europe since 1945.* Cambridge: Center for Economic Policy Research, Cambridge University Press.

CUBEL, A., and SANCHÍS, M. T. (2005): «Comercio de bienes de capital y desarrollo de la industria de bienes de equipo en España, 1950-1975», in P. PASCUAL, and P.

FERNÁNDEZ (eds.), *Del metal al motor. El desarrollo de la industria de transformados metálicos en España*. Fundación BBVA (*forthcoming*).

FIELD, A. (2003): «The Most Technologically Progressive Decade of the Century». *American Economic Review* 93, pp. 1399-1413.

— (2006): «Technological Change and U.S. Productivity Growth in the Interwar Years». *The Journal of Economic History* 66(1), pp. 203-236.

GANDOY, R. (1987): «Producción y productividad en la industria española, 1964-1981». *Economía Industrial* 256, pp. 33-46.

— (1988): «Evolución de la productividad global de la economía española. Un análisis desagregado». Doctoral Thesis, Madrid: Universidad Complutense de Madrid, Facultad de Ciencias Económicas y Empresariales.

GREASLEY, D., and OXLEY, L. (2000): «British Industrialization, 1815-1860: A Disaggregate Time-Series Perspective». *Explorations in Economic History* 37, pp. 98-119.

GU, W., and HO, M. (2000): «Comparison of Industrial Productivity Growth in Canada and the United States». *AEA Papers and Proceedings,* pp. 172-175.

HARBERGER, A. (1998): «A Vision of the Growth Process». *The American Economic Review* pp. 1-32.

HARLEY, C. K.(1993): «Reassessing the Industrial Revolution: A Macro View», in J. MOKYR (ed.), *The British Industrial Revolution: An Economic Perspective*. Boulder CO: Westview.

HULTEN, C. (1978): «Growth Accounting with Intermediate Inputs». *Review of Economic Studies* 45, pp. 511-518.

— «Growth Accounting when Technological Change is Embodied in Capital». *American Economic Review* 82 (4), pp. 964-980.

JORGENSON, D. W. (1995): *Productivity,* v. 2. Cambridge: MIT Press.

JORGENSON, D. W., and GRILICHES, Z. (1967): «The Explanation of Productivity Change». *Review of Economic Studies* 34 (3), pp. 245-284.

JORGENSON, D. W.; GOLLOP, and FRAUMENI (1987): *Productivity and US Economic Growth*. Cambridge MA: Harvard University Press.

JORGENSON, D., and STIROH, K. (2000): «Industry-level Productivity and Competitiveness between Canada and the United States». *AEA Papers and Proceedings,* May, pp. 161-171.

MARTÍN, C.; ROMERO, L., and SEGURA, J. (1981): *Cambios en la estructura interindustrial española, 1962-1970.* Serie E, N. 16, Madrid: Fundación INI.

MAS, M.; PÉREZ, F., and URIEL, E. (2005): *El stock de capital en España y su distribución territorial (1964-2002).* Bilbao: Fundación BBVA.

MAUDOS, J.; PASTOR, J. M., and SERRANO, L. (2000): «Crecimiento de la productividad y su descomposición en progreso técnico y cambio en la eficiencia. Una aplicación sectorial y regional en España (1964-1993)». *Investigaciones Económicas* 24 (1), pp. 177-205.

MYRO, R. (1983): «La evolución de la productividad global de la economía española en el período 1965-1981». *Información Comercial Española,* pp. 115-127.

O'BRIAN, P. K. (1993): «Introduction: Modern Conception of the Industrial Revolution», in P. K. O'BRIAN, and QUINAULT (eds.), *The Industrial Revolution and British Society.* Cambridge: Cambridge University Press.

OLINER, S. D., and SICHEL, D. E. (2000): «The Resurgence of Growth in the late 1990s: Is Information Technology the Story?». *Journal of Economic Perspectives* 14 (4), pp. 3-22.

PÉREZ, F.; GOERLICH, F. J., and MAS, M. (1996): *Capitalización y crecimiento en España y sus regiones, 1955-1995.* Madrid: Fundación BBVA.
PRADOS DE LA ESCOSURA, L. (2003): *El progreso económico de España.* Madrid: Fundación BBVA.
PRADOS DE LA ESCOSURA, L., and ROSÉS, J. R. (2005): «The Sources of Long-run Growth in Spain», paper presented at the Sixth European Historical Economics Society Conference (Istanbul, September 8-9, 2005).
RAYMOND, J. L. (1995): «Crecimiento económico, factor residual y convergencia en los países de la Europa comunitaria». *Papeles de Economía Española* 63, pp. 93-110.
SANCHÍS, M. T. (2000): «El desarrollo industrial español. Recuperación del crecimiento y límites al cambio estructural, 1950-1975». Unpubished Doctoral Thesis, Valencia: Universidad de Valencia.
— (2001): «Transferencias intersectoriales de productividad y crecimiento en la economía española, 1958-1975». *Revista de Historia Industrial.*
— (2005): «Disaggregated Productivity Growth and Technological Progress in the Interpretation of Spanish Economic Growth, 1958-1975». Madrid: Instituto de Historia Económica Laureano Figuerola, Working Papers ilf/05-03.
SOLOW, R. J. (1957): «Technical Change and the Aggregate Production Function». *Review of Economic and Statistics* 39, pp. 312-320.
SUÁREZ, F. J. (1992): «Economías de escala, poder de mercado y externalidades: medición de las fuentes del crecimiento español». *Investigaciones Económicas* (Segunda Época), XVI (3), pp. 411-441.

STATISTICAL REFERENCES

ALCAIDE INCHAUSTI, J. (2003): *Evolución económica de las regiones y provincias españolas en el siglo XX,* Bilbao: Fundación BBVA.
CONFEDERACIÓN ESPAÑOLA DE CAJAS DE AHORRO (1979): «La estructura productiva española. Tabla input-output de 1975 y análisis de la interdependencia de la economía española en el siglo XX», Fondo para la Investigación Económica y Social de las Cajas de Ahorro Confederadas.
DIRECCIÓN GENERAL DE ADUANAS, *Estadística del Comercio Exterior de España,* several years, Madrid.
INSTITUTO NACIONAL DE ESTADÍSTICA (1960): *Índice de Precios al por Mayor. Nuevo sistema de números índice, año 1955=100,* Madrid.
— (several issues): *Boletín Mensual de Estadística,* años 1963 a 1972, Madrid.
— (1961): *Boletín de Estadística,* noviembre, núm. 203, Madrid.
— (1973): *Contabilidad Nacional de España. Años 1964 a 1971 y avance de 1972,* Madrid.
— (1992): *Contabilidad Nacional de España. Serie enlazada, 1964-1991. Base 1986,* Madrid.
— *Salarios,* quartely publications for 1963-1973.
INSTITUTO NACIONAL DE ESTADÍSTICA, and MINISTERIO DE ECONOMÍA (1973): *Contabilidad Nacional de España. Años 1964 a 1971 y avance de 1972,* Madrid.
— (1979): *Contabilidad Nacional de España. Base 1970. Años 1964-1976, 1977 provisional y avance de 1978.*
— (1979): *Tablas de Correspondencia entre las Clasificaciones Nacionales de Actividades Económicas de 1974 y 1952,* Madrid.

INSTITUTO NACIONAL ESTADÍSTICA, and MINISTERIO DE PLANIFICACIÓN Y DESARROLLO (1975): *Clasificación Nacional de Actividades Económicas,* Madrid.

INSTITUTO DE ESTUDIOS FISCALES (1969): *La Contabilidad Nacional de España, 1954-1964,* Madrid.

MINISTERIO DE ECONOMÍA Y HACIENDA (several issues): *Estadísticas del Comercio Exterior de España,* Dirección General de Aduanas, varios años: 1950-1975.

MINISTERIO DE PLANIFICACIÓN Y DESARROLLO (1975): *Tablas input-output de la economía española. Año 1970.*

MINISTERIO DE INDUSTRIA Y ENERGÍA (1980): *Los coeficientes de capital-producto y capital-empleo en los principales sectores de la industria española.*

ORGANIZACIÓN SINDICAL ESPAÑOLA (1962): *Tablas input-output de la Economía Española, año 1962 (v. 2).*

SERVICIO SINDICAL DE ESTADÍSTICA (several issues): *Estadística de la Producción Industrial,* Madrid.

APPENDIX

Aggregation of Spanish Input-output tables (1958, 1962, 1970 and 1975) according to 1970 Spanish National Accounts classification

The Spanish input-output tables for the years 1958, 1962, 1970 and 1975 are an important part of the quantitative information used for the empirical analysis in this research. These tables show great divergence in their classification of productive branches. The number of productive branches included runs from 207 in the 1958 table to 86 in the 1962 input-output table. There are 137 branches in the 1970 table and 127 in the 1975 table. In order to make information homogeneous, we have aggregated all the tables at a level of the 25 branches established in 1970 Spanish National Accounts.

The detailed process of aggregating intermediate consumptions, primary inputs and final employment vectors is described in Sanchis (2000).

Intermediate Inputs Deflators

The objective has been to build a price index weighted by the share of national and imported inputs in the intermediate and final consumptions of each sector. The result is an average weighted price for each cell in the input-output table.

This appreciation is interesting as the Spanish economy progressively opened up over the period under analysis. This affected the composition of intermediate inputs, with an increasing participation of imports.

The series of domestic prices used as deflators for domestic consumption of goods and services are the following:

- Agriculture: The *Índice de precios percibido por los agricultores,* published by the Ministry of Agriculture, equivalent to the producer prices at which the tables are valued.
- Industry: *Índice de Precios al por Mayor* at 1955 base (IPM-55). In Sanchis (2000), equivalences have been established between branches of CNE-70 and IPM-55.
- Construction and services: It has been difficult to obtain appropriate deflators. For this reason we use the Value Added deflators. This means accepting that their prices vary in a similar way to their respective value added. The hypothesis is reasonable for more labour intensive services in which the value added is the most important component of overall cost. But for services like transport

and communications where the composition of input consumption and costs is more complex, this deflator is less suitable.

- Import prices: An import price index had to be produced using two kinds of import series: imports in values and imports in physical quantities. The data used are the series of values and quantities of imports summarised by the *Instituto Nacional de Estadística* in its *Anuarios Estadísticos,* over several years. The original source is the *Estadística del Comercio Exterior de España de la Dirección General de Aduanas*.

The deflating procedure was conducted as follows: 1) After establishing the composition of intermediate and final consumption between domestic and imported goods, we obtain a different deflator for all the cells in the tables. 2) This deflator is built as a Tornqvist index, which is commonly used to measure volume changes for productivity measurement purposes. The Tornqvist index is a discrete-time approximation to a Divisia index which takes into account share changes over time. When the production possibilities being analysed can be represented by a homogeneous translog function, as is the case, the Tornqvist index provides an accurate measure of the underlying theoretical volume index. In Sanchis (2000 and 2005) the input-output tables are aggregated at the same level and expressed at current and constant prices.