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# An Analysis of Differences in Labour Productivity in Manufacturing: Spain and Germany, 1993-2007

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# An Analysis of Differences in Labour Productivity in Manufacturing: Spain and Germany, 1993-2007[1]

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**Abstract**
The objective of this paper is to conduct a comparative analysis of labour productivity in manufacturing between Spain and Germany in the period 1993-2007. The aim is to identify the determinants that hinder the continued growth of productivity in Spanish industry when compared to Germany. The motivation is to find out if differences in productivity arise mainly from distinct production structures, if they are mainly due to an intrinsic problem of the industrial productivity itself or a combination of both. Results indicate that differences in industry structure do not totally justify the gap in productivity between the two countries. We conclude that there is a problem of convergence speed of both production structures, rather than one of absence of changes.

**Keywords**
Labour productivity; manufacturing industry; industrial composition.

[1] This paper is part of my PhD Dissertation "*Sources of productivity growth in developed countries: industry growth differences from intangible capital, R&D and competition.*" whose advisors are Dr. Josep Lladós Masllorens (Universitat Oberta de Catalunya, UOC) and Dr Raúl Ramos Lobo (Universitat de Barcelona, UB)

# Introduction

The crisis which started in 2008 is affecting most countries with different levels of intensity. Although it started in the financial sector, its impact has spread throughout the whole economy. Since the early 1990s the European Union economy has gone through two business cycles and is now in the downward phase of a third one. The troughs of the manufacturing cycles in EU occurred first in 1993 and then at the end of 2001. They were characterised by negative growth rates in manufacturing output. But in some countries the situation has been exacerbated by pre-existing low sectoral performance (EU Commission, 2009). That seems to be the case with Spain. Joining the European Union (EU) in 1986 played at least an important role in shaping Spain into what it is today (Mas et al., 2012). It benefited from the inflow of funds of the EU, which contributed definitively to Spanish economic growth and to its modernization. Consequently, one would have expected a better performance and a faster recovery of Spanish economy in front of the recent economic crisis. Spain's recovery patterns seem to be mostly affected not only by macroeconomic imbalances, but also by its difficulty to improve internal competitiveness.

As long as labour productivity is one of the drivers of internal competitiveness, this article focuses on its performance. In particular, we conduct a comparative analysis of industrial labour productivity between Spain and Germany in the previous years of the crisis, 1993-2007. The purpose is to identify the determinants that hinder the continued growth of productivity in Spanish industry, depriving from recovering of the present crisis. To this end, we aim to determine the existence of differences between industrial productivity in Spain and Germany, to assess its magnitude and the role of industry specialization. The motivation is to find out if differences in productivity arise mainly from distinct production structures, if they are mainly due to an intrinsic problem of the industrial productivity itself or a combination of both of them. There is now a vast amount of literature focusing on the explanation and impacts of the economic crisis at the macroeconomical level, with little emphasis on the sectoral patterns in relation to structural change and sectoral productivity growth (Timmer et al., 2011).

The results confirm that it is mainly an intrinsic problem of productivity itself. Industry specialization is becoming an influencing variable, although to a lesser degree. So the main contribution of this paper is that differences in industry structure do not totally justify the gap in productivity.

The remainder of this paper is organized as follows. After the introduction, the second section contains a brief description of the dataset. The third section describes the evolution of German and Spanish per capita gross value added (from now on GVApc) for the whole economy and for manufacturing. The aim is to see if both countries converge in total and in industrial GVApc, reducing their gap. Section 4 undertakes the decomposition of GVApc to assess if labour productivity is one of the main determinants of GVApc (Raymond and Garcia-Greciano, 1994; Lladós, 2002; Mas et. al. 2012)[2]. Furthermore, we confirm that differences in

[2] Raymond, J.L. and García-Greciano, B. (1994), "Las disparidades en el PIBpc entre las CC.AA. y la hipótesis de convergencia", *Papeles de Economía Española* 59:.38-58.

Lladós i Masllorens, J. (2002), "Estructura productiva y desigualdad regional: la transición hacia el euro y la economía del conocimiento", *Papeles de Economía Española* 93:.79-97.



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productivity are significant and persistent in the considered time period. The fifth section is devoted to the analysis of labour productivity growth and industry specialization. To this end, we implement three types of analysis. Firstly, we proceed to calculate an index of structural inequality that will conclude whether or not there has been a convergence between the two production structures. Secondly, we undertake a decomposition of aggregate productivity in to rate and level effects and a shift-share analysis. Both methodologies decompose aggregate productivity in two main explaining effects: roughly, one due to a pure productivity growth effect and the other one due to an industrial structure effect. Section 6 summarizes the main findings and conclusions

# 1. Data

To carry out this study we use the EU KLEMS Growth and Productivity Accounts (henceforth EUKLEMS; http://www.euklems.net)[3] which contain internationally comparable data for output and inputs. This database includes a wide range of measures on output growth, employment, skill creation, capital formation and multi-factor productivity at the industrial level for EU member states from 1970 until 2007.

As Timmer et al. (2007a & 2007b) states the main advantage of EU KLEMS database is that it allows to go beyond the aggregate level of economy to analyse the productivity performance of individual industries and their contribution to aggregate growth.

The data used in this paper covers the period from 1993 to 2007 for Spain and Germany. In all figures, tables and formulae E stands for Spain and Ger for Germany. Our analysis is implemented both at aggregate level as well as for individual branches of manufacturing industry. The dataset used here consists of 23 goods-producing industries that correspond to the 2-digit ISIC Revision 3.0.

Data on Population (P) and Labour force (LF) are obtained from Eurostat, both are annual averages expressed in millions. Labour force is defined as population in working age between 15 and 64 years. The rest of variables used in this paper are provided by EUKLEMS, more detailed explanation on the methodology followed to define and to obtain the variables is contained in http://www.euklems.net. Our output measure is gross value added at basic prices 1995=100. All monetary variables are expressed in Euros 1995 =100.

Mas, M. et al. (2012), *Industrial Productivity in Europe*: *Growth and* Crisis. Editors: Matilde Mas & Robert Stehrer, Edward Elgar Publishing.

[3] For a detailed description of the data, see Timmer et al. (2007 a, b) and http://www.euklems.net.

# 2. Comparison of the performance of per capita income in total economy versus manufacturing industry in Spain and Germany: are differences reducing?

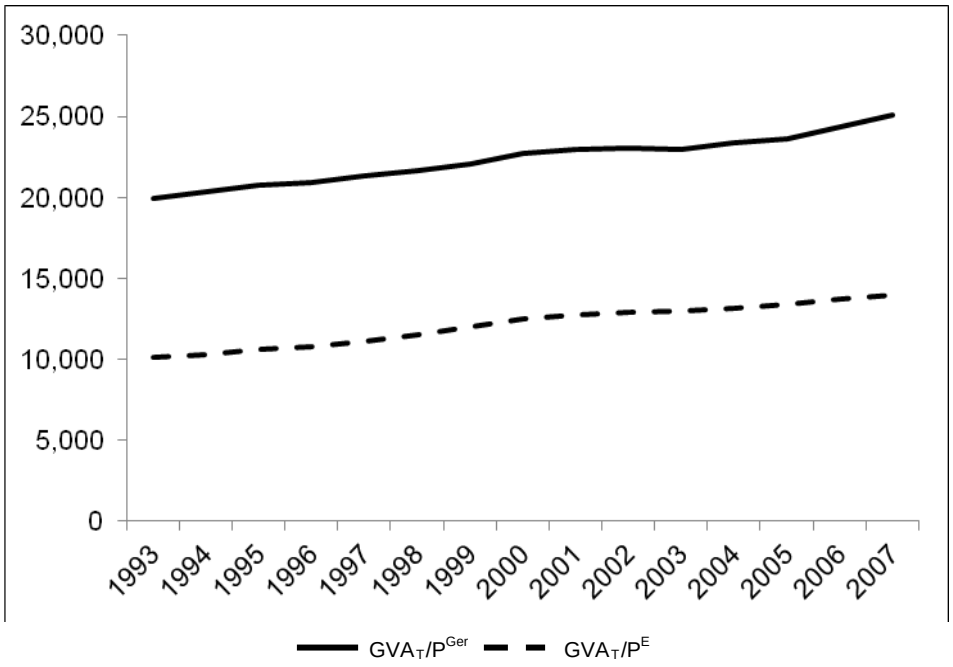
In this section we examine two aspects: on one hand, if differences in per capita income of the Spanish and German total economy have become less and, on the other hand, if this is also the case for manufacturing in 1993-2007. To this end per capital income of total economy is decomposed in two ratios: in per capita income of total economy over per capita income of the manufacturing ($GVA_T/GVA_I$) and industrial per capita income ($GVA_I$ /P):

$$\frac{GVA_T}{P} = \frac{GVA_T}{GVA_I} \times \frac{GVA_I}{P} \qquad (1)$$

where $GVA_T$ stands for gross value-added of the total economy; $GVA_I$ for gross value-added in the manufacturing industry and $P$ for the total population.

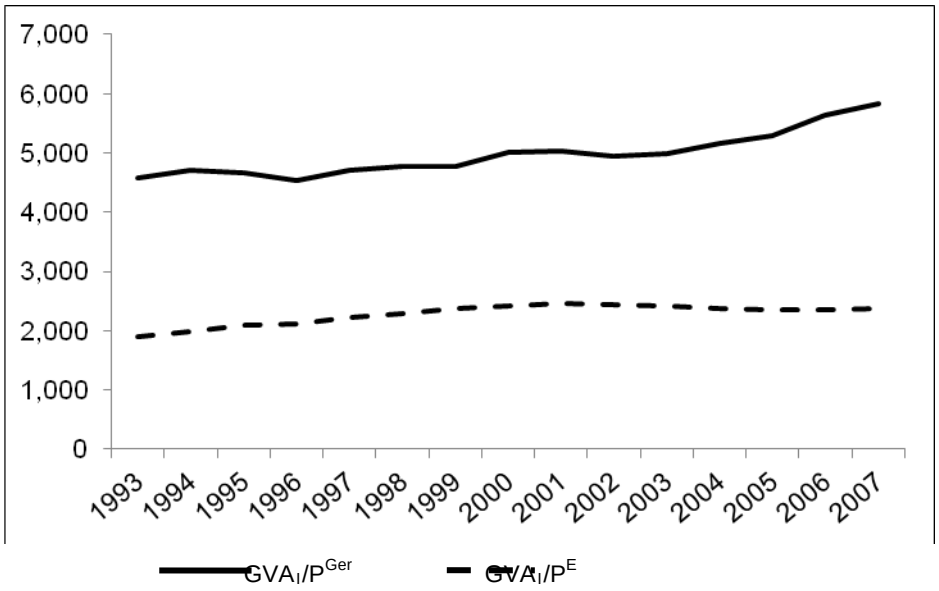
Figures 1, 2 and 3 display the evolution of $GVA_T/P$ and $GVA_I/P$, the differences between Spain and Germany each for both variables taking 1993 =100. At first glance, we can appreciate the gap and its persistence between Spain and Germany in terms of $GVA_T/P$ (Figure 1) as well as of $GVA_I/P$ (Figure 2). Both Figures 1 and 2 shows how per capita income of total economy and manufacturing follow the same slowly growing pattern in Spain and Germany. Just at the end of the considered period we appreciate a slight increase in the gap in $GVA_T/P$ between both economies, which is more pronounced in the manufacturing industry.

FIGURE 1. GVA PER CAPITA IN TOTAL ECONOMY. GERMANY AND SPAIN, 1993-2007
Millions of euros 1995 =100



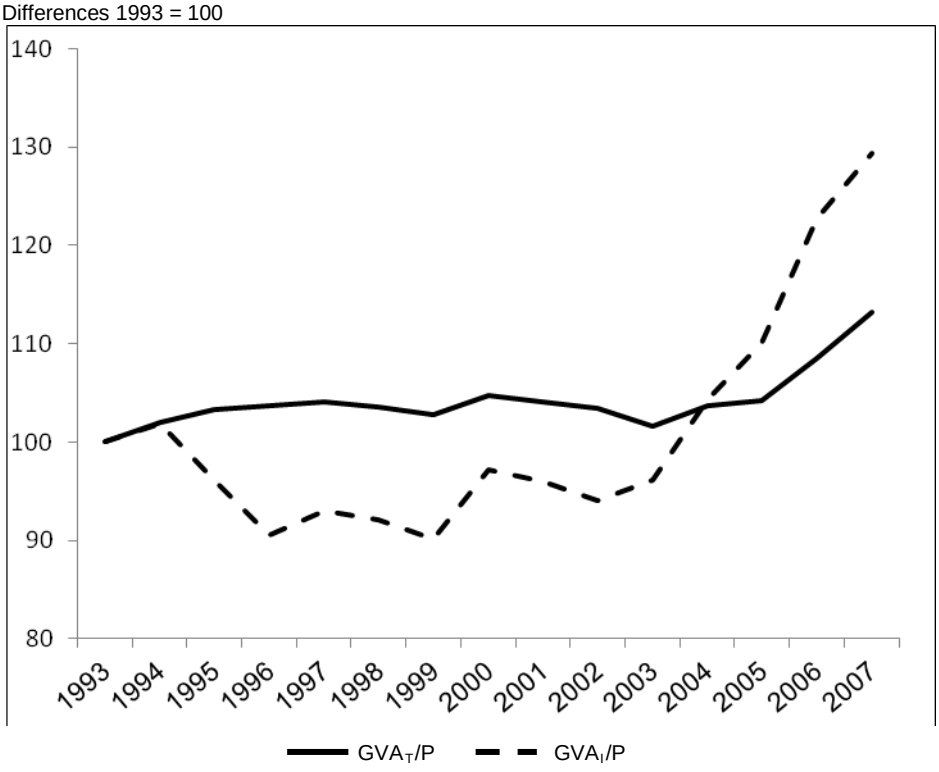

Source: EU KLEMS (2009), www.euklems.net and own calculations.

FIGURE 2. GVA PER CAPITA IN MANUFACTURING INDUSTRY. GERMANY AND SPAIN, 1993-2007
Millions of euros 1995 =100




Source: EU KLEMS (2009), www.euklems.net and own calculations.

FIGURE 3. GVA PER CAPITA DECOMPOSITION. SPAIN MINUS GERMANY
Differences 1993 = 100




Source: EU KLEMS (2009), www.euklems.net and own calculations.

Data contained in Table 1 panel (c) row (1) confirm it, in 1993 the difference between Spain's and Germany's $GVA_T/P$ was -9,798 millions of euros and increased in 2007 up to -11,093 millions of euros. In the whole period Spanish $GVA_T/P$ grows at an average annual rate of 2.31% while Germany's rate is 1.65% (Table 2 panels (a) and (b)). This faster growth of the

Spanish economy does not shorten the distance versus Germany, on the contrary, the difference in $GVA_T/P$ has become greater. Looking at its performance in the three subperiods (Table 2 panel (c) row 1 columns 1 to 3), it can be appreciated that Spain's growth rates are almost one point above the German, except for subperiod 2003-2007. The boom of the Spanish construction sector has played here a key role boosting economic growth. If we carry out the same exercise for per capita income in manufacturing in Figure 2 and 3 as well as Table 1 panel (c) row (3) we find a similar result: Spanish $GVA_I/P$ has diverged from the German one, in 1993 the difference represented about -2,675 millions of euros increasing up to -3,460 millions of euros in 2007. It is from 2002 on, when a clear divergence process (Figure 3) starts in per capita income in industry.

TABLE 1. GVA PER CAPITA DECOMPOSITION. SPAIN AND GERMANY, 1993-2007

Millions of euros 1995 =100

| | **1993** | **1999** | **2003** | **2007** |
|---|---|---|---|---|
| *(a) Spain* | | | | |
| $GVA_T/P$ | 10,126 | 11,992 | 12,989 | 14,000 |
| $GVA_T/GVA_I$ | 5.32 | 5.06 | 5.38 | 5.90 |
| $GVA_I/P$ | 1,905 | 2,370 | 2,413 | 2,372 |
| $(GVA_I/P)/(GVA_T/P)$ (1) | **18.8** | 19.8 | 18.6 | **16.9** |
| *(b) Germany* | | | | |
| $GVA_T/P$ | 19,924 | 22,064 | 22,945 | 25,093 |
| $GVA_T/GVA_I$ | 4.35 | 4.61 | 4.60 | 4.30 |
| $GVA_I/P$ | 4,580 | 4,782 | 4,985 | 5,831 |
| $(GVA_I/P)/(GVA_T/P)$ (1) | **23.0** | 21.7 | 21.7 | **23.2** |
| *(c) Spain minus Germany* | | | | |
| $GVA_T/P$ | -9,798 | -10,073 | -9,955 | -11,093 |
| $GVA_T/GVA_I$ | 0.97 | 0.44 | 0.78 | 1.60 |
| $GVA_I/P$ | -2,675 | -2,411 | -2,572 | -3,460 |
| $(GVA_I/P)/(GVA_T/P)$ (2) | -4.2 | -1.9 | -3.2 | -6.3 |

Note: (1) Figures in %. (2) Differences in percentual points.

Source: EU KLEMS (2009), www.euklems.net and own calculations.



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TABLE 2. GVA PER CAPITA DECOMPOSITION. SPAIN AND GERMANY, 1993-2007
(average annual growth rates in %)

| | **1993-2007** | **1993-1998** | **1999-2002** | **2003-2007** |
|---|---|---|---|---|
| *(a) Spain* | | | | |
| $GVA_T/P$ | **2.31** | 2.62 | 2.37 | 1.87 |
| $GVA_T/GVA_I$ | 0.75 | -1.14 | 1.53 | 2.30 |
| $(GVA_I/P)$ | **1.57** | 3.77 | 0.84 | -0.43 |
| *(b) Germany* | | | | |
| $GVA_T/P$ | **1.65** | 1.70 | 1.41 | 2.24 |
| $GVA_T/GVA_I$ | -0.08 | 0.92 | 0.27 | -1.68 |
| $(GVA_I/P)$ | **1.73** | 0.78 | 1.14 | 3.92 |
| *(c) Spain minus Germany* | | | | |
| $GVA_T/P$ | **0.67** | 0.92 | 0.96 | -0.36 |
| $GVA_T/GVA_I$ | 0.83 | -2.06 | 1.26 | 3.98 |
| $GVA_I/P$ | **-0.16** | 2.98 | -0.30 | -4.35 |

Source: EU KLEMS (2009), www.euklems.net and own calculations.

Summarizing, growth rates in Table 2 and the performance of the variables displayed in Figure 3 reveal how after a rapid increase in Spanish $GVA_I/P$ in the first subperiod 1993-1998, in which Spanish industry gains importance in the whole economy, 1999 marks a turning point reversing the performance of this variable. From then on, Spanish industry is rapidly losing weight in total economy.

In Figure 3 it can be appreciated how differences in GVAI/P between Spain and Germany are rapidly increasing whereas the gap in GVAT/P is growing slower. This is the case from 2002 onwards for industrial per capita income differences which starts its rapid increase some years earlier than total per capita income.

The main reading of this behaviour is that Spain seems to have neglected its manufacturing industry in terms of investments in technological capital in key sectors and also in human capital. So, obviously now the Spanish industry is not able to generate value-added at the same rate as the German one. As shown in Table 1 panels (a) and (b), the ratio [(GVAI/P)/(GVAT/P)] has grown for Germany from 23.0% up to 23.2% in front of Spain where it has decreased two points, from 18.8% to 16.9%. That means German manufacturing industry has undergone necessary adjustments in manufacturing industry in contrast to Spain, which seems as it is not able to overcome historical problems and thus lost weight in overall economy (see also Table 2).

We can confirm that neither the differences in per capita income of the whole economy are reducing between Spain and Germany in 1993-2007, nor do the per capita income differences in manufacturing industry. It is worth to point out that differences in industrial per capita income are growing faster than differences in total economy per capita income.

# 3. Main sources of Gross Value Added per Capita in Manufacturing Industry

In this section we first analyze whether or not labour productivity per hour is one of the main determinants of differences in gross value-added per capita among manufacturing industries of Spain and Germany. Second, and in order to check if differences in labour productivity between Spain and Germany are significant and persistent in time, we will carry out a static and a dynamic analysis. To this end, we take as a reference a rather useful decomposition of per capita income, which have been applied by several authors as Raymond and García-Greciano (1994), Lladós (2002) and Mas et al. (2012):

$$\frac{GVA_I}{P} = \frac{GVA_I}{H_I} \times \frac{H_I}{L_I} \times \frac{L_I}{LF} \times \frac{LF}{P} \qquad (2)$$

Where $GVA_I$ stands for gross value-added; $P$ for total population; $H$ is total hours worked; $L$ is total employment (in persons) and $LF$ represents the labour force, that is population of working age (16 to 65). All these variables are related to the industry (denoted with subindex $I$) with the exception of the population $P$ and $LF$ active population, which refer to the total of the country concerned.

Therefore, the term on the left-hand side of (2) measures per capita income for the manufacturing industry (GVAI/P) and it is decomposed in four ratios on the right-hand side. This expression indicates that the per capita gross value-added (GVAI/P) is explained by four components: the first (GVAI/H = LP) measures labour productivity in terms of hours worked; the second (HI/LI) total hours worked per employed person; the third (LI/LF) the employment rate and the last component (LF/P).

At first we will examine the status quo at the beginning and at the end of the considered period in order to compare both and also to assess the differences among both industries. Afterwards we study the variables' evolution that is from a dynamic point of view.

Table 3 presents the contribution of each component of (2) in levels for the years 1993 and 2007, as well as their growth rates for 1993-2007. In panel (a) and (b) we have the figures for each industry, in panel (c) we can see the ratio Spain over Germany (that is (a)/(b)) in percentage and in panel (d) we have the differences between Germany and Spain.



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TABLE 3. GROSS VALUE-ADDED PER CAPITA DECOMPOSITION IN MANUFACTURING INDUSTRY. SPAIN AND GERMANY, 1993-2007

Millions of Euro1995=100

| | 1993 | 2007 | 1993-2007(1) |
|---|---|---|---|
| *(a) Spain* | | | |
| GVA per capita | 1,905 | 2,372 | 1.6 |
| Labour productivity (LP) | 17.0 | 21.2 | 1.6 |
| Number of hours worked by engaged person (H/L) | 1,754 | 1,612 | -0.6 |
| Employment rate (L/LF) | 0.09 | 0.10 | 0.4 |
| Activity rate (LF/P) | 0.68 | 0.69 | 0.2 |
| *(b) Germany* | | | |
| GVA per capita | 4,580 | 5,831 | 1.7 |
| Labour productivity (LP) | 26.59 | 43.19 | 3.5 |
| Number of hours worked by engaged person (H/L) | 1,514 | 1,456 | -0.3 |
| Employment rate (L/LF) | 0.17 | 0.14 | -1.3 |
| Activity rate (LF/P) | 0.69 | 0.67 | -0.2 |
| *(c) Spain/Germany* (2) | | | |
| GVA per capita | 41.6 | 40.7 | -0.2 |
| Labour productivity (LP) | 64.1 | 49.2 | -1.9 |
| Number of hours worked by engaged person (H/L) | 115.9 | 110.7 | -0.3 |
| Employment rate (L/LF) | 56.9 | 72.2 | 1.7 |
| Activity rate (LF/P) | 98.5 | 103.6 | 0.4 |
| *(d) Spain minus Germany* (3) | | | |
| GVA per capita | -2,675 | -3,460 | 784.3 |
| Labour productivity (LP) | -9.6 | -22.0 | 12.4 |
| Number of hours worked by engaged person (H/L) | 240.4 | 155.7 | -84.6 |
| Employment rate (L/LF) | -0.1 | 0.0 | 0.0 |
| Activity rate (LF/P) | 0.0 | 0.0 | 0.0 |

Notes: (1) Average annual growth rate in %. (2) Weight Spain over Germany in %. The figures displayed in the third column in panel *(c)* are the vertical differences. (3) Figures in the third column in panel *(d)* are horizontal differences computed in absolute value.

Source: EU KLEMS (2009), www.euklems.net and own calculations.

The data show that the differences between the two countries are substantial and confirm that labour productivity is one of the main drivers of per capita income together with the number of hours worked per employed person ($H_I/L_I$) in both industries in the whole period showing both considerable dispersion among the variables and the subperiods. Furthermore, differences

in labour productivity increases its importance, while number of hours worked reduces it. The behaviour of the rest of variables plays a little role in industrial per capita income.

In Table 3 panel (d) we can see that not only German values are significantly higher than the Spanish ones, but the gap between both industries has increased displaying a persistent trend. Germany's productivity grows at 3.5% while Spain only at a 1.6%, showing a sluggish behaviour in contributing to value added growth (Table 3 panels (a) and (b)). This reflects the greater capacity of German industry to generate value added. This ability can be explained either by an increased production efficiency, by a greater qualification of human capital, by a larger stock of capital (it incorporates more technical progress) or a combination of all these factors. Taking a look at the weights of the different variables (panel (c)) that intervene in decomposition, we see that all of the Spanish components have lost weight in relation to Germany considering the whole period. The only exception is the employment rate and to a less extent the activity rate.

In fact, if we look at the employment rate in both industries, they are similar, though somewhat smaller in Spain. This is indicative of less specialization of the Spanish economy in the industrial sector. The total number of hours worked per engaged person in Spanish industry is slightly larger than the German, while the employment rate is a bit smaller. There are engaged persons working in the Spanish industry, but they work more hours than their German counterparts. Thus one would expect then a higher industrial value added than observed. A possible explanation for this fact is that in Spain the proportion of hours worked in the industrial sector in relation to total hours worked in all sectors of production is lower than in Germany. This lower relative importance of the industrial sector in the Spanish economy, along with a reduced ability to generate value added and a lower productivity show that Spanish industry suffers inefficiencies that prevent progress at the same rate as the German industry.

The figures analyzed allow us to answer the first question, productivity is one of the main factors explaining the gap between the Spanish and German per capita income as well as to confirm the hypothesis of the existence of significant differences in productivity between Spanish and German industries.

This was the situation at two concrete moments of the period examined, 1993 and 2007. But which has been the evolution between 1993 and 2007? Table 4 presents similar information as Table 3 but it distinguishes between the whole period 1993-2007 and different subperiods: 1993-1998, 1999-2002 and 2003-2007. The variables are expressed in percentual average annual growth rates. The aim is to confirm the significance and persistence of the differences between Spain and Germany. From this table, we can see that over the whole period both countries show significant dispersion in their growth rates, particularly Germany. In the subperiods, labour productivity is still one the main variables explaining the performance of GVAI/P in manufacturing. In the period 1993-1998 both GVAI and employment in Spain grew at a very fast rate, while in Germany both variables showed a sluggish pace. At this point it's important to say that Germany's industry is undertaking an adjustment mainly due to German reunification, which lasts approximately from 1993 to 2002. Subperiod 1999 to 2002 is characterized by a slowdown in productivity and the rest of determinants of per capita income. This trend is not only maintained but worsened in the case of Spanish industry with the exception of labour productivity in the last subperiod, 2003-2007. On the contrary Germany increases its value added and productivity significantly, while the other determinants show a slight improvement. Spain presents a very poor performance in labour productivity although the severe employment destruction in the last subperiod.

TABLE 4. GVA PER CAPITA DECOMPOSITION IN MANUFACTURING INDUSTRY. GERMANY AND SPAIN, 1993-2007
(average annual growth rates in %)

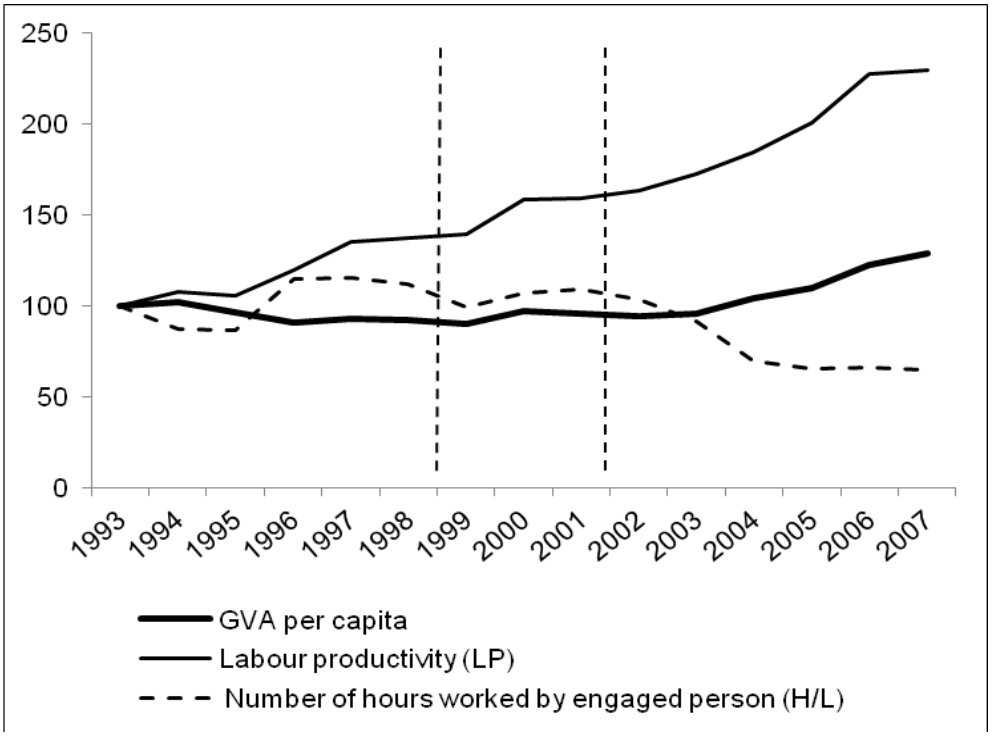
| | 1993-2007 | 1993-1998 | 1999-2002 | 2003-2007 |
|---|---|---|---|---|
| (a) Spain | | | | |
| GVA per capita | 1.6 | 3.8 | 0.8 | -0.4 |
| Labour productivity (LP) | 1.6 | 1.5 | 0.9 | 1.9 |
| Number of hours worked by engaged person (H/L) | -0.6 | 0.2 | -0.7 | -0.9 |
| Employment rate (L/LF)* | 0.4 | 1.8 | 0.5 | -1.5 |
| Activity rate (LF/P)* | 0.2 | 0.3 | 0.1 | 0.1 |
| (b) Germany | | | | |
| GVA per capita | 1.7 | 0.8 | 1.1 | 3.9 |
| Labour productivity (LP) | 3.5 | 3.4 | 2.8 | 4.5 |
| Number of hours worked by engaged person (H/L) | -0.3 | -0.1 | -1.1 | 0.1 |
| Employment rate (L/LF)* | -1.3 | -2.4 | -0.1 | -0.5 |
| Activity rate (LF/P)* | -0.2 | -0.1 | -0.4 | -0.1 |
| (c) Spain minus Germany | | | | |
| GVA per capita | -0.2 | 3.0 | -0.3 | -4.3 |
| Labour productivity (LP) | -1.9 | -1.9 | -1.8 | -2.5 |
| Number of hours worked by engaged person (H/L) | -0.3 | 0.3 | 0.4 | -1.0 |
| Employment rate (L/LF) | 1.7 | 4.2 | 0.6 | -1.0 |
| Activity rate (LF/P) | 0.4 | 0.4 | 0.6 | 0.2 |

Notes: (*) Computed taking simple differences as usual for this kind of variables and not taking average annual growth rates.

Source: EU KLEMS (2009), www.euklems.net and own calculations.

Figure 4 displays the differences between Germany and Spain taking 1993 =100. The most striking fact is how from 1993 on up to 2007 the gap in labour productivity grows at a rapid pace. Its performance confirms again that it is one of the main determinants of the differences in per capita income in manufacturing and that these differences are persistent.

FIGURE 4. $GVA_{PC}$, LABOUR PRODUCTIVITY AND NUMBER OF HOURS WORKED BY ENGAGED PERSON. SPAIN MINUS GERMANY. MANUFACTURING INDUSTRY, 1993-2007
Differences 1993 = 100




Source: EU KLEMS (2009), www.euklems.net and own calculations.

Summarising, labour productivity is one of the most important factor explaining differences in industrial per capita between both countries, that they are significant and persistent in the whole period 1993-2007. The rest of the components show no major differences.

# 4. Labour Productivity and Industrial Specialization

Up to now, we have seen that there is no process of convergence in manufacturing labour productivity between Spain and Germany from 1993 to 2007. The question posed in this section is if the differences in the industry specialization among both countries justify the existing differences in manufacturing labour productivity. To this end, we start by focusing on the productive structure in each country and then looking at the differences in their composition. So firstly, in order to answer this question, we make use of two indexes (Pérez García et al., 2006) to compute the share of each industry branch value added in total manufacturing industry value added[4].

Secondly, we undertake an analysis from two complementary perspectives in order to identify the causes of the productivity gap between both industries, to this end we study whether they are due to changes in the sectoral structure or to differences in productivity itself between

[4] The same exercise has been replicated using sectoral labour's share with similar qualitative results.

sectors. The first analysis is to decompose these differences in rate effect and level effect in the same way as in the paper Fernández Casillas and Mate Rubio (1994). The second involves the decomposition of aggregate productivity differences in three explanatory components (industry mix, productivity differential and allocative) by shift-share technique following the methodology of Esteban (1972, 2000) and will be computed in levels.

## 4.1. Changes in Industry Specialization

In this subsection we start analysing separately how the composition in the productive structure in terms of sectoral GVA over the total manufacturing GVA of the Spanish and the German industry has changed in the considered time period, 1993-2007. To this end, we compare the compositional differences between the same industrial sector at two points in time (t = 0 and t= T) using a structural change index $L_{0T}$. Afterwards, we proceed to compare both industrial structures to detect whether there has been a convergence between them or not.

According to Pérez García et al. (2006) $L_{0T}$ index is defined as follows:

$$L_{0T} = \frac{1}{2}\sum_{j=1}^{N}\left|X_{jT} - X_{j0}\right| \times 100 \quad (3)$$

$X_{j0}$ where is the weight of sector j in the total industry in the initial period 0 and $X_{jt}$ j sector weight in total industry in the final period T. The index $L_{0T}$ measures therefore the magnitude of change of sectoral specialization between these two periods and takes larger values, the more intense the change. Specifically, the index is bounded between 0 and 100 and expresses in terms of percentages the changes in the composition of production. The second one, is the index of differences in industries' composition ($L_{AB}$) which is identical to $L_{0T}$ but referred to two industries, A and B, in the same moment of time. It is computed according to (4):

$$L_{AB} = \frac{1}{2}\sum_{j=1}^{N}\left|X_{jA} - X_{jB}\right| \times 100 \quad (4)$$

In (4) $X_{jA}$ is the weight of sector j in total industry A in a given moment of time and $X_{jB}$ is the corresponding value for sector j in industry B. $L_{AB}$ index is bounded between 0 and 100 and measures the magnitude of the differences in sectoral specialization in industries A and B. It takes larger values, the lower the similarity. In this analysis, country A is Spain (E) and B is Germany (Ger), so henceforth $L_{AB}$ will be $L_{E\text{-}Ger}$

Figures 5 and 6 offer an overview at sectoral level for both industries in 1993 and 2007 of the weight of sectoral GVA on total manufacturing industry GVA and of both indexes. Let us start, firstly, by having a look at the performance of the index of differences in industries' composition LE-Ger (Figure 5) and, secondly, by seeing what has happened with the structural change index L0T in each industry in Figure 6.



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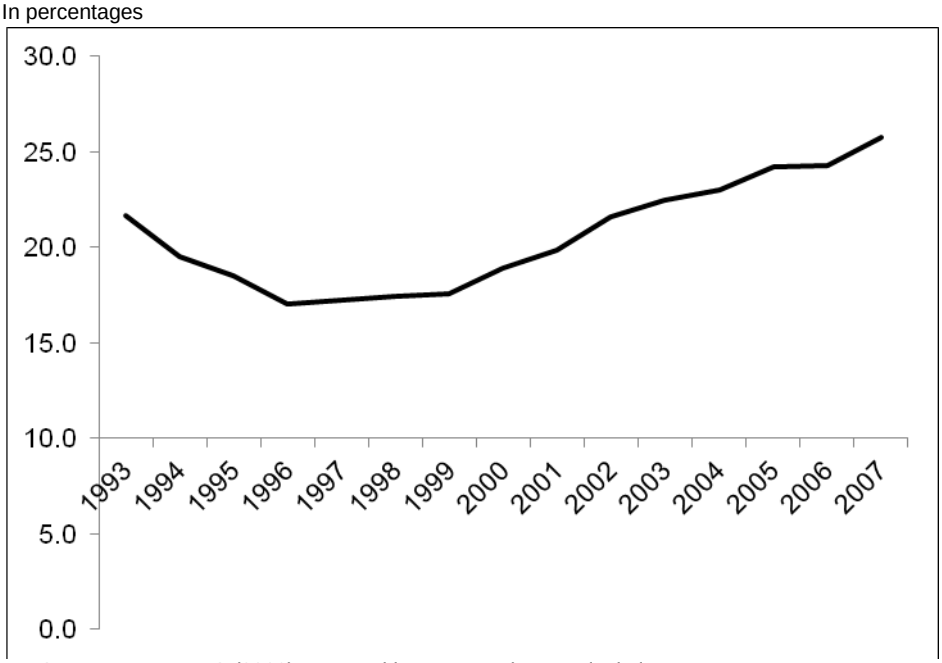
FIGURE 5. INDEX OF DIFFERENCES IN INDUSTRIES' COMPOSITION, $L_{E\text{-}GER}$.
In percentages

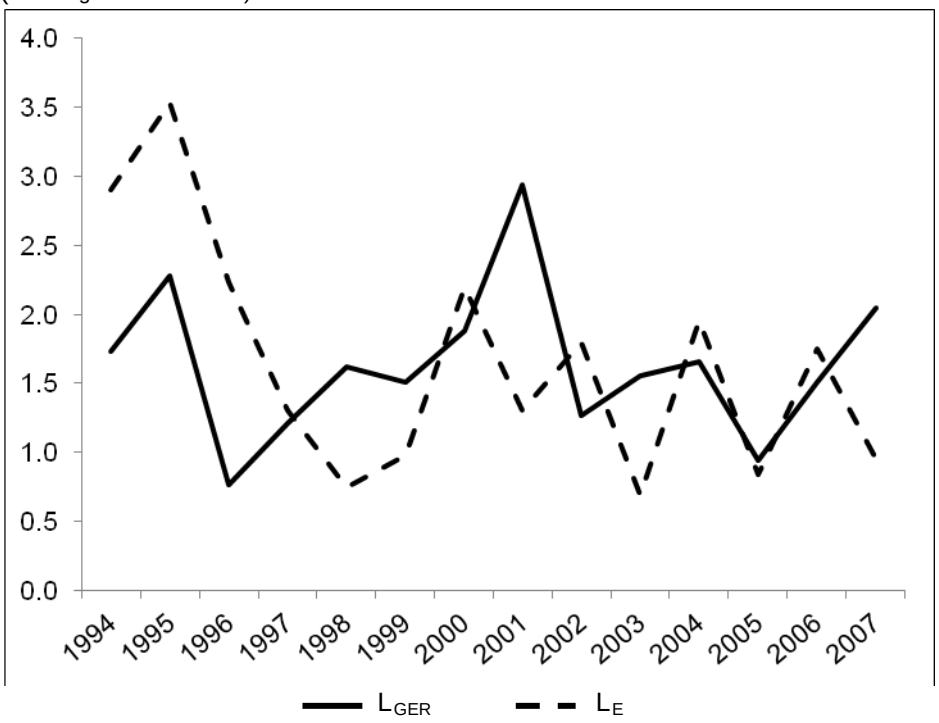



Source: EU KLEMS (2009), www.euklems.net and own calculations.

Figure 5 displays the evolution of the index of differences in industries' composition $L_{E\text{-}Ger}$, in it we can appreciate how the differences between Spain and Germany have grown from 21.6% to 25.7%.

Figure 6 shows the performance of structural change index L0T for Spain and Germany, here we observe that both industries show a great variability, indicating that both have implemented changes in its production composition. But the small values of the index L0T indicate that they haven't been significant.

FIGURE 6. STRUCTURAL CHANGE INDEX $L_{0T}$
(annual growth rates in %)




Source: EU KLEMS (2009), www.euklems.net and own calculations.

The main conclusion is that Spain has not undergone significant changes in its composition of production, concentrating its production in less productive branches which are thus less exposed to competence.

## 4.2. Decomposition of aggregate Productivity Changes in Rate and in Level Effect

Here we implement the same methodology used by Fernández Casillas and Maté Rubio (1994) in their decomposition of aggregate productivity change analysis, but for the Spanish and German manufacturing. Aggregate average productivity is affected over time by changes in productivity within sectors and movements in output and employment or hours worked across sectors with different levels of average productivity. We analyse to what extent the convergence (or divergence) of aggregate productivity in manufacturing between Spain and Germany is explained by changes in the sectoral structure (level effect), by productivity changes within sectors (rate effect) and by a small interaction effect (residual) consequence of the other two changes.

This methodology (Fernández Casillas and Maté Rubio, 1994) is interesting because it allows not only to study the aggregate productivity changes inside an industry, but its main advantatge is that it permits to compute and compare directly two industries. This will show us some useful evidences for our analysis, which may be conclusive. To carry out this study we take the same data as those in the former sections (see section 2). The results are examined for total manufacturing as well as for the different branches of production. We depart from the

following expression where the aggregate productivity growth can be decomposed in the rate effect (β), the second is the level effect (v) and the last term is the interaction effect (θ).

$$\frac{\Delta P}{P_t} = \sum_i q_{it}\left(\frac{\Delta P_i}{P_{it}}\right) + \left[\left(\frac{P_{it}}{P_t}\right) - 1\right]\Delta S_i + \sum_i q_{it}\left(\frac{\Delta P_i}{P_{it}}\right)\left(\frac{\Delta S_i}{S_{it}}\right) \quad (5)$$

Before turning to the discussion of the results it is convenient to point out two aspects. Firstly, the amount of the different effects is influenced by the degree of industrial disaggregation and, secondly, for any degree of disaggregation we depart from computing the average productivities of subsectors that may be very different among them.

The empirical results are displayed in Table 55. At a first glance, the figures in panel (a) and (b) confirm that the rate effect6 is the main determinant of aggregate productivity differences in both industries in the whole period as well in all the subperiods. As far as productivity is an indicator of efficiency of how inputs are allocated and combined in order to obtain an output, the results are indicative for the relevance of this effect as main driver of aggregate productivity and of economic growth. Here again we can appreciate the poor performance of Spanish manufacturing when it comes to be efficient and generating value added. Comparing the results of the level effect7 in the first and in the last subperiod, we observe how it experienced a slightly increase (form -0.095 to 0.836) in its importance in Spain (see Table 5) whereas the opposite happens in Germany (from 0.465 to -0.182). This is indicative of a small change in the production structure, confirming the results obtained in the

[5] *Table A1.1* displays the results of yearly average annual rates.

[6] The *rate effect* is the part of aggregate productivity that results from changes in average labour productivity *within* sectors. It is the amount of aggregate change that would have occurred if each sector's share of total hours worked by engaged person remained constant.

[7] The *level effect* also called *intersectoral composition effect*, is the part of the variation in aggregate productivity explained by the change in the structure of total hours worked by engaged person, plainly employment. Put in another way, it reflects the change in aggregate productivity due to variations in employment in manufacturing industry, remaining sectoral productivities constant.



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TABLE 5. DECOMPOSITION OF AGGREGATE PRODUCTIVITY CHANGE. MANUFACTURING INDUSTRY: SPAIN AND GERMANY, 1993-2007

(average annual growth rates in %average annual growth rates in %)

| | 1993-2007 | 1993-1998 | 1999-2002 | 2003-2007 |
|---|---|---|---|---|
| *(a) Spain* | | | | |
| Rate effect $\beta^{E}_{t}$ (1) | 22.180 | 7.812 | 1.855 | 7.149 |
| Level effect $v^{E}_{t}$ (2) | 1.388 | -0.095 | 0.879 | 0.836 |
| Interaction effect $\theta^{E}_{t}$ (3) | 1.045 | 0.388 | 0.064 | -0.329 |
| Δ Productivity/ Productivity $\gamma^{E}_{t}$ = (1) + (2) + (3) | 24.613 | 8.105 | 2.799 | 7.656 |
| *(b) Germany* | | | | |
| | | 17.69 | | 19.69 |
| Rate effect $\beta^{Ger}_{t}$ (1) | 61.896 | 0 | 8.471 | 3 |
| Level effect al $v^{Ger}_{t}$ (2) | 1.189 | 0.465 | 0.175 | -0.182 |
| Interaction effect $\theta^{Ger}_{t}$ (3) | -0.846 | -0.039 | -0.032 | -0.149 |
| Δ Productivity/ Productivity $\gamma^{Ger}_{t}$ = (1) + (2) + (3) | 62.239 | 18.11 6 | 8.615 | 19.36 2 |
| *(c)* Differences Spain minus Germany | | | | |
| | **1993-2007** | **1993-1998** | **1999-2002** | **2003-2007** |
| Rate effect($\beta^{E}_{t}$- $\beta^{Ger}_{t}$) | -39.716 | -9.879 | -6.616 | -12.544 |
| Level effect ($v^{E}_{t}$ - $v^{Ger}_{t}$) | 0.200 | -0.560 | 0.704 | 1.018 |
| Interaction effect ($\theta^{E}_{t}$- $\theta^{Ger}_{t}$) | 1.891 | 0.428 | 0.096 | -0.180 |
| Δ Productivity/ Productivity ($\gamma^{E}_{t}$-$\gamma^{Ger}_{t}$) = (1) + (2) + (3) | -37.626 | -10.011 | -5.816 | -11.706 |

Source: EU KLEMS (2009), www.euklems.net and own calculations.

previous section. Interaction effect is so small that is worthless to comment, being null its impact on productivity growth. Again we see that the subperiod 1999-2002 is one of slow progress of the three determinants and for thus also for productivity growth. Taking a look at panel (c) data confirm that the differences in aggregate productivity growth are mainly due to rate effect, rather than to level effect. So, we can conclude that the differences in industry specialization do not justify the existing gap in productivity among both industries.

In order to complete our analysis, in the next subsection 5.3, we will apply the shift-share methodology and so confirm our hypothesis that changes in industrial specialization do not justify productivity differences between Spanish and German manufacturing industries. This time instead of computing growth rates (dynamic analysis), we'll implement shift-share analysis taking the variables in level (static analysis). We aim to complement the dynamic point of view with the static one, in order to get a more complete view of our study.



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## 4.3. Shift –share Analysis

As we have seen from different perspectives, the industrial dimension seems to play an important role in labour productivity performance. Here we want to enforce the conclusions driven from the latter decomposition of aggregate productivity changes with a shift-share analysis following the methodology applied by Esteban (1972; 2000).

In 1972 Esteban modified the standard decomposition into two factors extending it to the sum of three components: structural, differential and allocative. The first part reports on the percentage of growth attributable to industry mix in each region .The second measures the part due to the fastest growth of the region at the sectoral level (possibly caused by increased productivity). Finally, the third component measures the covariance between the first two components. This can be interpreted as the contribution to regional growth resulting from their specialization in those activities in which the region is more competitive. His model has been widely accepted as there have been many researchers who still have used it with modifications (Herzog and Olsen, 1977; Tervo and Okko, 1983, Ledebur and Moomaw, 1983; Arcelus, 1984).

Although the shift-share analysis was originally conceived as a technique to analyze regional employment dynamics, its extension is immediate to decomposition of interregional differentials aggregate productivity. Here we will apply the shift-share analysis with the aim to decompose the difference in the level of average labour productivity between Spain and Germany. Since in this paper the comparison is between two manufacturing industries: Spain and Germany - industries instead of regions will be discussed. When computing differences between both industries, again we take Germany as a benchmark.

The objective is to examine whether the slower productivity growth is due to a lesser redistribution of factors towards branches with higher productivity levels and/or higher productivity growth (structural change effect), or if it is a consequence of an overall slower growth of productivity at industrial level (within-industry effect). The following expression reflects the gap between average productivity between country i and the reference or benchmark country decomposed into three components. Each of these components of the aggregate includes a source causing productivity differences (Esteban; 1972 and 2000).

$$x_i - x = \mu_i + \pi_i + \alpha_i \qquad (6)$$

In order to determine the relevance of industry-specific productivity differentials and/or industry mix, we contrast each industry branch against a benchmark one endowed with sectoral productivities and industry mix equal to an industry average. Thus, the peculiarities of the Spanish industrial branches will be captured by the differences between the Spanish and the benchmark industry mix and between the Spanish and the benchmark sectoral productivities. To this end we simulate for Spain the aggregate productivity that it would have had if it deferred from the benchmark standards in one respect only. The difference with respect to the benchmark German productivity gives the contribution of each of these components in explaining the gap between Spanish actual and benchmark German aggregate productivity.

Table 6 shows results for a few key years over time, as well as the average for the whole period. Firstly, in panel (a) we see the differences between both industries and, secondly, in (b) we have computed these differences as a percentage of labour productivity in the industry of reference. Let us start by looking at panel (a), all three effects display a growing trend in the differences between both industries in the whole period, showing a significant increase between the 2003 and 2007.



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TABLE 6. SHIFT-SHARE ANALYSIS. MANUFACTURING INDUSTRY: SPAIN - GERMANY, 1993-2007
(a) Shift-share components

In percentage

| | 1993 | 1999 | 2003 | 2007 | Average |
|---|---|---|---|---|---|
| Industry mix[8]: $\mu^E_i = \Sigma i\ (p^E_{it} - p^{Ger}_{it}) * x^{Ger}_{it}$ | -1.44 | -1.99 | -2.29 | -4.02 | -2.110 |
| Productivity differential[9]: $\pi^E_i = \Sigma i\ (x^E_{it} - x^{Ger}_{it}) * p^{Ger}_{it}$ | -8.78 | 11.83 | 14.85 | 20.42 | -13.027 |
| Allocative[10]: $\alpha^E_i = \Sigma i\ (p^E_{it} - p^{Ger}_{it}) * (x^E_{it} - x^{Ger}_{it})$ | 0.67 | 0.46 | 0.66 | 2.49 | 0.717 |
| Average productivity difference $(x^E_{it} - x^{Ger}_{it})$ $= \mu_i + \pi_i + \alpha_i$ | -9.55 | 13.36 | 16.48 | 21.96 | -14.923 |

(b) Weight of each component $\mu_i^E$, $\pi_i^E$ y $\alpha_i^E$ on the productivity differential (in %).

In percentage

| | 1993 | 1999 | 2003 | 2007 | Average |
|---|---|---|---|---|---|
| Industry mix: $\mu^E_i = \Sigma i\ (p^E_{it} - p^{Ger}_{it}) * x^{Ger}_{it}$ | 15.11 | 14.93 | 13.89 | 18.33 | 14.709 |
| Productivity differential: $\pi^E_i = \Sigma i\ (x^E_{it} - x^{Ger}_{it}) * p^{Ger}_{it}$ | 91.90 | 88.55 | 90.14 | 92.99 | 90.042 |
| Allocative: $\alpha^E_i = \Sigma i\ (p^E_{it} - p^{Ger}_{it}) * (x^E_{it} - x^{Ger}_{it})$ | -7.01 | -3.47 | -4.02 | -11.32 | -4.750 |
| Average productivity difference $(x^E_{it} - x^{Ger}_{it})$ $= \mu_i + \pi_i + \alpha_i$ | 100 | 100 | 100 | 100 | 100 |

Source: EU KLEMS (2009), www.euklems.net and own calculations.

*Productivity differential* or *country effect* is the main explaining factor of aggregate productivity differences, Spain seems not to be able to reverse this divergent trend. Concerning industry specialization it is also negative but significantly smaller, although the gap is increasing in time and gaining importance in explaining the performance of aggregate productivity differences. The allocation effect $\alpha_i$ shows a similar behaviour as the other two effects, but their figures are considerably smaller. Hence as they do have an almost null influence explain the differences in productivity changes, we ignore them.

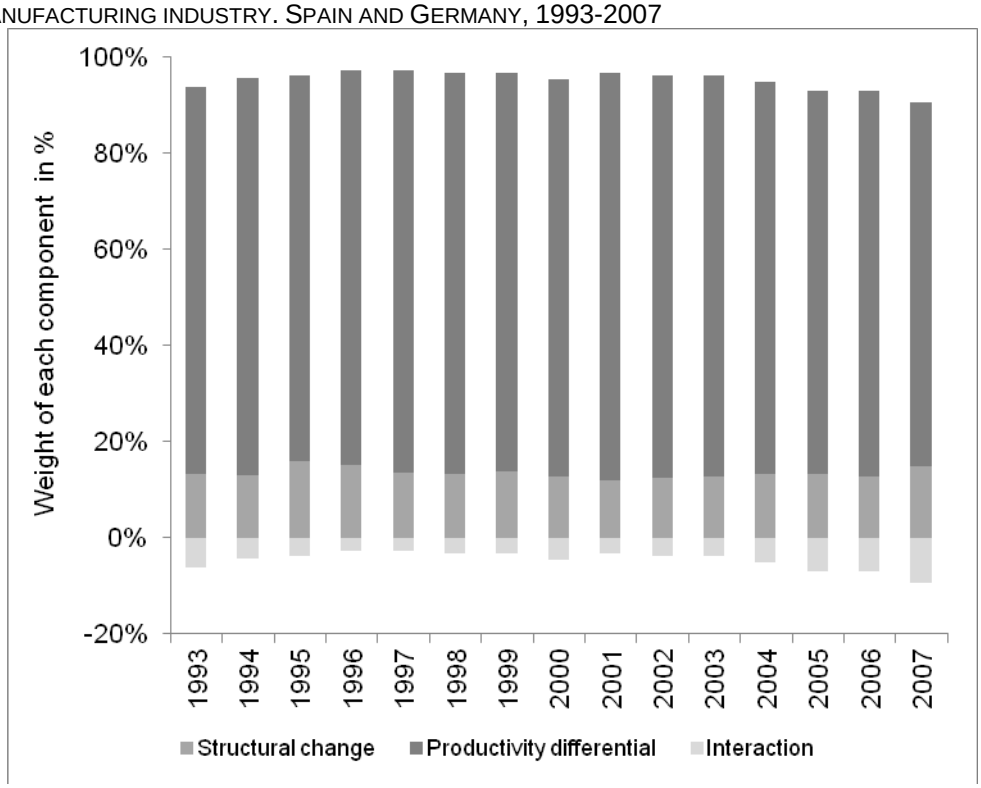
In Figure 7 the performance for all the years is displayed, confirming our interpretation of the results.

[8] $\mu_i$ is the so-called *industry mix, specialization* or *structural change effect* of country *i* and measures the productivity differential between two countries due to the production structure of their industries, under the hypothesis that sectoral productivities are the same as in the reference country.

[9] $\pi_i$ is the *productivity differential*, *country* or *within-industry* effect and shows the growth of labour productivity that would have occurred even without any structural change or difference in the industrial specialization.

[10] $\alpha_i$ is called *allocation*, *interaction* or *dynamic effect* and is positive if the industry is specialized with respect to the mean of the reference country/industry in sectors where productivity is higher than that of the benchmark industry, and negative if below.

FIGURE 7. WEIGHT OF EACH COMPONENT $\mu_{iE}$, $\pi_{iE}$ *and* $\alpha_{iE}$ ON THE PRODUCTIVITY DIFFERENTIAL (IN %). MANUFACTURING INDUSTRY. SPAIN AND GERMANY, 1993-2007




Source: EU KLEMS (2009), www.euklems.net and own calculations.

The overall image is that Spain is lagging behind Germany, showing a poor performance in within-industry effect and to a lesser degree lacking ability to change its productive structure or industry mix effect in a faster rhythm. Although this is the most immediate conclusion of both decomposition methodologies implemented here, the results suggest that industry specialization in Spain is changing, but its rhythm or speed of change is maybe too slow lagging behind Germany.

# 5. Conclusions

In this paper we have analyzed the sources in productivity differences between the Spanish and German manufacturing industry in the period 1993-2007. To this end we posed several questions in order to single out the factors that may determine this gap, taking Germany as the benchmark country. The first one was to confirm that the Spanish and German differences in per capita income of the total economy are reducing whereas on the contrary the one in manufacturing industry doesn't. Data shows that this is not the case: Spanish and German differences in per capita income of the total economy remained relatively stable until the last subperiod, when they started to increase.

Differences in per capita income between Spanish and German manufacturing industry are growing, particularly in the last subperiod. Spanish per capita income in manufacturing industry is losing weight in relation to Germany. The gap between per capita income of the Spanish and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German in total and manufacturing industry is increasing. Next, we carried out a decomposition analysis of per capita income in order to assess the influence of labour productivity The results obtained confirmed that not only that the differences in productivity were one of the main determinants, but that they were also significant and persistent along the considered period.

Differences in sectoral specialization could explain differences in productivity, and, in fact, our results have shown that Spain's manufacturing industry is characterized as a traditional one where low and medium technology branches generate the greatest part of value added while in Germany the bulk is on the high and medium technology branches, but the situation is changing although very slowly. The results obtained may shed some light on why Spanish economy is showing up difficulties for recovering from the present crisis. This opens a door to new questions on further determinants of aggregate productivity changes that will be explored in further research.

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country, March, 2007, available on the internet: http://www.euklems.net/data/EUKLEMS_Growth_and_Productivity_.

# Annex 1

*Table A.1. Decomposition of aggregate productivity change. Manufacturing industry: Spain and Germany, 1993-2007*

(average annual growth rates in %)

| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | Media |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Spain** | | | | | | | | | | | | | | | |
| Rate effect (1) $\beta^E$ | 6.830 | 4.538 | -3.495 | -0.223 | 0.223 | 2.152 | -0.640 | 2.106 | 0.417 | 2.001 | 1.037 | 0.742 | 1.738 | 3.564 | 1.499 |
| Level effect (2) $v^E$ | 0.269 | -0.290 | -0.084 | 0.055 | -0.062 | -0.126 | 0.411 | 0.289 | 0.216 | 0.141 | 0.219 | 0.297 | 0.375 | 0.322 | 0.145 |
| Interaction effect (3) $\theta^E$ | 0.001 | 0.030 | 0.044 | 0.013 | -0.025 | -0.008 | -0.004 | -0.021 | -0.022 | -0.011 | -0.022 | -0.320 | -0.016 | -0.091 | -0.032 |
| (Δ Productivity)/Productivity $\gamma^E$ = (1) + (2) + (3) | 7.100 | 4.277 | -3.536 | 0.155 | 0.136 | 2.018 | -0.233 | 2.374 | 0.611 | 2.130 | 1.233 | 0.719 | 2.097 | 3.796 | 1.612 |
| **Germany** | | | | | | | | | | | | | | | |
| Rate effect (1) $\beta^{Ger}$ | 7.469 | 1.636 | 2.283 | 4.751 | 0.465 | 1.904 | 5.476 | 1.422 | 1.343 | 3.558 | 3.940 | 4.548 | 7.722 | 2.357 | 3.491 |
| Level effect (2) $v^{Ger}$ | -0.044 | 0.286 | -0.004 | 0.165 | 0.248 | 0.004 | -0.035 | 0.124 | 0.157 | 0.149 | -0.063 | -0.006 | -0.002 | -0.060 | 0.065 |
| Interaction effect (3) $\theta^{Ger}$ | -0.001 | -0.074 | -0.021 | 0.020 | 0.010 | -0.008 | -0.010 | 0.005 | -0.028 | -0.067 | -0.067 | -0.035 | 0.003 | -0.063 | -0.023 |
| (Δ Productivity)/Productivity $\gamma^{Ger}$ = (1) + (2) + (3) | 7.423 | 1.848 | 2.258 | 4.936 | 0.723 | 1.900 | 5.451 | 1.551 | 1.471 | 3.640 | 3.810 | 4.507 | 7.723 | 2.234 | 3.534 |
| **Differences Spain minus Germany (in%)** | | | | | | | | | | | | | | | |
| Rate effect (1) ($\beta^E$ - $\beta^{Ger}$) | -0.639 | 2.902 | -5.778 | -4.974 | -0.242 | 0.248 | -6.115 | 0.684 | -0.926 | -1.557 | -2.903 | -3.806 | -5.984 | 1.207 | -1.992 |
| Level effect (2) ($v^E$ - $v^{Ger}$) | 0.313 | -0.576 | -0.080 | -0.110 | -0.310 | -0.130 | 0.447 | 0.164 | 0.059 | -0.008 | 0.282 | 0.304 | 0.377 | 0.383 | 0.080 |



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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Interaction effect (3) ($\theta^{E}$ - $\theta^{Ger}$) | 0.002 | 0.104 | 0.065 | -0.007 | -0.035 | 0.000 | -0.015 | -0.026 | 0.006 | 0.055 | 0.045 | -0.285 | -0.019 | -0.028 | -0.010 |
| ($\Delta$ Productivity)/Productivity ($\gamma^{E}$-$\gamma^{Ger}$) = (1) + (2) + (3) | -0.323 | 2.429 | -5.793 | -5.091 | -0.587 | 0.118 | -5.683 | 0.823 | -0.861 | -1.510 | -2.576 | -3.788 | -5.626 | 1.562 | -1.922 |

Source: EU KLEMS (2009), www.euklems.net and own calculations.

*Table A.2. Shift-share analysis. Manufacturing industry: Spain and Germany, 1993-2007*
(average annual growth rates in %)

| Components | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | Media |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Industry mix: $\mu^E_i = \Sigma i\ (p^E_{it} - p^{Ger}_{it}) * x^{Ger}_{it}$** | -1.44 | -1.48 | -1.74 | -1.84 | -1.85 | -1.88 | -1.99 | -2.13 | -1.97 | -2.14 | -2.29 | -2.62 | -2.96 | -3.22 | -4.02 | -2.11 |
| **Productivity differential: $\pi^E_i = \Sigma i\ (x^E_{it} - x^{Ger}_{it}) * p^{Ger}_{it}$** | -8.78 | -9.33 | -8.77 | -9.90 | -11.45 | -11.70 | -11.83 | -13.76 | -13.78 | -14.13 | -14.85 | -16.00 | -17.75 | -20.34 | -20.42 | -13.03 |
| **Allocative: $\alpha^E_i = \Sigma i\ (p^E_{it} - p^{Ger}_{it}) * (x^E_{it} - x^{Ger}_{it})$** | 0.67 | 0.48 | 0.42 | 0.31 | 0.36 | 0.44 | 0.46 | 0.74 | 0.51 | 0.65 | 0.66 | 1.00 | 1.54 | 1.78 | 2.49 | 0.72 |
| **Average productivity differential $(x^E_{it} - x^{Ger}_{it}) = \mu_i + \pi_i + \alpha_i$** | -9.55 | -10.33 | -10.10 | -11.43 | -12.94 | -13.14 | -13.36 | -15.15 | -15.23 | -15.61 | -16.48 | -17.62 | -19.17 | -21.78 | -21.96 | -14.92 |

**Weight of each component $\mu_i^E$, $\pi_i^E$ y $\alpha_i^E$ on the productivity differential (in %)**

| Components | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | Media |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Industry mix: $\mu^E_i = \Sigma i\ (p^E_{it} - p^{Ger}_{it}) * x^{Ger}_{it}$** | 15.1 | 14 | 17 | 16 | 14 | 14 | 14 | 14 | 12 | 13 | 13 | 14 | 15 | 14 | | 14.7 |
| | 1 | .36 | .26 | .06 | .27 | .32 | .93 | .05 | .92 | .68 | .89 | .85 | .46 | .79 | 18.33 | 1 |
| **Productivity differential: $\pi^E_i = \Sigma i\ (x^E_{it} - x^{Ger}_{it}) * p^D_{it}$** | 91.9 | 90 | 86 | 86 | 88 | 89 | 88 | 90 | 90 | 90 | 90 | 90 | 92 | 93 | | 90.0 |
| | 0 | .33 | .90 | .63 | .55 | .05 | .55 | .84 | .46 | .49 | .14 | .81 | .56 | .39 | 92.99 | 4 |
| **Allocative: $\alpha^E_i = \Sigma i\ (p^E_{it} - p^{Ger}_{it}) * (x^E_{it} - x^{Ger}_{it})$** | -7.01 | -4.69 | -4.15 | -2.69 | -2.81 | -3.36 | -3.47 | -4.88 | -3.38 | -4.17 | -4.02 | -5.65 | -8.02 | -8.18 | -11.32 | -4.75 |
| **Average productivity differential $(x^E_{it} - x^{Ger}_{it}) = \mu_i + \pi_i + \alpha_i$** | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

Source: EU KLEMS (2009), www.euklems.net and own calculati



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***Resumen***
*El objetivo de este artículo es llevar a cabo un análisis comparativo de la productividad del trabajo industrial entre España y Alemania en el período 1993-2007 con el fin de identificar los factores determinantes que dificultan el crecimiento continuo de la productividad en la industria española. La motivación es averiguar si las diferencias en la productividad se deben principalmente a distintas estructuras de productivas o si se deben principalmente a un problema intrínseco de la propia productividad industrial o una combinación de ambos. Los resultados indican que las diferencias en la estructura sectorial de la industria manufacturera no justifican en buena medida la brecha en la productividad. Concluimos que es más un problema de velocidad de convergencia de las estructuras de producción, que de ausencia de cambios.*

***Palabras clave***
*Productividad del trabajo; industria manufacturera; estructura productiva.*

***Resum***
*L'objectiu d'aquest article és dur a terme una anàlisi comparativa de la productivitat del treball en el sector de les manufactures entre Espanya i Alemanya en el període 1993-2007 amb la finalitat d'identificar els factors determinants que dificulten el creixement continu de la productivitat en la indústria espanyola. La motivació és esbrinar si les diferències en la productivitat es deuen principalment a diferents estructures productives o si es deuen principalment a un problema intrínsec de la pròpia productivitat industrial o una combinació de tots dos. Els resultats indiquen que les diferències en l'estructura sectorial de la indústria manufacturera no justifiquen en bona mesura la bretxa en la productivitat. Concloem que és més un problema de velocitat de convergència de les estructures de producció, que no pas d'absència de canvis.*

***Paraules clau***
*Productivitat del treball; indústria manufacturera; estructura productiva.*

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