

Explaining the US-EU productivity growth gap: *structural change vs. intra-sectoral effect*

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Abstract

This paper proposes a decomposition of labour productivity growth with the aim of analysing the slowdown of productivity in the EU15, relative to the US, since the mid 1990s. Using a shift-share analysis, results show that the acceleration in the growth of labour productivity in the US is explained by the greater productivity growth of individual industries (*intra-sectoral effect*) and not by the re-allocation of inputs among sectors (*structural change*). These findings suggest that the EU's productivity growth is limited by modest “pure” gains of productivity within sectors.

Key words: productivity growth, shift-share analysis

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1. Introduction

In recent years, several studies have shown that the deterioration in the productivity of the European Union (EU15) relative to the United States (US) is one of the principal reasons explaining the stagnation in the per capita GDP of the EU15 relative to the US. Thus, the empirical evidence available (European Commission, 2004a and 2004b; OECD, 2003 and 2004; O'Mahony and van Ark, 2003; Gordon, 2004; European Central Bank, 2004; Blanchard, 2004; Prescott, 2004; van Ark, O'Mahony and Ypma, 2007; among others) shows that the EU15's process of convergence to the higher levels of labour productivity of the US economy stops in the mid-1990s, producing a stagnation in the second half of the 1990s and a recession in recent years.

The aim of this study is to explore the causes of this break in the process of convergence and to analyse whether the slower growth of productivity in the EU15 in relation to the US was a consequence of a lesser redistribution of inputs towards sectors with higher productivity and/or with greater growth of productivity (*structural change effect*) or whether, on the contrary, it is a consequence of generally lower productivity growth at sector level (*intra-sectoral effect*). For this purpose, we decompose the labour productivity growth rates of the economies of the EU15 and the US by means of a shift-share analysis using the EU-KLEMS database. Results show that the higher growth of the productivity of the US relative to the EU15 since the mid 1990s is due to the *intra-sectoral effect*. On the other hand, the impact of structural change seems to have much less importance in both economies, its contribution being strongly negative in the US in the period 2000-04.

The paper is organised as follows. In section 2, shift-share analysis is used to decompose labour productivity growth into various components: *intra-sectoral effect*, *static sectoral effect* and *dynamic sectoral effect*. Based on this decomposition, section 3 analyses the divergences in labour productivity growth trends between the EU15 and the US. Section 4 concludes.

2. Shift-share analysis of productivity growth

Using a shift-share analysis, we can analyse the contribution of *structural change* and the *intra-sectoral effect* to labour productivity growth in the EU15 and in the US. The contribution of *structural change* to labour productivity growth takes place through the re-allocation of resources either to more productive sectors (*static-sectoral effect*), or to sectors with higher labour productivity growth rates (*dynamic sectoral effect*). More precisely, we use the following shift-share analysis:

$$\frac{Y_T}{L_T} - \frac{Y_0}{L_0} = \underbrace{\sum_{j=1}^J \theta_{j0} \left(\frac{Y_{jT}}{L_{jT}} - \frac{Y_{j0}}{L_{j0}} \right)}_{\text{Intra-sectoral effect}} + \underbrace{\sum_{j=1}^J (\theta_{jT} - \theta_{j0}) \frac{Y_{j0}}{L_{j0}}}_{\text{Static sectoral effect}} + \underbrace{\sum_{j=1}^J (\theta_{jT} - \theta_{j0}) \left(\frac{Y_{jT}}{L_{jT}} - \frac{Y_{j0}}{L_{j0}} \right)}_{\text{Dynamic sectoral effect}}$$

Structural change effect

where $Y_T/L_T - Y_0/L_0$ is the labour productivity growth between years 0 and T , j is the industry, and θ_{jT} is the share of hours worked in industry j in year T .

The *intra-sectoral effect* shows the growth of labour productivity that would have occurred even if there had been no structural change: it corresponds to the productivity gains achieved due to the internal improvements of productivity in each sector. The *structural change effect* captures the effect of the re-allocation of factors between sectors and decomposes, in turn, into two effects. The *static sectoral effect* is the sum of changes in input shares, weighted by the initial productivity levels, and therefore measures the growth of labour productivity due exclusively to the change in sector composition. It is the growth that would have occurred if there had been no change in the productivity of any sector during the period analysed. The *dynamic sectoral effect* captures the growth due to the interaction between structural change and the growth of productivity at sector level. Its sign depends on the factors of production having been re-allocated to the sectors with the highest relative growth in labour productivity (in which case the effect is positive) or, on the contrary, to the sectors with the lowest productivity growth (negative effect).

3. Results

The empirical exercise includes 47 sectors in the EU15 and US economies during the period 1977-2004 using the EU-KLEMS database¹. This database includes measures of economic growth, productivity, employment creation and capital formation at the industry level for the European Union member states, Japan and the United States from 1970 to 2004. Considering that for the US economy the database only reports information of value added (in real terms) since 1977, the sample period used is 1977-2004².

Labour productivity is measured as the quotient between gross value added at constant prices and the total hours worked by persons engaged.

¹ For more information and updates, see: www.euklems.net. The construction of this database is financially supported by the European Commission, Research Directorate General as part of the 6th Framework Programme, Priority 8, "Policy Support and Anticipating Scientific and Technological Needs". Although at the lowest level of aggregation data were collected for 71 industries, the level of detail in the EU KLEMS database varies across countries, industries and variables due to data limitations. For that reason, the maximum level of disaggregation used in the paper is 47 industries.

² For the US economy, the new industry classification system NAICS is used.

As table 1 shows, the labour productivity of the EU15 increased at a higher rate than that of the US until the mid 1990s, a process of convergence thus occurring. Nevertheless, this process of convergence ended in the second half of the 1990s (1995-2000), a process of divergence between the two economies starting thereafter.

For all subperiods, the *intra-sectoral effect* dominates the outcome, accounting for 104-168% of aggregate productivity growth in the case of the US and 74-112% of the change in the EU15. In the EU15 the *intra-sectoral effect* is observed to be smaller than aggregate productivity growth until 1995, showing that the sectors with higher productivity have increased their share in total employment. The *intra-sectoral effect* is higher than aggregate productivity growth in the EU15 in all other subperiods (1995-2000 and 2000-2004) and in the US in all subperiods.

The *static sectoral effect* has been negative for the US since 1990 suggesting that workers are moving into lower productivity sectors. In the EU15, on the contrary, this *shift-effect* was positive until 2000. However, it turned negative in the most recent period 2000-2004, although of small magnitude compared to the US economy. It is of note that the contribution of the *static sectoral effect* has been decreasing over time in the EU15, so that the effect of re-allocation towards more productive sectors is less and less important.

The *dynamic sectoral effect* is always negative for the US and also for the EU15, its importance being greater in the US. This negative sign suggests that there is a majority of industries where the productivity change and the labour input change have opposite signs. It is in the period 2000-04, of lower (higher) growth of the productivity in the EU15 (US), when the re-allocation of production towards sectors with lower relative growth of productivity contributes most, and negatively, to the growth of productivity. Concretely, the US *dynamic structural effect* was so negative in the period 2000-04 because there was a re-allocation of employment towards sectors with negative productivity growth rates (in general services industries such as “health and social work”, “education”, “hotels and restaurants”, etc. and also the construction sector). In addition, sectors with high productivity growth rates (“radio, television and communication equipment”, “textiles”, “machinery”, “post and telecommunications”, “computer and related activities”, “motor vehicles”, etc.) have diminished their weight in total employment.

In the case of the *structural change effect*, its contribution to the growth of aggregate productivity is always negative in the US, subtracting 1.5 percentage points from the growth of productivity in the period 2000-04. On the contrary, in the EU15, this total re-allocation effect was positive until the mid 1990s, explaining 26% of the growth of productivity over the period 1979-90. It is important to remark that the *structural change effect* had opposite signs in the EU15 and US until 1995, which is one of the explanations to the

higher productivity growth of the EU15 till the mid 90s. Just as in the US economy, since 1995, changes in the sectoral composition in the EU15 have not contributed to aggregate productivity growth.

The results obtained indicate that the key to the differential behaviour of the EU15 compared to the US, leading to the end of the trend to convergence, has to be sought in the *intra-sectoral effect*. Whereas in the US there is an acceleration of this effect, reaching 4.09% annually in the most recent period 2000-04, in the EU15 there was a slowdown, falling from 2.21% annually in the first half of the 1990s to 1.24% in the period 2000-04. It is important to highlight that during the last years (2000-04), the *intra-sectoral effect* of the EU15 is 2.8 percentage points more reduced than in the US. Thus, the acceleration of the growth of productivity in the US is not due to changes in sector specialisation (as in fact its contribution is negative), but is associated with its starting specialisation in sectors that have undergone rapid growth during recent years.

4. Conclusions

This paper proposes a decomposition of labour productivity growth with the aim of analysing the importance of the *intra-sectoral effect* and *structural change* to explain the slowdown of productivity in the EU, relative to the US, since the mid 1990s. Using a shift-share analysis, results show that the acceleration in the growth of the US labour productivity that occurred from the mid 1990s is explained by the productivity growth of the individual industries (*intra-sectoral effect*), the contribution from the re-allocation of employment between industries (*structural change effect*) being negative. Likewise, the divergence of the EU15 from the US is not due to the sectoral re-allocation of employment, which in fact is fostering convergence, but to the general slowdown in productivity growth in all sectors of production. These findings suggest that the EU's productivity growth is limited by modest "pure" gains of productivity within sectors. In consequence, the strategy of the EU15 to reduce the gap between it and the US should be based on a higher growth of productivity throughout its industries. For this, a new productivity agenda is needed with measures to facilitate the adoption and diffusion of new technologies, the accumulation of physical capital, the increase of human capital, etc., reconsidering the Lisbon agenda of the European Union.

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Table 1. Shift-share analysis for the decomposition of hourly labour productivity growth rates (annual averages)

a) Annual average volume growth rates (%)

US					
	1977-90	1990-1995	1995-2000	2000-2004	1995-2004
Intra-sectoral effect	1.25	1.59	2.38	4.09	3.91
Structural change effect	-0.04	-0.39	-0.28	-1.50	-1.59
<i>Static sectoral effect</i>	<i>0.21</i>	<i>-0.27</i>	<i>-0.09</i>	<i>-0.20</i>	<i>-0.04</i>
<i>Dynamic sectoral effect</i>	<i>-0.26</i>	<i>-0.12</i>	<i>-0.19</i>	<i>-1.30</i>	<i>-1.55</i>
Total effect	1.20	1.19	2.10	2.59	2.32
EU15					
	1977-90	1990-1995	1995-2000	2000-2004	1995-2004
Intra-sectoral effect	1.39	2.21	1.65	1.24	1.51
Structural change effect	0.48	0.17	-0.01	-0.14	-0.12
<i>Static sectoral effect</i>	<i>0.51</i>	<i>0.33</i>	<i>0.10</i>	<i>-0.04</i>	<i>0.09</i>
<i>Dynamic sectoral effect</i>	<i>-0.03</i>	<i>-0.16</i>	<i>-0.11</i>	<i>-0.10</i>	<i>-0.21</i>
Total effect	1.87	2.39	1.63	1.10	1.40

b) Total % change

US					
	1977-90	1990-1995	1995-2000	2000-2004	1995-2004
Intra-sectoral effect	104%	133%	113%	158%	168%
Structural change effect	-4%	-33%	-13%	-58%	-68%
<i>Static sectoral effect</i>	<i>18%</i>	<i>-23%</i>	<i>-4%</i>	<i>-8%</i>	<i>-2%</i>
<i>Dynamic sectoral effect</i>	<i>-22%</i>	<i>-10%</i>	<i>-9%</i>	<i>-50%</i>	<i>-67%</i>
Total effect	100%	100%	100%	100%	100%
EU15					
	1977-90	1990-1995	1995-2000	2000-2004	1995-2004
Intra-sectoral effect	74%	93%	101%	112%	108%
Structural change effect	26%	7%	-1%	-12%	-8%
<i>Static sectoral effect</i>	<i>27%</i>	<i>14%</i>	<i>6%</i>	<i>-3%</i>	<i>6%</i>
<i>Dynamic sectoral effect</i>	<i>-2%</i>	<i>-7%</i>	<i>-7%</i>	<i>-9%</i>	<i>-15%</i>
Total effect	100%	100%	100%	100%	100%

Source: "EU KLEMS Database, March 2007, <http://www.euklems.net>" and own elaboration.