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Multilateral Comparisons of Productivity among European Countries

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Executive Summary

The objective of this study which uses multilateral comparisons is to analyze differences between levels of total factor productivity among European countries for the period 2000-2012. Our results indicate that countries in West and Central Europe are doing better with respect to the level of productivity, when compared to other Mediterranean and East European countries.

Furthermore, we observe that most of the countries experienced increases in their productivity throughout the years. The productivity increases in the West and Central European countries are mainly due to increases in output, while the increases in the Mediterranean and East European countries are mainly due to more efficient use of their inputs.

It is important to note that our results suggest that the less productive countries are the countries with the most productivity growth. That is, Mediterranean and East European countries show a faster productivity growth compared to the West – Central European ones.

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ΠΕΡΙΛΗΨΗ

Ο σκοπός αυτής της μελέτης, η οποία χρησιμοποιεί πολυμερείς συγκρίσεις, είναι να αναλύσει τις διαφορές ανάμεσα στα επίπεδα παραγωγικότητας μεταξύ Ευρωπαϊκών χωρών κατά την περίοδο 2000-2012. Τα αποτελέσματα της μελέτης υποδεικνύουν ότι οι χώρες της Δυτικής και Κεντρικής Ευρώπης έχουν ψηλότερα επίπεδα παραγωγικότητας σε σύγκριση με τις Μεσογειακές και τις χώρες της Ανατολικής Ευρώπης.

Επιπλέον παρατηρούμε μια διαχρονική αύξηση της παραγωγικότητας στις πλείστες χώρες του δείγματος μας. Η αύξηση αυτή της παραγωγικότητας στη Δυτική και Κεντρική Ευρώπη οφείλεται κυρίως στην αύξηση του προϊόντος των συγκεκριμένων χωρών, ενώ η αντίστοιχη αύξηση στις Μεσογειακές και Ανατολικές χώρες προέρχεται από την πιο αποτελεσματική χρήση των εισροών τους.

Είναι σημαντικό να τονίσουμε ότι με βάση τα αποτελέσματα μας οι λιγότερο παραγωγικές χώρες είναι αυτές με τη μεγαλύτερη ανάπτυξη στην παραγωγικότητα τους. Δηλαδή, οι Μεσογειακές και οι χώρες της Ανατολικής Ευρώπης παρουσιάζουν μεγαλύτερο ρυθμό ανάπτυξης της παραγωγικότητας σε σύγκριση με τις χώρες της Δυτικής και Κεντρικής Ευρώπης.

1. Introduction

Productivity is considered a key source of economic growth and competitiveness in an economy and consequently on the well-being of its people. An economy is considered competitive, with other countries, if it can produce inputs of the same quality as other countries but with lower cost.

Studies in the literature are mainly concerned with the productivity gap between Europe and the United States. These studies find that Europe is lagging in productivity and the gap seems to widen steadily showing no signs of narrowing (see Miller and Atkinson, 2014; van Ark, O' Mahony and Timmer, 2008; Timmer and van Ark, 2005; Acemoglu, Aghion and Zilibotti, 2006; Kretschmer, 2009).

Most of the studies suggest that if Europe intends to catch up, it needs to adopt new upbeat information and communication technologies (Miller and Atkinson, 2014; van Ark, O' Mahony and Timmer, 2008; Kretschmer, 2009, Timmer and van Ark, 2005; Colecchia and Schreyer, 2002; Acemoglu, Aghion and Zilibotti, 2006), a more flexible approach towards labor, product and capital markets, and a truly single market across Europe (van Ark, O' Mahony and Timmer, 2008).

Fagerberg and Verspagen (1996) analyzing regional growth in the EU in the post war period, found that after a slow but steady reduction of differences in GDP per capita, during most of the post war period, now shows some signs of reversal in this trend. They suggest that the potential for poorer regions to catch-up is still there but that other variables such as differences in R&D efforts, investment support from the EU, industrial structure and differences in unemployment have had a diverging impact. They also find some support for the idea of a Europe at different speeds with three different growth clubs.

In this study, we compare differences between GDP per capita and total factor productivity among European countries in 2000-2012 period, and we find that countries that belong in the West and Central Europe are doing better with respect to the level of productivity and GDP per capita when compared to the Mediterranean and East European countries. Furthermore most of the countries experienced increases in their productivity throughout the years. The productivity increases in the West and Central European countries are mainly due to increases in output, while the increases in the Mediterranean and East European countries are mainly due to more efficient use of inputs. Productivity growth though suggests that on average the countries with lower GDP per capita are doing better with respect to productivity growth.

2. Empirical Implementation

The economic theory of index numbers provides useful tools that can be used in making multilateral (and bilateral) comparisons. Caves, Christensen and Diewert (1982), develop a methodology for making multilateral comparisons of output, input and productivity.

At period t , the general expression for bilateral productivity comparisons of a country s with the hypothetical country, is:

$$(1) \quad \ln\lambda_{st} = (\ln Y_{st} - \overline{\ln Y_t}) - \frac{1}{2}(W_{Kst} + \overline{W_{Kt}})(\ln X_{Kst} - \overline{\ln X_{Kt}}) \\ - \frac{1}{2}(W_{Lst} + \overline{W_{Lt}})(\ln X_{Lst} - \overline{\ln X_{Lt}}),$$

where Y is the output of the country, X is the input vector (capital K , and labor L), and W are the corresponding input shares in total cost. The bar indicates the arithmetic mean (geometric mean since it's the average of logarithms) over the total number of countries of the variable or product under the bar and represents the hypothetical country.

And then the multilateral productivity comparisons (country s and l) at period t are given by:

$$\ln\lambda_{slt} = \ln\lambda_{st} - \ln\lambda_{lt}$$

The productivity comparisons are the output differences with the hypothetical country minus the weighted input differences with the hypothetical country. Therefore, productivity difference will be positive if the productivity growth of a country is higher than the productivity growth of the hypothetical country.

The productivity growth for country s at period t is defined as:

$$\ln\delta_{st} = (\ln Y_{st} - \ln Y_{st-1}) - \frac{1}{2}(W_{Kst} + W_{Kst-1})(\ln X_{Kst} - \ln X_{Kst-1}) \\ - \frac{1}{2}(W_{Lst} + W_{Lst-1})(\ln X_{Lst} - \ln X_{Lst-1})$$

Using equation (1) for periods t and $t - 1$, along with a normalization of keeping all the variables of the hypothetical country to their base year, we obtain the following growth rate of productivity:

$$\ln\delta_{st} = \ln\lambda_{st} - \ln\lambda_{st-1}$$

3. Data and Empirical Results

In order to utilize the multilateral comparison methodology, we focus our analysis on the years 2000-2012 and on the countries of: Belgium, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Cyprus, Netherlands, Austria, Portugal, Slovenia, Slovakia and Finland. We obtained data from several publications of Eurostat and the European Commission.

The variables used are the Gross Domestic Product, the total Hours Worked, Investment, and the Compensation of Employees. The quantity of output is defined as the GDP in constant prices. The quantity of labor is defined as the value of labor divided by the price of labor. The compensation of employees was used as the value of labor, adjusted to include the self employees. The capital stock was constructed from investment data in constant prices by using the perpetual inventory method with a 5% depreciation rate. The value of capital was obtained by subtracting from GDP in current prices the value of labor. Following Christensen, Cummings and Jorgenson (1981) and Jorgenson and Nishimizu (1978) in order to be able to compare countries, we require comparable measures of factor inputs and output. To achieve comparability in measuring output and factor inputs one need to employ purchasing power parities (PPP) of output, capital and labor for all the countries under consideration. Therefore, all price and quantity data are expressed in constant 2000 Euros and are PPP adjusted.

Figure 1: GDP per capita (PPP adjusted) in 2012

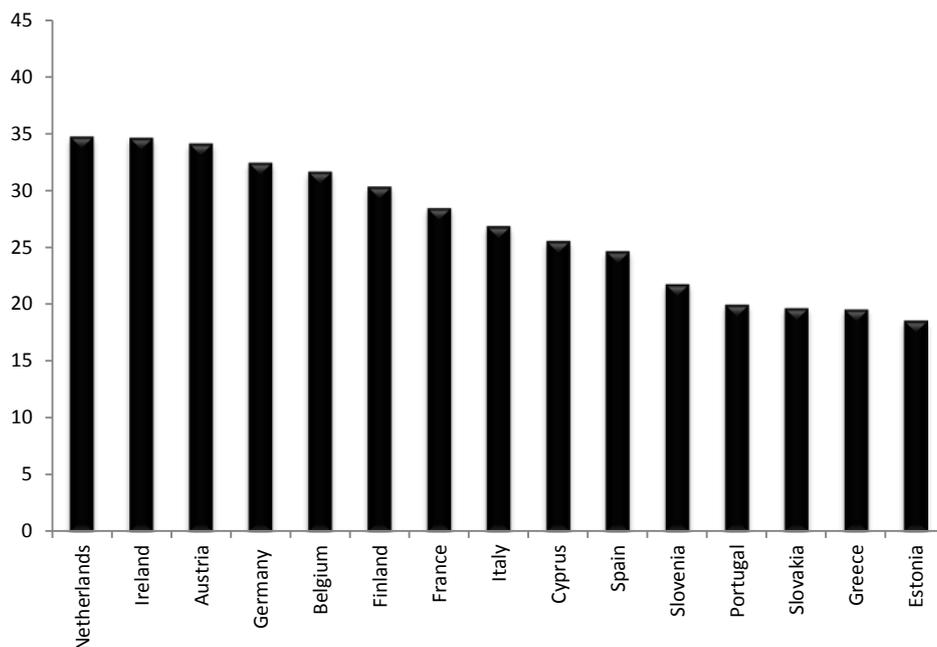


Figure 1 presents the level of GDP per capita (PPP adjusted) for all countries in the last year of our sample, 2012. We can identify two groups of countries moving together. The first group at the top of the scale is the West and Central European countries (Netherlands, Austria, Belgium, Finland, Germany and France) along with Ireland and Italy. The second group of countries located in the lower middle with respect to GDP per capita is mainly the Mediterranean countries, besides Italy, and the East European ones.

Table 1, presents the ranking of countries, with respect to productivity for the years 2000-2012, relative to the hypothetical country which has been normalized to be equal to 1. Reading this table vertically shows the productivity level of each country at the specific year, while reading this table horizontally shows the productivity change of a country over time.

Table 1: Rankings with respect to productivity

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Belgium	1.214	1.169	1.200	1.189	1.208	1.184	1.196	1.214	1.196	1.158	1.175	1.350	1.348
France	1.195	1.214	1.268	1.248	1.219	1.232	1.261	1.261	1.230	1.227	1.254	1.251	1.261
Germany	1.032	1.040	1.041	1.059	1.073	1.086	1.117	1.142	1.141	1.095	1.145	1.248	1.258
Netherlands	1.096	1.100	1.128	1.118	1.164	1.173	1.192	1.226	1.234	1.197	1.184	1.275	1.251
Austria	0.902	0.886	0.900	0.913	0.933	0.942	0.990	1.011	1.021	0.999	1.029	1.124	1.130
Finland	0.902	0.912	0.921	0.922	0.984	0.996	1.031	1.108	1.104	0.999	1.034	1.099	1.083
Italy	0.800	0.818	0.783	0.776	0.776	0.790	0.799	0.814	0.823	0.786	0.834	1.037	1.015
Ireland	0.737	0.760	0.789	0.829	0.878	0.892	0.892	0.901	0.876	0.916	0.933	0.986	0.998
Slovenia	0.675	0.675	0.666	0.679	0.711	0.766	0.829	0.881	0.871	0.766	0.793	1.009	0.996
Spain	0.855	0.862	0.881	0.882	0.883	0.886	0.896	0.910	0.924	0.928	0.923	0.981	0.996
Cyprus	0.579	0.577	0.597	0.612	0.643	0.669	0.693	0.719	0.770	0.766	0.754	0.867	0.858
Slovakia	0.410	0.435	0.476	0.499	0.499	0.530	0.581	0.667	0.718	0.700	0.746	0.820	0.832
Greece	0.523	0.555	0.601	0.630	0.663	0.644	0.666	0.674	0.679	0.677	0.651	0.832	0.800
Portugal	0.585	0.588	0.586	0.589	0.596	0.632	0.644	0.658	0.661	0.658	0.676	0.733	0.726
Estonia	0.510	0.526	0.559	0.593	0.620	0.657	0.683	0.731	0.714	0.680	0.708	0.681	0.713

Figure 2: Productivity differences in 2012

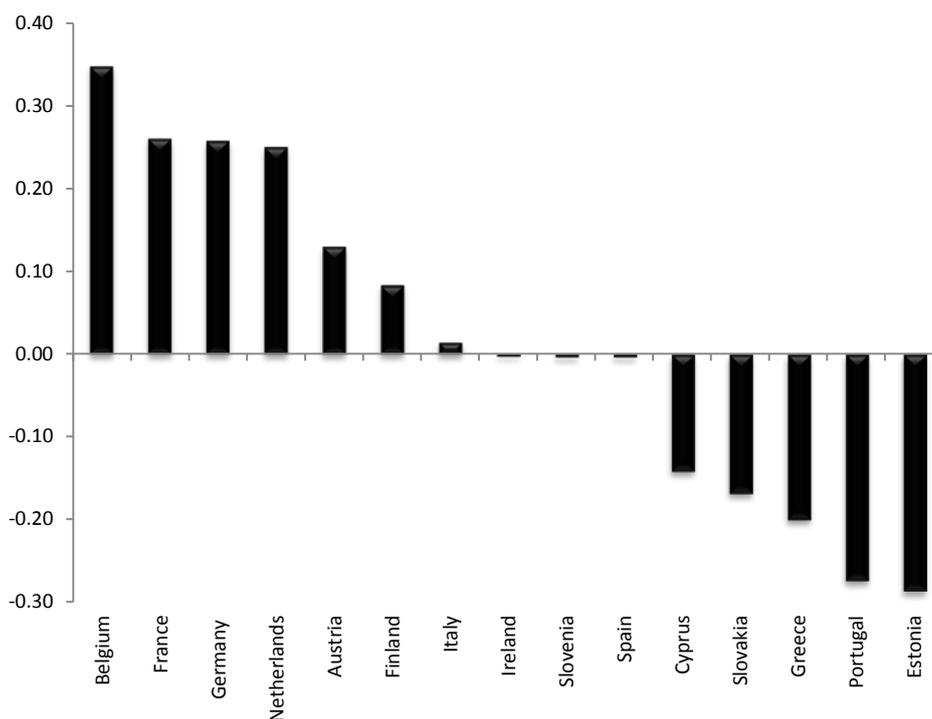


Table 1 shows that there are some variations with regard to the productivity ranking of the countries. However, four countries, Belgium, France, Netherlands and Germany are always at the top of the rank. The last five countries in the ranking are always also the same and these are: Portugal, Cyprus, Greece, Estonia and Slovakia.

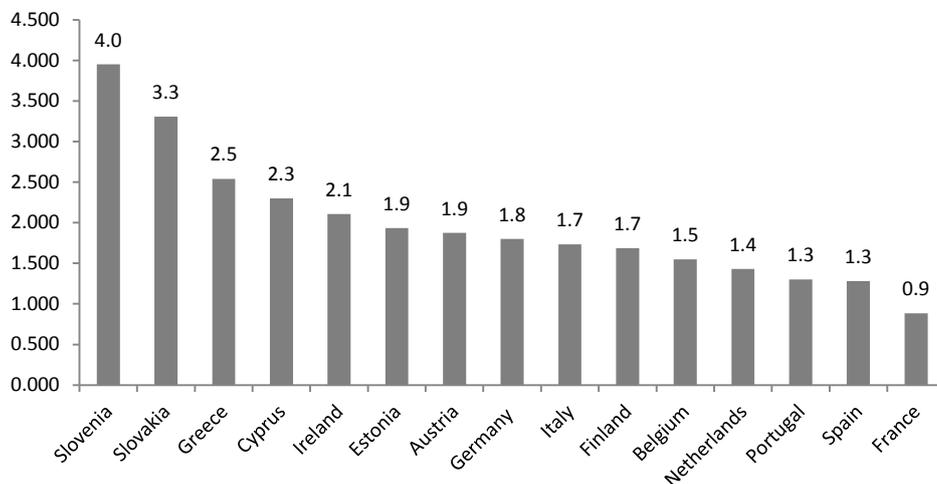
Figure 2, shows the productivity differences of all countries from the hypothetical one for the period 2012. In 2012, the West and Central European countries are doing better when compared to the hypothetical country, while the Mediterranean and East European countries are worse. We observe three convergence groups: At the top of the scale we have the West and Central European countries of Belgium, France, Germany, Netherlands, Austria and Finland, while in the middle and close to the hypothetical country we find Italy, Ireland, Slovenia and Spain. Last on the scale (of the rank) are Cyprus, Slovakia, Greece, Portugal and Estonia.

The results are different between the GDP per capita and the productivity level. With respect to GDP per capita (labor productivity), we observe two groups of countries converging together while when total factor productivity is considered (capital also included) the convergence clubs are three. In both cases the West and Central European countries are performing better.

Looking at Table 1 (each row), we also observe how the productivity of each country changes throughout the years. Most of the countries experienced an increase in their productivity in all years under investigation. Productivity increases or decreases (changes) are basically associated with changes in output and total inputs since the total factor productivity is constructed as output growth minus a weighted average of the growth of inputs. The productivity increases in the West and Central European countries are mainly due to increases in output, while the increases in the Mediterranean and East European countries are mainly due to more efficient use of their inputs.

Boosting productivity is critical to each country's future economic welfare (well-being). Raising productivity growth rates is crucial for European countries, especially Mediterranean and East-European countries if they are going to catch-up with the West and Central European ones. It is important to note that our results suggest that the less productive countries (compared to the hypothetical one) are the countries with the most productivity growth. Figure 3 shows the average productivity growth rate for the period 2000-2012. From Figure 3, we observe that productivity growth is higher in Slovenia, followed by Slovakia, Greece, Cyprus, Ireland, and Estonia, the countries with the lowest productivity levels.

Figure 3: Average productivity Growth % (2000-2012)



Looking at the empirical evidence, Miller and Atkinson (2014) suggest that one way to increase productivity growth is through investment in ICT (information and communication technologies). The countries, industries, firms that do invest in and use ICT reap significant benefits. The lack of gains that are observed in Europe and individual European countries is mainly due to lack of investment in ICT capital ().

5. Conclusion

In this study we make multilateral comparisons for a set of European countries for the period 2000-2012. We find that countries that belong in the West –Central Europe are doing better with respect to the level of productivity and GDP per capita when compared to other Mediterranean and East European countries. The Netherlands, Belgium, Germany and France are the most productive countries while the less productive ones are Portugal, Greece, Cyprus, Estonia and Slovakia.

Most of the countries experienced increases in their productivity throughout the years. The productivity increases in the West and Central European countries are mainly due to increases in output, while the increases in the Mediterranean and East European countries are mainly due to more efficient use of their inputs.

Countries with lower GDP per capita are growing faster in terms of productivity in the period 2000-2012. If countries want to catch-up with the West and Central European ones, making productivity growth the center of their economic policy is important. One possibility for countries to increase productivity is by encouraging the adoption and use of ICT capital a topics which is left for future research.

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