Factor decomposition of spatial disparities: The case of the European regions

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Abstract

This note examines the evolution and origin of regional disparities in per capita GDP in the European Union. To this end, we propose a new methodology that allows us to analze the role played in explaining the variability of per capita GDP across the European regions by spatial differences in labour productivity, employment rate and the ratio of active to total population.

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1 Introduction

The last fifteen years have seen the publication of numerous studies on regional disparities in the European Union (EU) using a variety of different methodological approaches (Quah, 1996a; López-Bazo et al., 1999; Le Gallo, 2004; Ezcurra et al., 2006). There are various factors underlying the interest in this issue. Among them, it is worth mentioning the major advances made over the last two decades in economic growth theory (Barro and Sala-i-Martin, 1995), in addition to the outstanding development of the "new economic geography" models (Ottaviano and Puga, 1998). Academic debate aside, however, the increasing relevance of this topic in the EU is largely due to the strong focus placed on achieving economic and social cohesion in the context of the economic integration process currently underway in Europe (European Commission, 2004).

In order to investigate more deeply into the territorial imbalances observed in the EU, this note presents a new methodology that allows us to assess the influence of spatial differences in productivity, employment rates and the ratio of active to total population on the variability of per capita GDP across the European regions. It should be noted that the approach in question might be particularly relevant from the point of view of EU regional policy, since the results of our analysis could yield potential information about the kind of public initiatives that should be adopted to improve the relative situation of the least developed areas of the Union.

2 Methodology and data

Let y_i be the per capita GDP of region i, that is $y_i = Y_i/N_i$ where Y_i is the GDP and N_i total population. Likewise, let E_i and A_i be region i's employment and active population, respectively. Note that y_i can be expressed as the product of various factors: labour productivity (p_i), employment rate (e_i), and the ratio between active population and total population (a_i). In particular,

$$y_i = \frac{GDP_i}{E_i} \cdot \frac{E_i}{A_i} \cdot \frac{A_i}{N_i} = p_i \cdot e_i \cdot a_i \tag{1}$$

From this identity, we aim to determine the contribution of each of these factors to spatial disparities in per capita GDP. To this end, we simulate various virtual distributions of per capita GDP in different settings. These virtual distributions are obtained assuming the absence of regional differences in labour productivity, employment rate and the ratio of active to total population. Specifically,

$$y_i^p = \overline{p} \cdot e_i \cdot a_i \tag{2}$$

$$y_i^e = p_i \cdot \overline{e} \cdot a_i \tag{3}$$

and

$$y_i^a = p_i \cdot e_i \cdot \overline{a} \tag{4}$$

where $\overline{p}$, $\overline{e}$ and $\overline{a}$ are the corresponding sample averages. Accordingly, the various virtual distributions defined in this way can be interpreted as that part of the actual distribution of regional per capita GDP that remains unexplained by the existing disparities in each of the factors considered. Thus, if the factor in question had no effect on the actual distribution, then the actual and the virtual distributions should coincide. Otherwise, the virtual distribution will not show the characteristics induced by the factor selected.

In order to examine the role played in this context by productivity, employment rate and the ratio of active to total population, we estimate the density functions of the actual per capita GDP distribution and of the three virtual distributions constructed above. This approximation will allow us to consider the entire cross-sectional distribution, thus avoiding the numerous methodological limitations that characterize the standard regression approach used in conventional convergence analysis (Quah, 1993, 1996b, 1997). According to this strategy, we employ an adaptive kernel method with flexible bandwidths (Pagan and Ullah, 1999). This approach is particularly advisable in the present context, since the possibility of varying the bandwidth along the support of the distribution allows a reduction in the variance of the estimates in areas characterized by the presence of few observations, and decreasing the bias of the estimates in areas with many observations. Specifically, the adaptive two-stage estimator used in this case is the one proposed by Abramson (1982) and given for a generic variable x by:

$$\hat{f}\left(x\right) = \frac{1}{n}\sum_{i=1}^{n}\frac{1}{h\lambda_i}K\left(\frac{x-x_i}{h\lambda_i}\right) \tag{5}$$

In the above expression K is a kernel function and $\lambda_i = \sqrt{\frac{g}{\tilde{f}(x_i)}}$, where g is the geometric average over all i of the pilot density estimate $\tilde{f}(x)$. The pilot density estimate is a standard fixed bandwidth kernel density estimate obtained with h as a bandwidth. In this study, Gaussian kernel functions were used, while the value of h was selected following Silverman (1986, p. 47).

The data employed in this note were drawn from the Cambridge Econometrics regional database. Specifically, the sample used in the empirical analysis covers 196 NUTS-2 regions in fifteen EU member states during the period 1980-2002[1]. It is worth mentioning that the absence of working age population data for these 196 regions over the study period prevented us from decomposing the ratio of active to total population into two new factors: the participation rate and the share of working age population in total population.

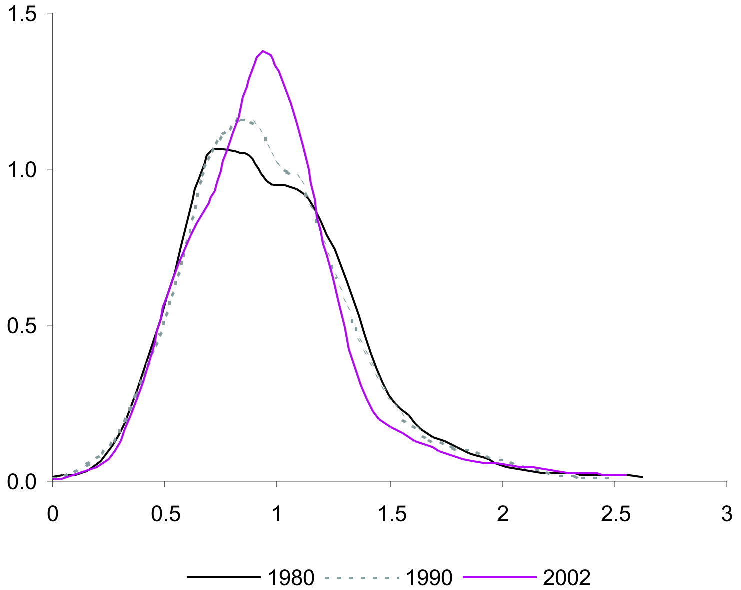
3 Results

Figures 1, 2, 3 and 4 show the density functions estimated from the various distributions mentioned in the preceding section. It is worth mentioning that all the distributions were normalized according to the average per capita GDP in order to facilitate

[1]The lack of complete series obliged us to exclude the 2004 EU enlargement countries, the *Länder* of former East Germany, the French overseas departments and the Portuguese regions of Açores and Madeira.

comparisons and eliminate from the analysis the effect of absolute changes over time[2]. Likewise, although we obtained estimates of the density functions for each year of the study period, to save space, we report only those of 1980, 1990 and 2002[3].

Figure 1: Density functions of EU-relative regional per capita GDP distribution.



As can be observed in Figure 1, the presence of a single mode is a constant in the EU regional distribution of per capita GDP throughout the twenty-three years considered. Nevertheless, there exist certain differences between the various density functions estimated, which reveals that the initial situation did not remain stable over time. Thus, there was an increase in the probability mass concentrated around the EU average between 1980 and 2002. This was due to two main factors. On the one hand, it should be taken into account that several regions with per capita GDP values between 50 and 75% of the EU average succeeded in narrowing their development gaps during the nineties. On the other hand, it is worth noting the behaviour registered by a set of regions with above-average per capita GDP, which tended to worsen their relative positions over the study period. All this suggests the presence of a regional convergence process in per capita GDP in the EU between 1980 and 2002. To confirm this result, we calculated the coefficient of variation of the distribution, a measure of dispersion widely used to capture the concept of sigma convergence (Barro and Sala-i-Martin, 1995). The value of this statistic was found to have decreased by 6% between 1980 and 2002.

In order to investigate the causes of regional disparities in per capita GDP in the EU, Figures 2, 3 and 4 present the density functions estimated from the various virtual

[2]Note that the average per capita GDP, $\overline{y}$, can be expressed as $\overline{y} = \overline{p} \cdot \overline{e} \cdot \overline{a}$.

[3]The rest are available from the authors upon request.

distributions defined above. As can be checked in Figure 2, if we remove the regional differences in productivity, the probability mass is clearly more concentrated around the average than the actual distribution of per capita GDP (Figure 1). This analysis, therefore, highlights the relevance of productivity in explaining territorial imbalances in terms of development observed in the EU, which is in line with the conclusions obtained by Ezcurra et al. (2006) using different methodology from that considered in this note. By contrast, Figure 3 and 4 show that the employment rate and the ratio of active to total population play a considerably less important role in this context. In fact, both the virtual distributions exhibit during the study period a degree of dispersion similar to that registered by the actual per capita GDP distribution. It should be noted, however, that the density functions estimated in Figure 4 are characterized by the presence of two local maxima (bimodality). This suggests that regional differences in the ratio of active to total population contribute to a reduction in the level of polarization of the regional distribution of per capita GDP in the EU.

Finally, it is worth mentioning that the empirical evidence presented in Figures 2, 3 and 4 raises the need for EU regional policy to focus primarily on initiatives that might help to increase productivity in more backward regions of the Union. As an example, we might mention policies aimed at encouraging investment in the productive environment, in human capital and infrastructure stocks, and in innovation and technology diffusion. According to our analysis, however, interventions to reduce regional differences in employment levels would be of less relevance in this context.

Figure 2: Density functions of EU-relative regional per capita GDP distribution without differences in productivity.

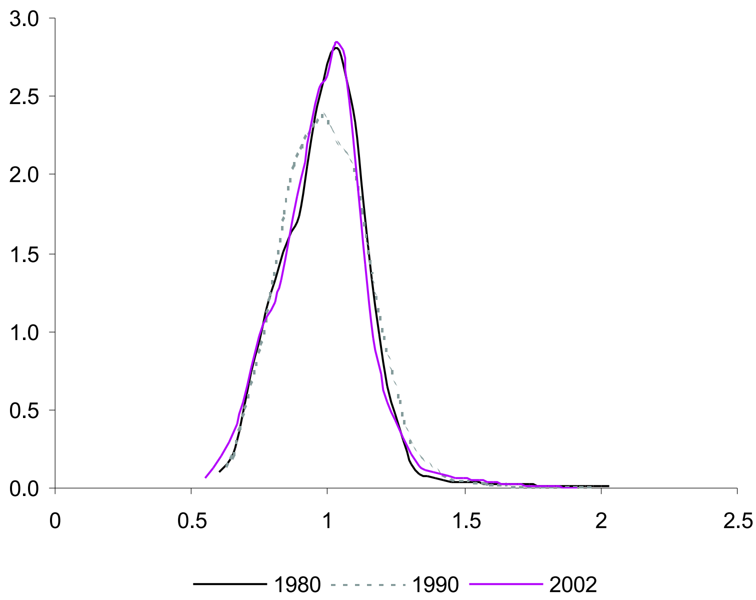


Figure 3: Density functions of EU-relative regional per capita GDP distribution without differences in employment rates.

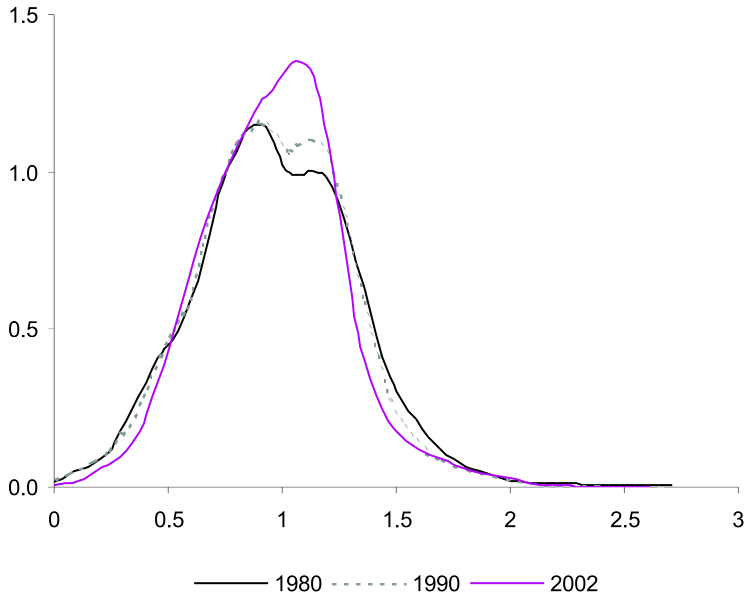
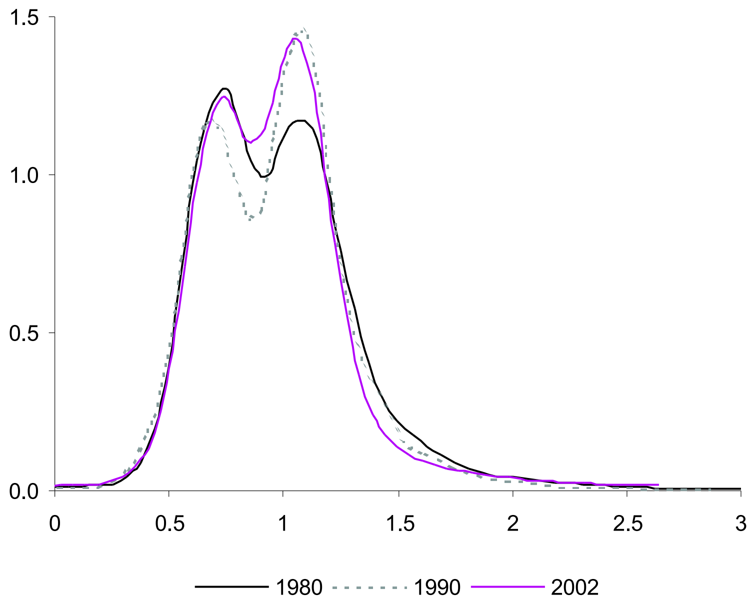


Figure 4: Density functions of EU-relative regional per capita GDP distribution without differences in the ratio of active to total population



4 Conclusions

In this note we have examined the evolution and origin of spatial disparities in per capita GDP across the EU regions between 1980 and 2002. The various density functions estimated reveal that the probability mass located around the EU average increased during the study period, which explains the convergence process detected.

In order to complete these results, we present a new methodology that allows us to analyze the role played in this context by labour productivity, activity rate and the ratio of active to total population. In this respect, our study shows that regional differences in productivity are the main factor when it comes to explaining the variability of per capita GDP observed across the EU regions, while the employment rate and the ratio of active to total population have clearly less impact.

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