REGIONAL PRODUCTIVITY DIFFERENTIALS IN POLAND, HUNGARY AND THE CZECH REPUBLIC

by

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Summary:

This paper starts by describing the distribution of GVA, employment and productivity growth across the regions of Poland, Hungary and the Czech Republic. Next, we investigate in what extent regional per capita income gaps to the European average can be attributed to differences in productivity per worker. Finally, we extend Esteban's (2000) shift-share analysis to measure how regional productivity gaps are due to differences in industrial mix as opposed to region-specific factors. The results point out the greater influence of the second element and therefore support policies benefiting homogenously all the sectors in the least developed regions.

Keywords: Eastern Europe, Poland, Aggregate Productivity, Shift-share, Regional Policy

1. Introduction

The unraveling of post-transition scenarios in the countries of Central and Eastern Europe presents a challenge for regional economic analysis. This transformation has created a turn of economic events that have been hitherto unprecedented. Central planning mechanisms have been replaced by market mechanism, and at the same time domestic production bases have become linked to wider international markets. This interplay of internal economic transformation and integration into European economy raises important questions about the effects of the transition process on regions as well as future spatial patterns of economic development. This is because the nature and the pace of structural reforms implemented in these countries involve changes in income distribution in favor of some groups and against others, and there are limits on the extent of distributional changes that can be tolerated on political and equity grounds (Bhattacharya, 1997).

In addition, the new accession countries are poorer, have larger population and higher share of agriculture than the poorest four members of the EU. Therefore, the European Commission has already started to analyze the consequences of enlarging to the Central and Eastern countries since their characteristics will necessarily lead to the most important reform of European regional policies since the enlargement to the Southern countries (Greece, Spain and Portugal) during the 1980's. For instance, if the enlargement to these last three countries increased the population by 22% but decreased the per capita GDP by 6%, the coming enlargement (assumed to 11 countries) will increase the European population by 29%, but dramatically decrease the per capita GDP by 16%.

In this paper, rather than using the usual approach that focuses on regional disparities in income (see, for instance, Barro and Sala-I-Martin, 1995)[1], we prefer to analyze the extent to which these disparities can be due to each component of per capita income, since the latter one is closely related to combined aggregate productivity per worker, share of worker over total labor force, and the share of the labor force in total population. Regional inequalities in income depend on factors such as capital funding, technology, infrastructure and human capital. However, since these variables are not always homogeneous or available at the regional level, it shifts the focus onto labor productivity, which acts as a proxy for these variables (Esteban, 2000; Cuadrado-Roura *et al.*, 2000; Cuadrado-Roura, 2001). As a consequence, the point of our paper becomes to identify the causes of interregional differences in productivity per worker. This will be performed using shift-share analysis.

While shift-share analysis does not imply causality, it is a useful technique for the analysis of transition economies where there is no well-established theory. A descriptive analysis like shift-share is informative, the results can be used to suggest explanations and contribute to building of theory of transition process. Moreover, many studies emphasize the regional and sectoral changes that accompany the transition process (in the case of employment growth differentials, see Boeri and Scarpetta, 1996; Traistaru and Wolff, 2002). This is related to the emerging body of work on regional performance following the transition, i.e. detecting the loosing vs. winning regions (Kratke, 1999; Nemes-Nagy, 2000; Petrakos, 2000). The decomposition technique can then be used to trace effects of policy changes where there is a strong sector-region link. For example, in the case of new EU entrants, the EU antidumping policy will be lifted against specific sectors following EU entry (mainly chemical and steel sectors in Poland, Hungary, Czech Republic and Slovakia) (Faucompret *et al*. 1999). Kennedy (1997) shows that economic reforms in Poland have already been reflected in different patterns of development according to the sector where they were implemented. He distinguishes a group of sectors where restructuring appears to have worked very well from a second group (mostly composed of large state-owned enterprises) where little changes occurred. These sectors are geographically concentrated. The advantage of the shift-share approach relies in its ability to decompose the regional and sectoral components of changes in employment or productivity that follow policy reforms.

Our analysis is performed on the regions of Poland, Hungary and the Czech Republic for the period of 1990-2000 for data availability reasons. We choose to perform the same type of analysis on Spain and Portugal over the decade before the time of their membership (1977-1985) because before their integration the gap of their level of development compared to the European average was substantial as well. In this paper, inequalities will be thought as the difference to the European average, since most of regional policy funds are allocated according to criteria based on this average. In other words, the average of the current 15 EU members will be used when the three Eastern countries are considered, the average of the 10 former EU members in the case of Spain and Portugal.

The paper proceeds as follows. Section 2 displays the main features of regional distribution of Gross Value Added (GVA), employment and productivity growth, compared to the ones of the EU average. Section 3 measures the extent to which differentials in regional per capita income can be attributed to aggregate productivity per worker, the share of workers in the labor force or the labor force per inhabitants, each of them being expressed as a difference to the EU average. Section 4 relies on the shift-share decomposition introduced by Esteban (2000) where regional productivity growth is modeled as the sum of three components: structural, differential and allocative. We then assess the role played by each of these elements in explaining regional differences in productivity per worker. While our analysis incorporates elements of methodologies demonstrated in Esteban (2000), it includes a number of important modifications. His work deals with differential in productivity of the European regions to the EU average, in other words, the studied region belongs to the benchmark it is compared with. In our case no region belongs to the benchmark. Second, the benchmark we use takes into account the 15 current EU members, whereas Esteban (2000) includes only 5 countries. Finally, instead of Esteban (2000) and Traistaru and Wolff (2002), we perform a shift-share analysis for a number of consecutive years, which is more relevant for assessing the dynamics of inequality in aggregate productivity per worker.

2. Typology of productivity distribution

The most important part of regional policy instruments takes the European average as the reference point for deciding where to allocate development funds. With the same idea, this paper uses the European average of the 15 current members as a benchmark for the evaluation of the gap in terms of productivity, employment, GVA that characterize each of the region of Poland (16 regions) , Hungary (7 regions) and the Czech Republic (8 regions) over the 1990-2000 period. The name of these regions is displayed in table 1 below. As explained in the introduction, the same type of analysis is performed on the regions of Spain (18 regions) and Portugal (7 regions) compared to the European average that existed a decade before their accession (EU 10 over 1977-1985, due to missing data for the years 1975 and 1976). All the data come from the regional database of Cambridge Econometrics (2001)[2] .

<<insert table 1 here>>

Figure 1 below displays the gap that separates the per capita GVA of the Polish and Portuguese regions to the European average. Although the Polish regions are the best performing (in terms of per capita GVA) within the sample of the transition countries, it appears that even the richest Polish regions have to cover a distance almost equal to the one the poorest Portuguese ones had to cover twenty years ago (the gap, although it had decreased, still remains substantial by 1995; see figure 1). Moreover, the poorest regions of the Eastern countries of our study were twice as far from the EU average during 1990-2000 as were the poorest Portuguese ones during 1977-1985. The rest of the time-series figures of our analysis are omitted due to space constraints. However, we can note that while the Polish and Hungarian regions are below the EU average in terms of employment per population levels, practically all the Czech ones are well above it. The employment per population levels for the Spanish and Portuguese regions were below the EU average over 1977-1985, but their gap to the EU average was greater than the one of the Polish and Hungarian regions to the current average. The difference in employment rates between Poland and Hungary on one hand and the Czech Republic on the other is representative of the particular restructuring paths that these countries have taken. The legacy of the command-and-control economy has been an inefficient use of labor, which may result in overemployment (Jackman, 1994; Dries and Swinnen, 2002). According to Warzynski (2003), high unemployment rates in the case of Poland and Hungary are evidence of painstaking restructuring as the economy changes gears. On the contrary, Sorm and Terrell (2000) show that the low unemployment in the Czech Republic during most of the 1990's was due to greater shifts in the structure of sectoral employment than the other transition economies.

<<insert figure 1 here>>

Following Cuadrado-Roura *et al.* (2000) analysis, figure 2 below displays the productivity growth in each region of the candidate countries against the European mean over 1990-2000, but also highlights the role that employment growth and production growth plays in that process. Figure 2 provides two types of information. First a regional (productivity or employment) growth rate is positive or negative when it is compared to the continuous line. Second, a regional (productivity or employment) growth rate is greater or smaller than the European average according to its relative location compared to the broken line. Depending on their positions in the figure, Cuadrado-Roura *et al.* (2000) suggest a typology of the regions displayed in table 2.

<<insert table 2 and figure 2 here>>

Since the 31 regions of the 3 candidate countries are represented all together in figure 2, it appears first that the regions of a same country are clustered together. Second, there are some differences in the behavior of these regions. Following the regional typologies depicted in table 2, the regions of Poland and Hungary belong to the category IIb. In other words, there is a relative restructuring in these regions, characterized by a productivity growth and a GVA growth higher than the ones of the EU average, but an employment growth smaller (and negative) than the one of the EU average. In this case, productivity gains have been achieved mainly at the expense of a decrease in employment growth. Note however that the Polish regions are in a better situation than the Hungarian regions since their employment growth is much closer to the one of the EU average. With the exception of Prague, the Czech regions belong to the category III: economic decline. Their productivity growth, their GVA growth and their employment growth are all below the EU average. The region Prague has also its productivity and GVA growth below the EU average, but its employment growth is above it.

This region is characterized by a conservative restructuring (category IVa). During the transition process, employment growth was always higher in capitals than in the rest of the country (Petrakos, 2000). Figure 2 displays a higher employment growth in the region Kozep-Magyarorszag (where Budapest is located) than in the other Hungarian regions. Boeri and Scarpetta (1996) note also that the labor market conditions prevailing in Prague were exceptional with up to 10 vacancies per job seeker in 1994.

<<insert figure 3 here>>

When the same type of analysis is performed on the Spanish and the Portuguese regions before the time of their membership, it appears that the behavior of regions belonging to the same country differs more than in the previous cases. As displayed in figure 3, two Spanish regions (Ceuta y Melilla and Baleares) show a greater productivity growth, employment growth and GVA growth than the EU average. However, the results of these two regions should be considered carefully since they both are remote and very small regions, and thus not representative of the overall behaviors of Spanish regions. In fact, the rest of the Spanish regions and four Portuguese regions (Norte, Centro, Lisboã and Alentejo) belong to the category IIb, like the Polish and Hungarian regions, which characterize the regions with a productivity growth and a GVA growth greater than the ones of the EU average, but at the expense of a smaller employment growth. The three remaining Portuguese regions are Algarve, the Azores and Madeira. Algarve belongs to category IIa, dynamic restructuring, with a productivity growth and a GVA growth greater than the EU average, but a smaller (and positive) employment growth than the average. The Azores belong to category III, vicious circle, having a smaller productivity growth, GVA growth and employment growth than the

EU average. Finally, Madeira is in the category IVa, conservative restructuring, with an employment growth greater than the average, but GVA and productivity growth are smaller.

The results above suggest that the difference in employment growth and productivity growth of the Hungarian and Polish regions to the European average is pretty similar to what they were for Spain and Portugal a decade before they integrated the European Union. The case of the Czech Republic seems more alarming since its regions (except Prague) are characterized by a productivity, GVA and employment growth below the EU average.

In order to bring more insights into the role played by productivity differentials in explaining income differentials to the European average, the next section displays a decomposition of regional income inequalities.

3. Decomposition of Regional Inequalities

The first step of our analysis decomposes each region i's GVA per population as the product of aggregate productivity per worker, the share of employment in the labor force and the share of the labor force in total population as follows:

$$\left(\frac{gva}{pop}\right)_i = \left(\frac{gva}{w}\right)_i * \left(\frac{w}{l}\right)_i * \left(\frac{l}{pop}\right)_i \qquad (1)$$

where the element on the left hand side is region i's per capita GVA; on the right hand side, the first element is region i's productivity per worker, the second element is the share of workers in the labor force and the last one is the labor force per inhabitants in region i. In logarithmic form, expression (1) becomes:

$$\log\left(\frac{gva}{pop}\right)_i = \log\left(\frac{gva}{w}\right)_i + \log\left(\frac{w}{l}\right)_i + \log\left(\frac{l}{pop}\right)_i \quad (2)$$

Similarly, for the European average, this expression is:

$$\log\left(\frac{gva}{pop}\right)_{EU} = \log\left(\frac{gva}{w}\right)_{EU} + \log\left(\frac{w}{l}\right)_{EU} + \log\left(\frac{l}{pop}\right)_{EU} \quad (3)$$

Combining (2) and (3) we have:

$$\log\left(\frac{gva}{pop}\right)_i - \log\left(\frac{gva}{pop}\right)_{EU} = \log\left(\frac{gva}{w}\right)_i - \log\left(\frac{gva}{w}\right)_{EU} + \log\left(\frac{w}{l}\right)_i - \log\left(\frac{w}{l}\right)_{EU} \quad (4)$$
$$+\log\left(\frac{l}{pop}\right)_i - \log\left(\frac{l}{pop}\right)_{EU}$$

One way of measuring the role played by each component in explaining the total difference of GVA of each region to the EU average is to compute the relative weight of the variance of each component in the overall observed variance, together with a term collecting the covariances:

$$\mathrm{var}(\frac{gva}{pop}) = \mathrm{var}(\frac{gva}{w}) + \mathrm{var}(\frac{w}{l}) + \mathrm{var}(\frac{l}{pop}) + 2\,\mathrm{cov}(\frac{gva}{w},\frac{w}{l}) + 2\,\mathrm{cov}(\frac{gva}{w},\frac{l}{pop}) + 2\,\mathrm{cov}(\frac{w}{l},\frac{l}{pop}) \quad (5)$$

where each element into brackets corresponds to the respective logarithmic difference (between the region and the EU average) expressed in (4), the last elements being terms collecting the covariance between the three previous variables. A similar type of variance decomposition has been used by Boeri and Scarpetta (1996) in application to six European transition economies. In their analysis, the variance of regional employment rates of change is decomposed into a main component explained by structural changes and a residual related to regional effects.

<<insert table 3 here>>

The results for three different years are displayed in table 3 above. Most of the variance of per capita GVA in the Polish and Portuguese regions is attributable to productivity per worker differentials to the EU average. Their variance represents respectively an average of 1.05 and 1.52 times the variance of per capita GVA differentials. The results for the Czech and Hungarian regions clearly support the idea that per capita GVA variances come from differentials in the share of the labor force in total population (around 0.8 in both countries, whereas productivity differentials count only for less than 0.23 in total per capita GVA variance). Finally, most of the variance of per capita GVA differentials comes from the share of employment in the labor force in Spain.

When looking at the evolution of variances over time[3], the results differ from one country to another as well: within Poland, the variance of regional productivity per worker differentials increases by 2% whereas it decreases by 84% within Portugal, indicating a convergence of productivity per worker levels among its regions. Within the Czech Republic and Hungary, the variance of the share of the labor force in total population differentials increases respectively by 6 and 34%, indicating increasing regional differences within these countries. Note however that this increase is much more steadily in Hungary.

To complete the above analysis, a three-factor decomposition of productivity differentials will be given in the next section, using the shift-share approach. This methodology allows analyzing the extent to which inequalities in aggregate labor productivity can be attributed to region-specific or to sector-specific factors.

4. THE SHIFT-SHARE APPROACH

In this section, we further decompose regional labor productivities. In that purpose, we base our analysis on the traditional shift-share approach depicted in Esteban (1972, 2000). A number of studies have focused on analyzing changes in employment and productivity as determinants of income growth using shift-share analysis or a related methodology. First used by Dunn (1960) as a forecasting technique for regional growth employment, the shift-share approach has been applied more recently by Esteban (1972, 2000) to analyze productivity changes among the European regions. With regard to our studied countries, Garcia-Mila and Marimon (1999) apply the shift-share technique to the regional growth rate of employment and productivity in Spain; whereas Traistaru and Wolff (2002) perform it on the regions of Romania, Bulgaria and Hungary. These last two studies conclude that regional differences in employment growth are only little responsive to the inherited employment structure of the various regions, while it is almost driven entirely by region-specific factors.

Our approach can be formulated as follows: let p_i^j be sector j's employment share in region i so that $\sum_j p_i^j = 1$ for all regions i [4]. We denote by p_{EU}^j sector j's employment share at the European level (EU 15 in the Eastern countries case, EU 10 in the Spanish and

Portuguese cases). We shall also have $\sum_j p_{EU}^j = 1$. Similarly, we denote by x_i^j the productivity per worker in sector j and region i, respectively x_{EU}^j at the European level. Five sectors are concerned: agriculture, construction, total energy and manufacturing, non market services, market services. Therefore, the following equalities hold:

$$x_i = \sum_j p_i^j x_i^j \qquad \text{and} \tag{6a}$$

$$x_{EU} = \sum_j p_{EU}^j x_{EU}^j \,. \tag{6b}$$

The regional differential in productivity per worker between region i and the European average is therefore: $x_i - x_{EU}$.

The difference of aggregate regional productivities to the EU average decreases over time in the Czech Republic and in Hungary[5]. In other words, instead of catching up to the EU average, the productivity levels within these regions tend to diverge during the period 1990-2000. For the Polish regions, we observe (slightly) increasing regional disparities and the leading position of Malopolskie (where Krakow is located) which is by far the best performing region of the Eastern countries dataset in terms of average productivity. The observations for the Spanish and Portuguese regions are similar to the ones presented at the beginning of the second section: before their entrance to the EU they had to cover a much smaller distance than the Czech, Polish and Hungarian regions had to cover at the early nineties. There was an increasing trend in Spanish regions' productivities during 1977-1985 and most of them approached closely the EU average while at the same time regional disparities were increasing. This is in contrast with the Portuguese regions for which one observes diminishing regional inequalities through a negative trend for the most productive regions.

Esteban (2000) shows that the regional differential in productivity per worker can be attributed to three possible causes. The first one is due to the specialization of a region in the more productive sectors, which would result in a regional aggregate productivity above the mean, even if the productivity of each single sector is the same at any location. It may result from local advantages that have been growing with history. The second cause comes from each region's sector-by-sector productivity differential to the average, assuming that the sectoral composition of the regional industry is the same than the one at the European level. It may come from previous investments in technology, human capital and public infrastructures. The third cause of differential in productivity per worker is due to a combination of both.

In order to assess the extent to which each of these component impacts on the different levels of regional productivity per worker compared to the EU average, the three components of the regional deviation in productivity are defined as follows:

a) *The industry-mix component* μ_i of region i measures the differential in productivity per worker between region i and the EU average due to the specific sectoral composition of its industry. Here we assume that the productivity per worker in each sector is the same across all the regions and the European average. We thus write:

$$\mu_i = \sum_j \left(p_i^j - p_{EU}^j\right)x_{EU}^j \tag{7}$$

μ_i takes positive values if the region is specialized (i.e. $p_i^j > p_{EU}^j$) in sectors with high productivity compared to the European level or de-specialized (i.e. $p_i^j < p_{EU}^j$) in sectors of low productivity. μ_i is at a maximum if the region is specialized in the most productive sector.

Note that (7) can be rewritten as:

$$\sum_j p_i^j x_{EU}^j = x_{EU} + \mu_i \tag{8}$$

The left hand side of (8) is the average productivity per worker in region i if European and regional productivities coincide sector by sector. According to (8), region i's average productivity is equal to the European average plus the regional industry-mix component.

Using data on the five sectors cited above, the industry mix component evolves steadily with no trend for the Polish and Czech regions whereas for the Hungarian ones there is a clear increasing trend. Due to the fact (mentioned in section 2) that the Czech regions are well above the European average in terms of employment per population, their industry mix component is strictly positive during the period 1990-2000. Most of the Polish regions have negative industry mix values; whereas after 1994 practically all the Hungarian regions display positive industry mix values. The Spanish regions behave similarly to the Polish ones (no trend and mostly negative industry mix values) whereas the Portuguese ones display negative values with no trending behavior. For these last three countries, the results may be due to the importance of the agricultural sector in the economy.

b) *The productivity differential component* π_i focuses on productivity differentials due to region i's sector by sector productivity differential to the EU average, assuming that the region's industry mix coincides with the European one. We then define π_i as:

$$\pi_i = \sum_j p_{EU}^j \left(x_i^j - x_{EU}^j \right) \tag{9}$$

π_i takes on positive values if the region has sectoral productivities above the European average. Equation (9) can also be written as follows:

$$\sum_j p_{EU}^j x_i^j = x_{EU} + \pi_i \tag{10}$$

The left hand side of (10) stands for the average productivity of region i when its industry mix equals the European one and hence any differential in average productivity must be caused by sectoral productivity differences. Region i's average productivity could thus be expressed as the sum of the European average plus the regional productivity differential component.

The productivity differential component leads to similar observations as the ones that came out for the aggregate productivity levels. Regional disparities appear to be significantly less important in the Eastern countries than in Spain and Portugal. On the other hand, their difference with the European average is much greater than it was some years ago for the Spanish and Portuguese regions. However two regions behave in a different way: Malopolskie (in Poland) and Prague (in the Czech Republic), which are far from the other Eastern European regions and close to the EU average.

c) *The allocative component* α_i is a combination of the two previous components and is defined as follows:

$$\alpha_i = \sum_j \left(p_i^j - p_{EU}^j \right)\left(x_i^j - x_{EU}^j \right) \tag{11}$$

This component is positive if the region is specialized, relative to the European average, in sectors whose productivity is above the European average, and negative if below it. α_i is at its maximum if the region is completely specialized in the sector with the largest productivity differential with respect to the European average. This component is an indicator of the efficiency of each region in allocating its resources over the different industrial sectors. The allocative component can also be viewed as measuring the covariance between the two previous components.

The allocative component is characterized by decreasing dynamics (from positive values towards zero) for Hungary and Poland and steady dynamics close to zero for the Czech regions. Prague is an outlier again since its values are significantly less important than the ones of the other Czech regions. The allocative component for the Portuguese regions increases from small negative values towards zero. On the other hand, the values of the Spanish regions oscillate around zero.

The gap between regional and European average productivities decomposed into the three components can be formulated as follows:

$$y = x_i - x_{EU} = \mu_i + \pi_i + \alpha_i \tag{12}$$

In order to measure the role played by each component in explaining regional differences in aggregate productivity per worker, we estimate the following three pooled regressions, each of them including the productivity gap as the explained variable and one single component of the shift-share decomposition as an explanatory variables:

$$x_{it} - x_t = a_\mu + b_\mu \mu_{it} + \varepsilon_\mu \qquad i = 1,...N \text{ and } t = 1,...T \tag{13a}$$

$$x_{it} - x_t = a_\pi + b_\pi \pi_{it} + \varepsilon_\pi \qquad i = 1,...N \text{ and } t = 1,...T \tag{13b}$$

$$x_{it} - x_t = a_\alpha + b_\alpha \alpha_{it} + \varepsilon_\alpha \qquad i = 1,...N \text{ and } t = 1,...T \tag{13c}$$

where N is the total number of regions, T is the number of periods, ε_μ, ε_π and ε_α are error terms with the usual properties (~iid (0, σ^2)).

<<insert table 4 here>>

The estimations by Ordinary Least Squares of models (13a), (13b) and (13c) have been performed using S+ and the results for each of the five countries are presented in table 4 above. Note that in each case, a test for homogeneity of slopes has been performed and that the null hypothesis could never be rejected. Therefore, all the results are presented without time fixed effects.

It appears that all coefficients are significant at the 10% level, except the coefficient associated to the allocative component for Spain. While the levels of significance of the other coefficients vary across countries and across components, we note that the coefficient associated to the productivity differential component is always very strongly significant at 1%. Moreover, the goodness of fit, measured by the value of R^2, in model (13b) is always much better than the one for the two other models. Only in the case of Portugal is the fit for model (13c) almost as good as the one for model (13b). In other words, these findings reveal that the main factors determining interregional per worker productivity differences compared to the EU average are region-specific factors that have a homogeneous effect on productivity across sectors. On the contrary, regional industry specialization has a small role in productivity differentials compared to the EU average. Traistaru and Wolff (2002) provide two explanations justifying the analysis of regions on an aggregate level, neglecting the sectoral composition of their industries: first, the regions of transition countries the sectors are strongly interrelated so that if one sector is affected by one shock, all the other sectors in the respective region will be affected as well. Second, only very few shocks affect only one sector, whereas region specific shocks are more likely and affect regions as a whole.

5. Conclusion

A reconsideration of the origin of regional imbalances within the transition countries is necessary for two reasons. First, the pace of the reforms implemented involves changes in the distribution of income that must be taken into account for political and equity reasons. Second, a reconsideration of the current regional policy is necessary in order to prevent a budget deficit when the Eastern countries will belong to the enlarged European Union. This paper meets these expectations by bringing more insights into the gap in per capita GVA between the regions of three candidate countries, namely Hungary, Poland, the Czech Republic, and the European average. Because of the development gap they experienced a decade before the date of their membership, the analysis is also performed on the regions of Spain and Portugal.

When the main features of regional distribution of GVA, employment and productivity growth are displayed, it appears that the behavior of the Hungarian and Polish regions is similar to the one of most of the Spanish and Portuguese regions. Compared to the EU average, their greater growth of employment and GVA occurred at the expense of a lower employment growth. On the contrary, all three variables display a smaller growth (than the one of the EU average) in the Czech regions, representative of their economic decline. Moreover, these results point out the large gap in GVA and productivity levels between all the regions of Poland, Hungary, the Czech Republic and the EU average. This differentiates these candidate countries from the previous entrants, Spain and Portugal, who exhibited smaller gaps with the EU average. At the same time, we identify differences between the three accession countries with Poland seemingly on the trajectory of a slow catching up to the EU average, Hungary being the intermediate case and the Czech Republic trailing behind.

Next, we investigate the extent to which regional per capita income gaps can be attributed to differences in aggregate productivity per worker. In the case of the Polish and Portuguese regions, they can mostly be attributed to the variance of aggregate productivity per worker differentials. For Hungary and the Czech Republic, the results support the idea that they mostly come from the variance of the labor force over total population differentials. The Spanish regions are the only one to display a variance of employment in the labor force as the most important share of their per capita GVA variance.

Finally, we extend Esteban's (2000) shift-share methodology to decompose regional productivity differentials (to the EU average) into three elements: the industry mix (structural component), the region-specific factors (differential component) and the allocative component, a combination of the previous two. When we estimate their individual contribution over the total productivity differentials, the results show that the productivity differential component explains the most important part of regional productivity differences to the EU average in the three Eastern countries, in Spain and Portugal as well. On the contrary, the industry-mix component has a small role. As a conclusion, our findings do not lend themselves to supporting particular sectoral policies, but rather to benefiting homogenously all the sectors in the least developed regions. This is particularly true in the Polish regions among which regional income inequalities come mostly from differentials in aggregate productivity per worker.

NOTES

1. In the case of transition economies, convergence analyses are mostly performed at the country level (see for example, Campos, 2001; Kočenda, 2001).

2. Some modifications were necessary before performing the analysis. In the case of Poland, the data on regional employment show a downward shift for the year 1998 due to a redefinition of regional boundaries within the country that year. It has been corrected using an exponential smoothing algorithm. Data on regional population presented also a much greater level over 1990-1997 than for the 1998-2000 period. Since the REGIO database (created by Eurostat) confirms the data over 1998-2000, we decided to adjust the levels over 1990-1997 to those of the last three years, but the annual growth rates remain similar. Finally, the Hungarian regional GVA data display an abrupt decline in 1995 as well, but we decided not to correct them since we could not find any evidence that it was due to a data problem.

3. Complete results available from the authors upon request.

4. Index i runs from 1 to 31 for the dataset of the Eastern countries and from 1 to 25 for the dataset of the Spanish and Portuguese regions. Index j runs from 1 to 5 for all of them.

5. All the figures for section 4 are available from the authors upon request.

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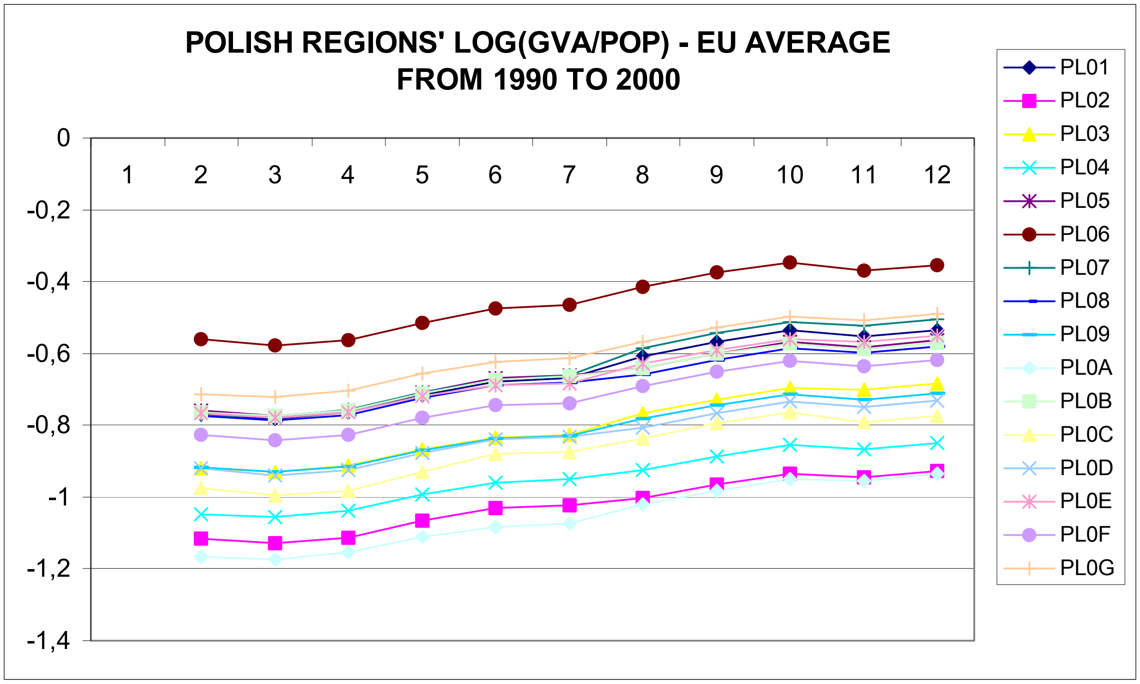

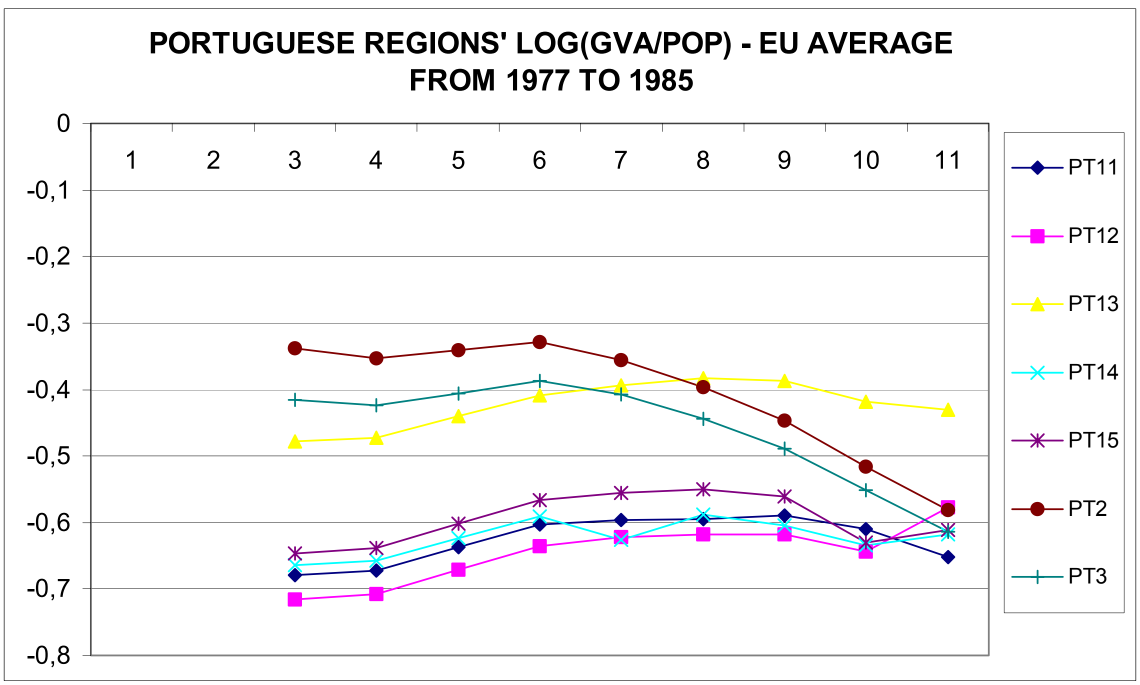

Figure 1: $\log\left(\frac{gva}{pop}\right)_i - \log\left(\frac{gva}{pop}\right)_{EU}$ for Polish (1990-2000) and Portuguese regions (1977-1985). (*Source*: Cambridge Econometrics (2001), see table 1 for the region's codes and names).

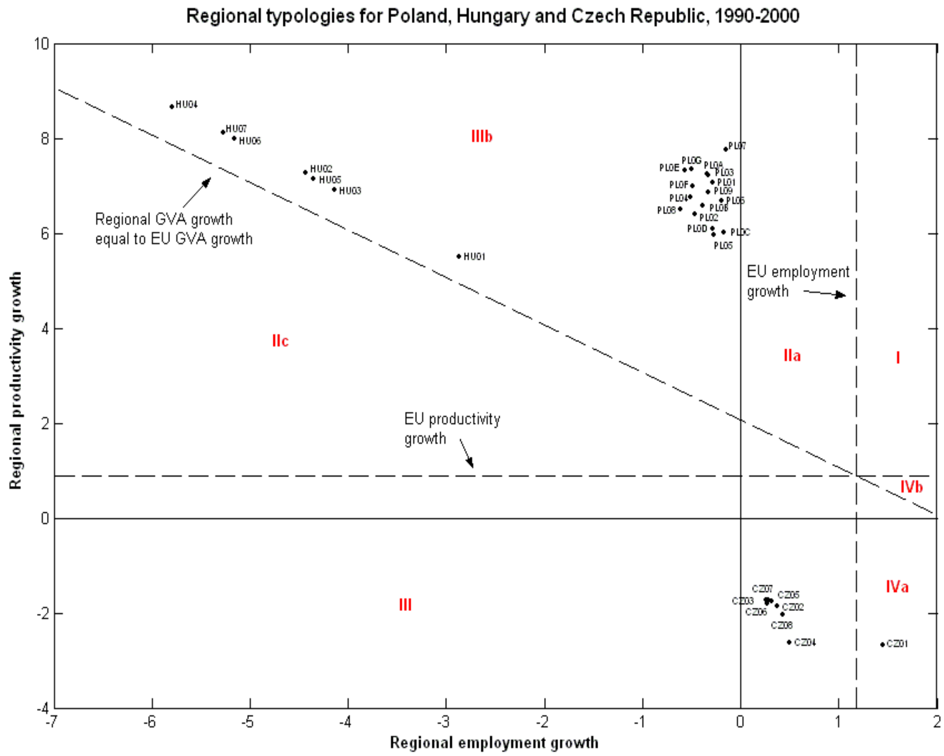

Figure 2: Regional typologies for Poland, Hungary and the Czech Republic over 1990-2000. (*Source*: Cambridge Econometrics (2001), see table 1 for the region's codes and names).

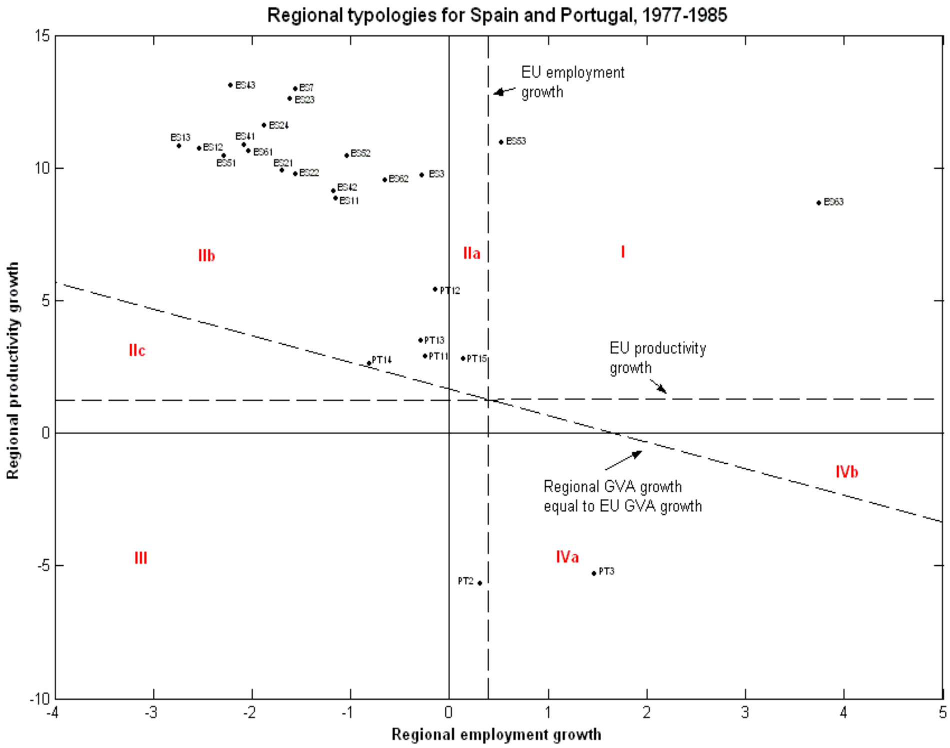

Figure 3: Regional typologies for Spain and Portugal over 1977-1985. (*Source*: Cambridge Econometrics (2001), see table 1 for the region's codes and names).

Table 1- Regions' code and name

Code	Name	Code	Name	Code	Name
	SPAIN		**PORTUGAL**	CZ05	Severovychod
ES11	Galicia	PT11	Norte	CZ06	Jihovychod
ES12	Asturias	PT12	Centro	CZ07	Stredni Morava
ES13	Cantabria	PT13	Lisboa e V.do Tejo	CZ08	Ostrava
ES21	Pais Vasco	PT14	Alentejo		**POLAND**
ES22	Navarra	PT15	Algarve	PL01	Dolnoslaskie
ES23	Rioja	PT2	Acores	PL02	Kujawsko-Pomorskie
ES24	Aragon	PT3	Madeira	PL03	Lubelskie
ES3	Madrid		**HUNGARY**	PL04	Lubuskie
ES41	Castilla-Leon	HU01	Kozep-Magyarorszag	PL05	Lodzkie
ES42	Castilla-la Mancha	HU02	Kozep-Dunantul	PL06	Malopolskie
ES43	Extremadura	HU03	Nyugat-Dunantul	PL07	Mazowieckie
ES51	Cataluna	HU04	Del-Dunantul	PL08	Opolskie
ES52	Com. Valenciana	HU05	Eszak-Magyarorszag	PL09	Podkarpackie
ES53	Baleares	HU06	Eszak-Alfold	PL0A	Podlaskie
ES61	Andalucia	HU07	Del-Alfold	PL0B	Pomorskie
ES62	Murcia		**CZECH REPUBLIC**	PL0C	Slaskie
ES63	Ceuta y Melilla	CZ01	Praha	PL0D	Swietokrzyskie
ES7	Canarias	CZ02	Strední Cechy	PL0E	Warminsko-Mazurskie
		CZ03	Jihozapad	PL0F	Wielkopolskie
		CZ04	Severozapad	PL0G	Zachodniopomorskie

Table 2- Regional Typologies

	Productivity	GVA	Employment
I. “Virtuous” circle	$\dot{P}_R > \dot{P}_{EU}$		$\dot{N}_R > \dot{N}_{EU}$
I. “Virtuous” growth	$\dot{P}_R > \dot{P}_{EU}$	$\dot{Y}_R > \dot{Y}_{EU}$	$\dot{N}_R > \dot{N}_{EU}$ and > 0
II. Restructuring*	$\dot{P}_R > \dot{P}_{EU}$	$\dot{Y}_R > \dot{Y}_{EU}$	$\dot{N}_R > \dot{N}_{EU}$ and < 0
II. Restructuring via productivity	$\dot{P}_R > \dot{P}_{EU}$		$\dot{N}_R < \dot{N}_{EU}$
II.A. Dynamic restructuring	$\dot{P}_R > \dot{P}_{EU}$	$\dot{Y}_R > \dot{Y}_{EU}$	$\dot{N}_R < \dot{N}_{EU}$ and > 0
II.B. Relative restructuring	$\dot{P}_R > \dot{P}_{EU}$	$\dot{Y}_R > \dot{Y}_{EU}$	$\dot{N}_R < \dot{N}_{EU}$ and < 0
II. C. Absolute restructuring	$\dot{P}_R > \dot{P}_{EU}$	$\dot{Y}_R < \dot{Y}_{EU}$	$\dot{N}_R < \dot{N}_{EU}$
III. “Vicious” circle	$\dot{P}_R < \dot{P}_{EU}$		$\dot{N}_R < \dot{N}_{EU}$
III. Economic decline	$\dot{P}_R < \dot{P}_{EU}$	$\dot{Y}_R < \dot{Y}_{EU}$	$\dot{N}_R < \dot{N}_{EU}$
IV. Restructuring via employment	$\dot{P}_R < \dot{P}_{EU}$		$\dot{N}_R > \dot{N}_{EU}$
IV. A. Conservative restructuring	$\dot{P}_R < \dot{P}_{EU}$	$\dot{Y}_R < \dot{Y}_{EU}$	$\dot{N}_R > \dot{N}_{EU}$
IV. B. Intensive restructuring	$\dot{P}_R < \dot{P}_{EU}$	$\dot{Y}_R > \dot{Y}_{EU}$	$\dot{N}_R > \dot{N}_{EU}$

* This typology only appears when country cases are considered
Source: Couadrado-Roura *et al.* (2000)

Table 3- Share of total variance by component

		$\mathrm{var}(\frac{gva}{w}) / \mathrm{var}(\frac{gva}{pop})$	$\mathrm{var}(\frac{w}{l}) / \mathrm{var}(\frac{gva}{pop})$	$\mathrm{var}(\frac{l}{pop}) / \mathrm{var}(\frac{gva}{pop})$	$2\,\mathrm{cov}(\frac{gva}{w},\frac{w}{l}) / \mathrm{var}(\frac{gva}{pop})$	$2\,\mathrm{cov}(\frac{gva}{w},\frac{l}{pop}) / \mathrm{var}(\frac{gva}{pop})$	$2\,\mathrm{cov}(\frac{w}{l},\frac{l}{pop}) / \mathrm{var}(\frac{gva}{pop})$
Poland	1990	1.064	0.002	0.214	-0.030	-0.289	0.039
	1995	1.050	0.005	0.182	-0.048	-0.246	0.057
	2000	1.032	0.007	0.146	-0.044	-0.204	0.064
Hungary	1990	0.175	0.000	0.586	0.002	0.216	0.020
	1995	0.073	0.007	0.693	0.011	0.074	0.141
	2000	0.084	0.004	0.807	0.001	-0.014	0.118
Czech Republic	1990	0.224	0.001	0.777	-0.002	-0.033	0.033
	1995	0.113	0.002	0.825	-0.022	0.039	0.043
	2000	0.164	0.000	0.812	-0.007	0.020	0.011
Spain	1977	0.721	1.819	0.482	-0.601	0.120	-1.542
	1981	0.549	1.052	0.224	-0.164	0.020	-0.681
	1985	0.665	0.445	0.172	-0.106	0.004	-0.180
Portugal	1977	1.671	0.854	0.758	-0.603	-0.189	-1.491
	1981	1.721	0.944	0.782	-0.431	-0.466	-1.550
	1985	1.159	1.186	1.295	0.328	-0.763	-2.206

Table 4- OLS estimation results for models (13a), (13b) and (13c)

		$\hat{a}$	$\hat{b}$	Multiple- R^2
Poland (1990-2000) N=16 and T=11	Model (13a) (μ)	-27.1410*** (-92.5805)	0.5112*** (4.5085)	0.1046
	Model (13b) (π)	-6.5424*** (-8.5297)	0.8307*** (27.8792)	0.8171
	Model (13c) (α)	-28.5575*** (-90.3563)	-0.7302*** (-5.2655)	0.1374
Hungary (1990-2000) N=7 and T=11	Model (13a) (μ)	-30.9826*** (-191.8155)	-0.1358* (-1.6683)	0.03578
	Model (13b) (π)	-2.3860** (-2.5923)	0.9186*** (31.1123)	0.9281
	Model (13c) (α)	-31.0083*** (-192.9240)	0.1910** (1.9521)	0.04835
Czech Republic (1990-2000) N=8 and T=11	Model (13a) (μ)	-33.9123*** (-55.7540)	0.3811** (2.0421)	0.04625
	Model (13b) (π)	-18.3570*** (-12.3741)	0.4509*** (9.7901)	0.5271
	Model (13c) (α)	-33.1905*** (-94.6397)	-0.1093* (-1.6785)	0.03172
Spain (1977-1985) N=18 and T=9	Model (13a) (μ)	-7.0054*** (-13.4626)	0.9437*** (6.6842)	0.2183
	Model (13b) (π)	-3.6261*** (-8.9807)	0.8757*** (17.9589)	0.6684
	Model (13c) (α)	-9.4580*** (-22.5969)	-0.0945 (-0.2857)	0.0005
Portugal (1977-1985) N=7 and T=9	Model (13a) (μ)	-17.1306*** (-13.7591)	0.6365*** (3.6146)	0.1764
	Model (13b) (π)	-14.1418*** (-18.0162)	0.4950*** (9.7950)	0.6113
	Model (13c) (α)	-21.3812*** (-70.8382)	-0.8237*** (-6.6705)	0.4218

Notes:
t-value are in parentheses.
* parameter is significant at 10%
** parameter is significant at 5%
*** parameter is significant at 1%