The dynamics of regional inequalities *

Salvador Barrios [a] and Eric Strobl [a,b]

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Abstract

This paper analyses empirically the dynamics of regional inequalities in GDP per capita. Our starting hypothesis is that the evolution of regional inequalities should follow an inverted u-shaped curve depending on the level of national economic development. This hypothesis relates directly to a number of theoretical findings put forward in the new growth literature, in particular, by Tamura (1996) and Lucas (2000) who study the growth transition dynamics of regional/national economies arguing that inequalities should first rise then decline depending on the total amount of knowledge available in the economy which is directly linked to the level of economic development. These arguments also correspond to earlier seminal papers by Kuznets (1955) and Williamson's (1965) who argued that national growth dynamics may drive, at least initially, to a rise in regional inequalities. We test empirically these predictions by using regional data for a panel of European countries and by making use of semi-parametric estimation techniques. Our results provide strong support for an inverted U-shaped curve in the relationship between the national per capita income level and the extent of regional inequalities independently of the time period and regional administrative units considered. The nature of this non-monotonic relationship is not altered by the inclusion of other possible determinants of regional inequalities.

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1. Introduction

This paper investigates empirically the way regional inequalities in GDP per capita are influenced by nation-level economic development dynamics. Our analysis is grounded on a simple theoretical framework derived from Lucas (2000) who describes the transition of regional economies from stagnation to growth. Following this model, regional economic inequalities must be seen as a by-product of the national development process. Accordingly, economic inequalities among regions within the same country should first increase as the country they belong to starts growing and then decrease after a certain level of national economic development is reached. Using semi-parametric estimation techniques applied to a sample of EU countries we find strong evidence for such an inverted U-shaped relationship between the national per capita income level and the extent of regional inequalities.

Our results contribute to the existing empirical literature on growth and convergence in a number of ways, see for instance Temple (1999) and Durlauf and Quah (1999) for comprehensive reviews. In particular, while elements such as spillover effects and nonlinearities have become prominent features of the new endogenous growth theory, empirical studies have, up to recently, continued to stick to the linear specification derived from the neoclassical Solow types of models, see Durlauf (2001) and Durlauf and Quah (1999) for critical reviews.[1] Within this context, our result may help understanding why, depending the sample of countries/regions and the time frame considered, one may alternatively observe convergence or divergence in GDP per capita. Indeed, when considering the theoretical literature on growth and convergence, a wide array of arguments arise advocating either for the long-term reduction or, to the contrary, for the persistence and self-reinforcing nature of economic inequalities across countries, see, for instance, Galor (1996) and Prichett (1997). Independently of the type of result obtained, authors have increasingly focused on the role played by knowledge and spillovers in order to explain countries' growth differentials and growth diffusion both across countries and regions, see Jones (2004) and Klenow and Rodriguez-Clare (2004) for recent contribution on these issues. Knowledge spillovers would give rise to substantial scale effects in productivity stemming from the non-rivalry nature of knowledge, and this a central theme in the works of Romer (1990), Kremer (1993) and Jones (2001) among others. Since knowledge and technological progress are often seen as the main engines of economic development, the latter may inevitably increase rather than decrease inequalities since these two elements are very unlikely to be evenly spread both across time and space. The latter means that economic growth may, at least initially, foster divergence, rather than convergence across spatial

[1] Exceptions to this assertion can be found, for instance, in studies investigating the non-linearity of the convergence process such as Liu and Stengos (1999), Kalaitzidakis et al. (2001), Fiaschi and Lavezzi (2003) and in studies

units. Within this context, the potential for convergence crucially hinges on the existence of spillovers. Other authors have put emphasis on the role played by human capital externalities in driving regional differences in economic development. In particular, Tamura (1996) shows theoretically that regional differences in population and human capital can inhibit the formation of large markets. As economies evolve and human capital heterogeneity is eliminated, markets expand and growth accelerates. Interregional human capital convergence thus produces market expansion through a cumulative process. The possibility for regional inequalities to fall will rise as time passes and the total amount of knowledge available to all regions reaches a given level.

Interestingly though, the idea that regional inequalities would evolve in a nonlinear way as national development proceeds was developed by a number of authors back in the 1950s and the 1960s. As a matter of fact, it was Kuznets (1955) in his analysis of income disparities who suggested a *"long swing"* in regional income inequalities, where there was first a rise and then a subsequent fall of income differentials caused by the urbanization and industrialization process accompanying national economic development and the decline of agriculture. Several authors have built on this idea for regional analysis suggesting that inequalities should first rise as developed areas benefit from external economies, location of decision-makers, political power and capital and labour mobility, see for instance Myrdal (1957), Hirschman (1958) and Williamson (1965). The idea of a non-linear relationship between economic development and regional inequalities is also knows as the *bell-shaped curve of spatial development* in the economic geography literature, see Ottaviano and Thisse (2004) for a theoretical analysis.

The above arguments can be extended to a cross-country framework as well which is indeed the objective of the study by Lucas (2000). Accordingly, over the very long-run, all countries should engage into economic growth providing that spillovers are strong enough to promote growth and technological diffusion. Following Lucas (2000), this is also most likely the higher is the total amount of knowledge available at the world level, which is directly related to the average world income level. While, in practice, the above scenario may take some time to materialise, one is more likely to be able to test such prediction *within* rather than *between* country given that in the former case, barriers to both technological and knowledge spillovers are known to be less biding. The existence of a common institutional and legal setting, common language, higher factor mobility and income redistribution policies al potentially contribute to this state of affairs. An additional reason for adopting a regional perspective is related to data availability. Cross-country data availability over a sufficient long-time span describing transition from stagnation to growth is rarely available which strongly limits the scope for observing the long-run transition process described above, see

investigating the existence of convergence clusters such as Durlauf and Johson (1995), Paap and van Djik (1998), Quah (1996b, 1997) and Canova (2004).

Durlauf (2001). One may, instead, consider a sample of countries displaying substantial differences in both national and regional economic development. The EU economy is, to this respect, especially interesting given the sizeable disparities in economic development both across regions and countries, compared to, let say, the US. One may thus exploit the fact that these countries are on very different position on their development path and observe how important regional inequalities are within countries. In doing so, one may get a pretty good picture of existing transition dynamics in regional inequalities. This is the strategy that we follow in this paper by studying the evolution of regional inequalities and its link to national development paths. Our paper is, to the best of our knowledge, the first study to provide robust evidence to the bell-shaped relationship between regional inequalities and national economic development. To do so we use data on GDP per head for European regions between 1975 and 2000. We show using a flexible semi-parametric estimator that the relationship between national GDP per head and regional inequalities follows a bell-shaped curve, suggesting that growth first increase regional inequalities but then tends to lower them as the national level of income rises. This is found to hold for both samples of Western and Eastern European countries and independently of the administrative unit considered to measure regional inequalities. In the sequel, we use alternative datasets for European metropolitan areas and for a sample of OECD regions, including non-European countries. Our main results appear to hold when using these alternative datasets. Our results also appear to be unchanged after including other potential determinants of regional inequalities such as the degree of international openness, industrial specialization, regional aid and the level of fiscal decentralization.

The remainder of the paper is organized as follows. In Section 2 we review the existing empirical literature concerning the link between national development and regional inequalities. In this section we also present a simple theoretical model to illustrate the main mechanisms at hand. Sections 3 and 4 present some preliminary evidence and our main econometric results. Section 5 summarises our findings and discusses some policy implications.

2. Revisiting the link between national development and regional inequalities

2.1 Related empirical literature

A number of empirical artefacts tend to support the possibility of a bell shaped relationship between regional inequality and national development. Williamson (1965) provides an extensive analysis on the topic by analyzing the key elements driving the evolution of regional inequalities according to the stages of development of a nation. Following Williamson (1965), spillovers may occur through a number of channels, namely, migration, capital flows, government policy and interregional trade. Using evidence based on descriptive statistics for a number of countries between the end of the

XIXth Century and World War II, Williamson found some supportive evidence for a non-linear relationship between regional inequalities and national development. His conclusions derives from two main empirical artefacts: first, regional disparities are greater in less developed countries and smaller in the more developed ones; second, over time regional disparities increase in the less developed countries and decrease in the more developed. Accordingly, regional income inequalities can be considered as a by-product of the development process of a nation and any attempts at lowering them may eventually hamper this process. [2] Kim and Margo (2003) also show that in the US the rise of industrialization during the second half of the nineteenth century has increased regional income disparities, where manufacturing was concentrated in the North and specialization in agricultural activities occurs in the South. By the second half of the twentieth century, however, regional industrial structures converged through a dispersal of agriculture and the rise of services activities across the US States.

More recently, in the European context, De la Fuente and Vives (1995) have noted that the European integration process fosters international convergence across countries rather than convergence across regions within the same country which may drive regions located in the same country to income divergence. Quah (1996a) also observes that the two countries that have reached the highest rates of economic growth, Spain and Portugal, are those that have experienced the most striking rise in regional imbalances. In another contribution, Quah (1999) considers the case of three EU cohesion countries, Spain, Portugal and Greece, and shows that while the first two have experienced strong growth rates and growing regional imbalances during the 1980-89 period, Greece has experienced only modest growth rates accompanied by decreasing income inequalities across its regions. Petrakos and Brada (1989) and Petrakos and Saratis (2000) also find similar evidence for Greece. In particular, the latter authors find that, during the 1980ies, the most developed regions in Greece have faced growing difficulties due to tighter foreign competition implied by the European integration process, while less developed regions were less affected. The previous authors also argue that this may be one of the reasons explaining why regional inequalities have tended to decrease during the 1980ies. In more recent contributions, Davies and Hallet (2000) together with Petrakos et al. (2003) consider more closely the possibility of a bell-shaped curve in regional inequalities for European regions. The former study is essentially descriptive and finds some evidence for growing regional income imbalances for fast-rowing cohesion countries while the latter tests econometrically the link between regional inequalities and the level as well as the growth rate of national GDP together with a measure of intra-EU trade openness. However,

[2] The evidence concerning the non-linear relationship between urbanization and development is also a well documented fact in urban economics, see for instance Alonso (1969), Wheaton and Shishido (1981) and more recently Henderson (2003) and Davis and Henderson (2003).

Petrakos et al. (2003) only allow for GDP level to have a linear effect, which is unlikely to capture the inverted U-shaped. This point will be further developed in Section 3.

Before presenting our econometric results it is worth setting the basic mechanics underlying the non-linear relationship between regional inequalities and national economic development. The next section present a simple growth model derived from Lucas (2000) where the transmission of growth occurs essentially through spillovers.

2.2 A simple model of growth, catching-up and technological diffusion

The model is a simplified version of the model developed by Tamura (1996) which is discussed in Lucas (2000). Let consider a country composed by a number *n* of regions. Initially all regions are supposed to have a constant level of income per capita y_0. Now let consider that growth occurs in only one region at date $t=0$. By making this hypothesis we assume that innovation is the main determinant of growth and thus that growth is, at least initially, localized. This hypothesis corresponds to the one generally made in the New growth literature where innovation and technological diffusion involve interactions between agents which are made easier when these are located close to each other geographically. For instance, Lucas (1988) seminal paper builds on this idea to point out that externalities that are central for endogenous growth, are mostly local in nature which provides cities with an important role in promoting growth. A similar argument holds in Romer (1990)-type of models where the location of innovative activities is crucial for growth and technological progress.[3]

The other regions will start growing at date $s>0$ and each region start growing at a different date. In making this assumption, we assume that regions differ in their technological capability. The model thus implies a distribution of starting dates characterising regional differences in technological capability. We can thus index region by the date at which they start growing such that $y(s,t)$ will be the income per capita level of a region *s* which starts growing at a date $t=s$. The level of income of the innovative region at any date *t* can thus be written as $y(0,t)$. This leading region grows at a constant rate *a* such that its level of income at any date *t* can be written as:

$$y(0,t) = y_0(1+a)^t \qquad (1)$$

When the other regions start growing at a date t>0, they do so according to the following expression:

[3] See also Baldwin and Martin (2004) for a theoretical review.

$$y(s,t+1) = (1+a)\ y(s,t)\ (\frac{y(0,t)}{y(s,t)})^{b} \qquad (2)$$

where *ß* is a catch-up rate that we assume to be constant for all the (followers) regions. While the nature of such spillovers is not specified nor their mechanisms described, for simplicity we assume that they are simply knowledge spillovers through which regions get acquainted of the best production techniques developed by a leading region. As noted by Lucas, one could as well assume that such spillovers may occur through human capital externalities in Tamura (1996), through institutions and the removal of barriers to technology adoption such as regulatory or legal contraints as argued by Parente and Prescott (1994), or simply through factor mobility and non-constant returns to capital as in Solow (1956). In the end, determining which factors drive the fall and rise on economic inequalities is an empirical issue that goes beyond the scope of the present study.

Let consider now the (unconditional) probability *F(t)* that any of such region starts growing at date t. The basic hypothesis behind this model is that, once the leading region starts growing, as time passes and average national income grows, the probability for any region to switch from a stagnation to a growth regime will rise and follow a cumulative process. Put differently, the larger the number of existing regions that are in a growth regime, the higher the probability for any other region to start growing. Given (1) and (2) the growth path of any of such economy can thus be described according to a hazard rate model where the conditional probability for an economy to experience growth is given by a hazard rate ?(t). In order to simplify things we consider the case where the hazard rate is constant:

?(t) = ? (3)

and thus the corresponding survival rate function can easily be derived as:

$$S_t = e^{-l\ t} \qquad (4)$$

The probability *F(t)* that any region starts growing at a date *t* can be derived in the usual way from the hazard rates model such that:

$$F(t) = l\,(t)\left[1 - \sum_{s<t} F(s)\right] \qquad (5)$$

Considering a simple numerical example, the cumulative probability for regions to be in a stagnation regime, i.e. *1-F(t)*, and the cumulative probability for regions to be in a growth regime, *F(t)*, can be represented graphically by figure 1.[4]

According to Figure 1, the probability for regions to be in a growth regime is largely inferior to the probability for being in a stagnation regime for small values of *t*.

[4] Parameter values for figures 1-3: a = 0.02 y0 = 50 t=300 , ?=0.02, ß=0.05.

It is important to note here that the relationship we derive between the growth rate and the income gap of equation (2) is similar to the one put forward in the convergence literature. However, in the growth literature, convergence occurs when a country's output and capital stock levels are lower than their steady-state values. Convergence takes place due to high rate of investment as the capital stock grows towards its steady-state level depending, in particular, on the saving rate. Here, instead, we identify the relationship between the growth rate and the level of income through the accumulation of knowledge. This accumulation of knowledge takes place at the global level, that is, each region's wealth will depend on the total amount of knowledge accumulated at the country level. The differences in level of income between regions can thus be explained by the differences in access to knowledge, which drives to higher productivity levels. The average level of income in this country x(t) can be written as a weighted sum of income corresponding to the growth and stagnation regimes according to the following equation:

$$x(t) = \sum_{s \le t} F(s)\ y(s,t) + \left[1 - \sum_{s \le t} F(s)\right] y_0 \qquad (6)$$

The model implies that growth is necessarily unequal across regions because of its very nature. Spatial inequalities must then arise, at least initially and their potential reduction lies on technological externalities. Figure 2 illustrates this by plotting the evolution of the average national growth rate, i.e. the growth rate of x(t).

Figure 2 shows that initially, the average growth rate rises very fast and then decline relatively and tends towards its steady state level *a* that we assumed to be equal to 2%. As economies converge towards their steady state level of income and the income gap with respect to the leading economy closes-down progressively, the national growth rate also converges towards its steady state level. The evolution of the relative number of growing regions compared to the non-growing regions is directly linked to the average level of income and governs the evolution of regional inequalities. The extent of regional inequalities can be, as in Lucas (2000), described by log standard deviation of income across regions *s(t)* such that:

$$s\,(t)^2 = \sum_{s \le t} F(s) \left[\ln\left(\frac{y(s,t)}{x(t)} \right) \right]^2 + \left[1 - \sum_{s \le t} F(s)\right] \left[\ln\left(\frac{y_0}{x(t)} \right) \right]^2 \qquad (7)$$

Figure 3 depicts the relationship between the average level of income (or national average of income per capita) and *s(t)*. According to this figure, the relationship between the level of regional inequalities and the per capita national income level is non-monotonic and follows an inverted u-shaped curve. First regional inequalities rise given that the forces for divergence dominates while, after a certain threshold depending on the level of development of the national economy, regional inequalities start falling. With sufficiently large t and $x(t)$ one could indeed show that regional inequalities converge towards their initial level which is equal to zero.

The model of economic growth presented here is thus purely of model of technological diffusion. Therefore, a larger country-wide stock of knowledge (or a higher level of average income) improves the level of technology (i.e., the level of income) of each region. We must reckon, however, that the diffusion of growth described by equation (2) looks very much like a black box. Our model thus does not rule out, the fact that other mechanisms could as well explain growth transmission across regions. As argued earlier, one could well imagine as well that other elements such as capital flows, migrations, the diffusion of best public policy practice or human capital externalities may equally explain the nature of the relationship found between regional inequalities and national economic development. While the purpose of this paper is not to disentangle the possible influence of each of these elements on the evolution of regional inequalities, in the sequel we will test whether our results concerning the non-monotonic nature of the relationship between national economic development and regional inequalities holds after controlling for other possible factors influencing regional inequalities. Before doing this we first try to assess whether the relationship depicted by Figure 3 holds for different samples of European countries. Of course one may argue that to observe such an evolution one needs observations concerning these variables over a very long time period. As shown by the subsequent sections, most of regional data in Europe is available, at most for the past 25-30 years in the best scenarios. This is clearly insufficient given that, over such a time span, national income levels and economic development are unlikely to vary much in order to induce such radical changes in regional economic inequalities within a same country. One feature of EU economies, however, is the existing huge levels of income disparities both across regions and countries, compare to, let say, the US. The latter means that, by observing the evolution of regional inequalities and level of national economic development all countries/regions together across time one may be able to have a pretty good picture of existing transition dynamics in regional inequalities. This would amount to consider that any point on the curve plotted in Figure 3 corresponds to the relative values of income per capita and level of regional inequalities of a given country at any date t.

One must note, however, that in the model we assume that externalities occur exclusively within countries. Existing empirical literature suggests that this is unlikely to be true, especially within the European context. In particular, because knowledge and innovation are crucial for economic growth, economic integration may eventually trigger regional income inequalities by favouring the emergence of growth and innovation poles within EU countries. This is the hypothesis supported by Giannetti (2002) who argues that greater economic integration intensifies international knowledge spillovers (compared to within country spillovers) which has favoured convergence at the country-level rather than the regional-level in the EU over the period 1986-1992, which also corresponds to the setting-up of the European Single Market Program. Despite these results, however, innovation and technological diffusion in the EU seem to remain predominantly dominated by country-specific features. Bottazzi and Peri (2003) show this by studying the spatial distribution of R&D and innovation spillovers and by linking R&D and patenting activities across EU regions over the period 1977-95. They find that R&D spillovers are subject to strong distance-decay effect with a significant influence exerted by national borders. Accordingly, despite the fact that increased economic integration tend to lower the barriers to technological spillovers, the diffusion of knowledge and innovation in the EU have still strong country-specific components. From a theoretical viewpoint one could well extend the model presented above and show that, in fact, if some regions benefit more than others from economic integration, this would not fundamentally change our result regarding the shape of regional inequalities except that convergence may take longer given that the steady-state growth rate of the leading region increases. Ultimately, whether or not international economic integration affects the relation between regional inequalities and national development is an empirical issue that will be considered further below.

3. Data used and Preliminary evidence

3.1 Data

We use data on Gross value added per capita by NUTS2 regions using three alternatives data sources. The first two are extracted from the Regio database from Eurostat that provides two datasets, one following the esa75 accounting system which covers the 1977-96 period for the EU15 countries, and the other the esa95 accounting system which covers the EU25 during the period 1995-2000. The regional unit observed is the NUTS2 corresponding to the nomenclature used by Eurostat. This dataset includes 175 regions with esa75, 196 regions with esa95 and 381 when including the accession countries including the new German länders, Romanian and Bulgarian regions. Although the data provides consistent information across regions and countries, the break between both accounting systems together with the existence of many missing values for some countries make difficult the use of these databases in order to study the trends in regional inequalities. We thus also use an alternative database from Cambridge Econometrics, which provides the same data for the 1975-2000 period by completing Regio with the use of more detailed information coming from the national statistical offices and national experts. Because this second database may suffer from the use of extrapolations we will be careful in interpreting our results by systematically comparing these to that with the Cambridge Econometrics database for comparable periods of time and the same set of regions.[5]

A problem with the use of such data is that the geographical definition of regions NUTS2 may sometimes be artificial in order to comply with European standards. This problem has been raised by several authors and may somewhat hamper the economic significance of studies using such data; see for instance, Davies and Hallet (2003) and Boldrin and Canova (2001). One could use the NUTS1 classification as an alternative definition of regions at a larger spatial scale. The problem with this level of aggregation is that it is no less artificial and in some cases entire countries (like Austria for instance) are considered as regions. The other alternative is the NUTS3 classification which encompasses smaller regions than NUTS2. However, beside the fact that time series using NUTS3 are much shorter than both NUTS1 and NUTS2, here the problem is that such areas may be too small and increase artificially disparities in economic activities and population; see Davies and Hallet (2002). One must then reckon that, although, the NUTS2 definition is far from being the optimum one would use in order to define economically homogenous regions, one is left with this as the best alternative in order to operate a cross-country study of this type. In section 4.3 we will use alternative datasets and definition of spatial units in order to check the robustness of our results.

The level of national development is represented by the GDP in Purchasing Power Standards (PPS), which is obtained from the European Commission-AMECO database. GDP in PPS unit represents an identical volume of goods and services in each country, irrespective of price level, and thus provides a comparative measure of the purchasing power in each country, with one unit of PPS representing approximately one euro.

3.2 Preliminary evidence

Our measure of regional inequalities is the standard deviation of the logarithm of the GDP per capita following the model presented in Section 2. A number of alternative indicators could have been considered as well such as the Gini index although one must note that the results obtained with these other possible measures are in line with the ones presented in what follows.[6] As usual in the growth literature, the indicators on GDP per capita and regional inequalities are measured relative to the EU average. According to the existing evidence for Europe, the poorest EU members have experienced fast catching-up over the past two decades or so and this has translated

[5] Note that we systematically checked the results obtained using the Cambridge Econometrics data by using the regio database under ESA79 and ESA95 nomenclature for the period they cover. The results obtained were nearly identical to the ones presented here. Results available upon request.

[6] Note also that, in order to check whether the standard deviation of regional GDP per capita was influenced by the number of regions by country, we computed correlation these two variables for the EU15 and it was equal to –0.33. We

into rising regional inequalities. In order to provide evidence on this, we first consider the EU15 countries for which we have the longest time series. More specifically, we consider first the countries which, at the start of the period, had the lowest level of GDP per capita, namely, Greece, Portugal and Spain. These countries also belong to the Cohesion country group given that, for most of the period covered by this paper, they have benefited from the EU Cohesion funds awarded to the EU countries with a below than 90% of EU average GDP per capita. Lack of sufficiently disaggregated data at the regional level for Ireland does not allow including evidence for this country despite the fact that Ireland also benefited from the EU Cohesion fund. Table 1 displays the level of national GDP and the standard deviation of regional GDP per capita for these countries. The level of regional inequalities appears to be, on average and for most of the period considered here, higher in the Cohesion country group compared to the rest of the EU. This can be observed from the Figure 4 displaying annual weighted average values of our regional inequality measure by country. This distinctive feature also holds when considering Cohesion countries individually, except for Greece, which is also the EU15 country with the lowest GDP per capita. It is rather difficult to draw any conclusive evidence concerning the evolution of regional inequalities given that this indicator is rather volatile, especially, but not exclusively, for the cohesion country group as shown in Table 2. Despite this, we can still identify two distinct periods concerning the evolution of regional inequalities and convergence in the Cohesion countries. The first is the 1975-1985 period, marked by slow economic growth in the EU as a whole, and declining regional inequalities in Spain, Greece and Portugal. By contrast, the following two periods were characterized by fast catching-up and rising regional inequalities. It is important to note that these two periods are also marked by the accession of two cohesion countries in 1986, namely Spain and Portugal, with initial GDP per capita much lower than the EU15 average. During 1985-1992 income per capita converged steadily in Portugal and Spain together with a rise in regional income inequalities. In Greece, however, the slight decline in income per capita relative to the EU average was accompanied by a rise in regional inequality compared to the rest of the EU but remaining at levels well below the EU average. The period 1992-2000 is characterized by a general rise in regional inequalities in Greece and Portugal and a rather stable level in Spain. This rise in turn corresponds to a rapid convergence of GDP per capita in the first two countries compared to the last one.

The evidence regarding the rise in regional inequalities that accompanies national economic development is even more pronounced when considering the countries that joined the EU in 2004. Table 3 provides detailed statistics for these and shows that, as for the Cohesion countries, these countries display, on average, higher regional inequalities than the EU15 countries, including the

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also used the Gini index as alternative measure of regional inequalities. Results were very similar to the ones presented in this paper. Results are available upon request.

Cohesion countries.[7] In addition, they have almost invariably all experienced a continuous increase in the level of regional inequalities during the period 1995-2000, excepting Bulgaria, Poland and Slovenia. While part of this evolution is probably due to the transition process from a planned to a market-oriented economy, most of the impact of this process at the regional level was experienced in the early 1990s. It follows that a large part of the rise in regional imbalances is likely to be due to the rapid catching-up process experienced by these countries during the past decade as shown by Petrakos et al. (2000). However, not all countries have been catching-up during the 1995-2000 period. Countries such as Bulgaria, the Czech Republic and Romania have even seen the level of their GDP per capita compared to the EU15 average decline during these years. On average, these countries have also experienced less pronounced rise in regional inequalities.[8] This is further confirmed by evidence provided in Figure 4, which plots the change in regional inequalities on the y-axis vs. the index of GDP per capita relative to the EU15 in 1995. Figure 4 shows that the variation in regional inequalities is negatively correlated with the initial level of GDP per capita, suggesting that countries starting initially from a low level of economic development are more likely to experience a rise in regional income inequalities as they catch-up with the richest EU countries. Our results concerning the new member states are in line with existing evidence put forward by other authors. For instance, Tondl and Vuksic (2003) analyse regional growth in Central and Eastern Europe in the second half of the 1990s. They find increasing income disparities between regions with some steadily catching-up with Western European countries, while others display very poor performance.

The preliminary evidence just presented tends to provide some evidence suggesting that, on average, during periods of fast catching-up, regional inequalities have tended to rise in those countries starting from the lowest level of GDP per capita. This suggests that the strong structural changes experienced by the cohesion countries and the new member states have tended to increase regional inequalities. However, these preliminary results face some limitations. First, one needs to further check whether non-observable country-specific features influence the nature of this relationship. Second, as mentioned earlier, regional inequalities have not only risen in the poorest EU countries but also in some of the richest ones. It follows that the non-linear relationship between economic development and regional inequalities is hard to detect from the descriptive statistics presented above. In order to go a step further in the analysis, the next section provides econometric result based on parametric and semi-parametric methods.

[7] This result holds for a majority of years and countries. The few exceptions to this are the Czech republic between 1995 and 1997, Lithuania during the period 1995-1998, Romania for 1995 only and Slovenia for the period 1995-2000.

[8] This can be seen by splitting the Eastern European countries considered here into two samples, those that have caught-up and those that have not. If one considers weighted average (using country-level population as weight), the non catching-up countries have seen the level of regional inequalities to increase by around 21% while the catching-up countries have more than doubled this figure with a rise equal to 43%.

4. Econometric Analysis

4.1 Econometric methodology

In this section we present the econometric methodology used to study the relationship between the level of economic development represented by the GDP per capita (that we call *Y*) and regional inequalities, represented by *X*, both variables being observed at the country-level. Following our underlying hypotheses, the level of economic development of a country should explain where this country lies in terms of regional inequalities with poorer countries tending to have growing regional imbalances as they catch up with richer countries. Regional inequalities should then start decreasing beyond a certain point in the development spectrum. As a consequence, one should observe that regional inequalities are lower, beyond this point, in richer countries. The relationship between the level of economic development *Y* and regional inequalities *X* should then follow a bell-shaped curve. One way to test this hypothesis is to run a simple parametric OLS estimation including both country and time dummies to control for country specific time invariant unobservables and time specific factors common to all countries in the sample. In order to normalize our series, we consider as dependent variable the relative level of the log standard deviation of a country with respect to the EU average while we take the log of the relative level of GDP per capita a the national level as the explanatory variable of interest.

An example of the results obtained with such method can be provided by using, for instance, the data concerning the EU15 regions over the 1975-2000 period. The results of running the parametric estimations are given in the first column of Table 2. As can be seen, our results suggest that national prosperity acts to decrease regional inequalities. However, a simple Ramsey RESET tests suggest that the specified functional form may not be correct. We thus also included the squared value of our explanatory variable of interest in column two. Accordingly, including this variable simple renders the levels coefficient insignificant. Nevertheless, the test statistics from the RESET test still suggests that the functional form may be miss-specified. We further also experimented with other higher order terms but were unable to obtain a RESET test statistic that did not suggest misspecification.[9] One problem, of course, with simply using higher order terms to estimate a possibly non-linear relationship is that even these place fairly strong restrictions on the possible link between the dependent variable and the explanatory variable of interest that may not reflect the true underlying relationship.

[9] The result of the RESET test when including the level of national GDP only displays a F-value equal to 10.84 and significant at 1%. When including this variable and its squared term the F-test value is 8.18 and is also significant at 1%.

A more flexible approach to tackle non-linearity issues in growth and convergence studies is to use semi-parametric methods, as suggested by Durlauf (2001). This way one can investigate the possible non-linearity of the relationship between regional inequality and national development, while also allowing for the (linear) effect of other conditioning variables, follows the semi-parametric methodology proposed by Robinson (1988) using the Kernel regression estimator.[10] Accordingly, one can consider the following equation to be estimated:

$$Y = \alpha + g(X) + \delta Z + u \qquad (8)$$

where *Z* are a set of explanatory variables that are assumed to have a linear effect on *Y*, *g()* is a smooth and continuous, possibly non-linear, unknown function of *X*, and *u* is a random error term. A common used non-parametric estimator of an unknown function like *g(X)* without allowing for the effect of other conditioning variables is the well-known Nadaraya-Watson estimator:[11]

$$\hat{m}_h(X) = \frac{n^{-1} \sum_{i=1}^{n} K_h(X - X_i) y Y_i}{n^{-1} \sum_{i=1}^{n} K_h(X - X_i)} \qquad (9)$$

such that $i=1\ldots n$ are the *n* number of observations, $K_h()$ is the shape function, commonly referred to as the Kernel, that is a continuous, bounded and real function that integrates to one and acts as a weighting function of observations around *X* and depends on the choice of bandwith *h*. The appeal of this estimator lies in its very flexible approach to non-linearity by allowing the relationship of *Y* with respect to *X* to vary over all values of *X*. Specifically, this technique corresponds to estimating the regression function at a particular point by locally fitting constants to the data via weighted least squares, where those observations closer to the chosen point have more influence on the regression estimate than those further away, as determined by the choice of *h* and *K*. An additional appeal of this sort of technique is that it avoids any parametric assumptions regarding the conditional mean function *m(X)*, and thus about its functional form or error structure.

Allowing for the linear effect of other explanatory variables only slightly complicates the estimation of *g(X)*. Specifically, Robinson (1988) showed that in controlling for other conditioning variables the (semi-parametric) Kernel regression estimator for *g(X)* simply becomes:[12]

$$\hat{g}(X) = \hat{m}_{\tilde{y}}(X) - \hat{d}\, \hat{m}_Z(X) \qquad (10)$$

[10] See Blundell and Duncan (1998) for details and a helpful discussion of the implementation of this method.
[11] See Nadaraya (1964) and Watson (1964).
[12] The fact that δ is in part estimated using OLS makes this a semi- rather than non-parametric estimator.

where $\hat{m}_{\tilde{y}}(X)$ and $\hat{m}_Z(X)$ are the (non-parametric) Kernel regression estimates of *E(y ½X)* and *E(Z½X)*, and $\hat{d}$ is the OLS estimator of:

$$Y - \hat{m}_{\tilde{y}}(X) = d\left(Z - \hat{m}_Z(X)\right) + e \qquad (11)$$

where e is a random error term. Intuitively, $\hat{g}(X)$ is the estimate of *g(X)* after the independent effect(s) of *Z* on *Y* has been removed.

Given that the estimate of $\hat{g}(X)$ is at least in part based on non-parametric estimation techniques, one cannot subject it to the standard statistical type tests (e.g., *t*-test). One can, however, relatively easily calculate upper and lower pointwise confidence bands as:[13]

CI = g^(X) +/- $(c_\alpha c_K)^{1/2}$ η^(x) / [h$CI = \hat{g}(X) \pm (c_a c_K)^{\frac{1}{2}} \hat{h}(X) \Big/ \left[\sum_{i=1}^{n} K_h(X - X_i)\right]^{\frac{1}{2}}$ (12)

where $c_a c_K$ is a kernel specific constant corresponding to the α quantile of the distribution and $\hat{h}^2(X)$ is defined as:

$$\hat{h}^2(X) = n^{-1} \frac{\sum_{i=1}^{n} K_h(X - X_i) Y_i}{n^{-1} \sum_{i=1}^{n} K_h(X - X_i)} \qquad (13)$$

One should note that (13) ignores the possible approximation error bias of $\hat{g}(X)$. Including this in (13) would complicate the expression considerably since the bias is a complicated function of the first and second derivatives of *g(X).* This bias tends to be highest at sudden peaks of $\hat{g}(X)$ and at the necessarily truncated left and right boundaries of the data. However, if h is chosen proportional to $1/n^{(1/5)}$ times a sequence that tends slowly to zero then the bias vanishes asymptotically for the interior points.[14] For all our estimations we use a Gaussian kernel for K_h and an optimal bandwidth *h* such that:

$$h = \frac{0.9m}{n^{1/5}} \qquad (14)$$

where m = ($\hat{s}^2(X) \times$ (interquantile range)$_X$ / 1.349)

[13] See Haerdle (1990) for details.
[14] See Haerdle (1990) and Wand and Jones (1995) for a discussion of these aspects.

One should also note that the size of $\hat{s}^2(X)$ at any point of X will depend proportionally on the marginal distribution of X. In other words the accuracy of the estimate of *g(X)* at X is positively related to the density of other observations around that point. In order to visualize this effect we, as suggested by Haerdle (1990), calculate the point wise confidence bands at points chosen according to the distribution of X. Specifically, we chose points so that one per cent of the observations lie between them.[15] In terms of explanatory control variables to included in estimating (1) we utilised time and country specific dummies. The latter allows for year specific effects that are common to all countries, while the former controls for unspecified time invariant country specific effects that could bias results.

4.2 Results for the EU15

Our semi-parametric kernel regression estimate of *g(X)* along with pointwise confidence bands for the EU15 countries over the 1975-2000 period is shown in Figure 5. Before commenting on this, it is important to point out that, in contrast to the horizontal range, one cannot read too much into the vertical scale of the Figures, as the range is derived from predicted values where there is a problem of non-identification of an unrestricted intercept term, and thus does not completely overlap with actual observed inequality values. However, this is not necessarily a problem since we are mainly interested, as one is normally when implementing this class of semi-parametric estimators, in the slope of the curve and how this changes across the range of explanatory variable in question, i.e., national development. The distance between the confidence interval points and their vertical distance from the estimated Figure suggests that our estimates are made with some precision. Even at the end points, where estimates normally tend to be relatively poorer because the neighbourhood around points is necessarily truncated, the large number of observations available produces fairly accurate estimates. Most importantly, in terms of the shape of the relationship between regional inequalities and national economic development one discovers a clear u-shaped relationship, which plateaus out at high levels of development. In other words, at early stages of economic development regional inequalities tend to rise, but, after reaching a peak, this trend is reversed and inequalities fall.

According to Petrakos et al. (2003), regional income for two regions, Groningen of the Netherlands and Alentejo of Portugal may be inaccurately measured. For the first region, one observes important variations in GDP due to changes in the allocation of North Sea oil revenues. For Alentejo, the problems are more due to statistical reasons. In order to verify that these two observations are not influencing our results we dropped these two regions from the inequality measures of the Netherlands and Portugal, and re-estimated our semi-parametric Kernel regression as shown in

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[15] For the endpoints we chose the 1 and 99 percentiles of the distribution.

Figure 6. However, as this Figure indicates their exclusion does not change the estimated curve in any obvious manner. We also experimented with dividing our sample into sub-periods in order to investigate whether any structural changes in the relationship between national development and regional inequalities may have taken place. There are a number of reasons to believe this may have been the case. First, the late 1980ies have witnessed a deepening of the economic integration process of EU countries with significant increases in trade flows and intra-EU FDI; see, for instance, Head and Mayer (2000). Second, towards the end of the 1980ies the European Union has developed the use of structural funds in order to aid the poorest regions to catch-up with the most developed regions. In particular, the largest part of these funds were directed toward objective 1 regions defined as having a GDP per capita less than 75% of the overall EU average; see Tondl (2001). Figure 7 from the earlier period, 1975-1987, confirms the bell shaped curve found for the overall sample. Examining the remaining period in Figure 7, while one still finds some evidence of an inverted u-shaped relationship, near the end values, i.e., in very early and very late stages of national development, the kernel semi-parametric estimates indicate that there may be no clear-cut relationship between national prosperity and regional inequality. Results for the 1988-2000 period are also very similar to the previous ones as shown by Figure 8. Slightly reducing the sample to the years 1991-2000 also allows us to recalculate the German variables using informat While the nature of such spillovers is not specified nor their mechanisms described, for simplicity we assume that they are simply knowledge spillovers through which regions get acquainted of the best production techniques developed by a leading region. As noted by Lucas, one could as well assume that such spillovers may occur through human capital externalities in Tamura (1996), through institutions and the removal of barriers to technology adoption such as regulatory or legal contraints as argued by Parente and Prescott (1994), or simply through factor mobility and non-constant returns to capital as in Solow (1956). In the end, determining which factors drive the fall and rise on economic inequalities is an empirical issue that goes beyond the scope of the present study.

ion on the new German Landers, see Figure 9. As can be seen, however, redefining national prosperity and regional inequality including these additional regions for Germany after re-unification does not significantly alter the shape of the Figure.

It is interesting to also examine whether the bell-shaped curve holds for the new Member States that entered the EU in 2004. Unfortunately the small sample of new EU entrants, ten countries over five years, is not enough to produce any separate estimates for these countries alone. Instead we include them with our EU sample for the period 1995-2000 and thus, any result must be roughly viewed in contrast to the ones found for the later period of the EU15 on their own. However, introducing these countries allows one to consider a wider range of development levels.

This should also allow us to better capture the bell-shaped curve hypothesis in that we may expect eastern European countries to catch-up economically with respect to their western counterparts. This, in turn, may have important implications in terms of regional inequalities in these countries if the bell-shaped curve hypothesis is verified. The results of this exercise are shown in Figure 10. Accordingly, this produces a much more continuous inverted u-shape than was obvious for the EU15 1991-2000 sample. These results give strong support our starting hypothesis as our estimations now cover a much wider range of GDP per capita levels with both the upward and downward part of the bell-shaped curve being well explained by our estimations. The regional data used for the new member states is not always based on the same spatial disaggregation, however. In fact, the NUTS2 level which was used for the EU15countries sample is only available for Poland, the Czech republic, Hungary and Slovakia.[16] In order to see whether these influenced our results we estimated again our equation including only the new member states for which NUTS2 regional data was available. Results displayed in Figure 11 shows indeed that our results remain broadly in line with those presented in Figure 10 although the precision of our estimate is clearly less satisfactory due to the loss of data.

One can use our estimates from the semi-parametric regressions to say something further about where countries' position along the national prosperity – regional inequality path currently and have lied in the past. For this we first use information at what level of development (i.e., at what value on the horizontal axis) the turning point lies from our most general Figure, i.e., Figure 5. Accordingly, the peak occurs around a value of the relative GDP level of 0.85. Referring to the actual values of this variable for EU 15 countries in 1975 in Table 1, one finds that at the beginning of our sample period, Greece and Portugal lied clearly to the left of the turning point, while Spain was slightly to the left. Thus, particularly for the former two countries, any increase in relative national prosperity was to go hand in hand with a rise in regional inequality. In contrast, the remaining members of the EU 15 would have experienced a fall in regional income dispersion with further economic growth. One should note that, while some countries did experience changes in their national prosperity, this was never enough to push them to the opposing part of the curve. For example, while Sweden and Greece were subject to a stark decrease and stark increase in their relative national development position, the former still would benefit while the former would suffer in terms of regional inequality.

We also used our estimated turning point from Figure 10 to assess positions along the path for our entire EU 25 sample in 2000. Accordingly, the peak occurs when the relative GDP ratio measure is equal to 0.55. Table 3 reveals that in 2000, all the new EU Member States, excepting the Czech republic and Slovenia, lied to the left of the turning point and thus their further

[16] For the other countries the NUTS3 level was used instead given that NUTS2 data was not available.

development is likely to result in further inequality. In contrast, Slovakia, Hungary, Czech Republic, and Slovenia are on the downward sloping part of the Figure, where thus further economic growth should lower regional income discrepancies.

Although, because of their small number of regions, Ireland and Denmark were not used in the estimation, we provide their relative national prosperity values for 1975 and 2000 in Table. Comparing these to the relative turning point found from Figure 5, it is apparent that Denmark has been located on the downward sloping part of the relationship. In contrast, Ireland constitutes the only nation that was able to move from a point of national prosperity where small increases caused further regional disparities, to enjoying a level of economic development where further growth can reduce regional inequalities. While, as mentioned earlier, our dataset does not contain information at the regional level for this country, evidence provided by Davies and Hallet (2000), tend to support this contention. Following these authors, Irish spectacular growth in the 1990s and the 1990s was essentially localized in the Southern and Eastern regions, in particular Dublin and its surrounding areas. The rest of Ireland started to catch-up at the end of the 1990s and also converged to the EU average.

4.3 Robustness check: Alternative datasets

In order to check the robustness of our results we will use two alternative datasets. The first dataset used is from a database compiled by the London School of Economics on European Functional Urban Areas (FURs). The FURs are defined on the basis of core cities identified by concentrations of employment and surrounding areas on the basis of commuting data. They are broadly similar in concept to the (Standard) Metropolitan Statistical Areas used in the US, see Cheshire and Hay (1989) for more details. Following Magrini (1999, 2004), if we are to evaluate growth and convergence dynamics across regions correctly, the spatial units used should abstract from commuting patterns. Because of the very nature of regional economic disparities, any empirical study on the subject - of regional growth – should take place space into consideration which implies to define regions around a particular spatial area of socio-economic influence of any basic unit. The FURs are especially designed to take these issues into account by using commuting patterns as base for their definition. The database on FURs contains information on GDP per capita in US $ expressed in PPP terms for the period 1977-1996. The advantage of this data is that regions are not defined on some administrative units but have specific economic meaning, see Magrini (1999) for an example of study using this database in a growth/convergence context.

The second dataset comes from the Territorial Statistics of the OECD. Statistics are collected through the National Statistical Offices of OECD Member countries and Eurostat. National censuses and surveys are undertaken in different time periods and years of observation may vary between countries. In order to ensure time consistency for all countries, Territorial Statistics and Indicators are therefore organised in four waves: Wave 1 (about 1980), Wave 2 (about 1990), Wave 3 (about 1995) and Wave 4 (about 2000). GDP figures are expressed in constant US dollars. Data are collected at the level of 300 regions of the OECD area. Initially data on Island, Ireland and Luxembourg were available with the OECD database but concerned very few regions. These countries were thus not considered in the analysis. In addition, in the case of Germany, the OECD database includes Eastern German Landers after 1990, which greatly influences the level of regional inequalities. Only data before 1990 was thus used for this country.

These two alternative databases use different regional boundaries and, as consequence, the number of regions for each country may differ depending on the database used. Table A1 in Annex provides an overview of the number of regions available by country for the three different databases used in the paper. Figure 12 presents our semi-parametric estimates using the Functional Urban Areas. As can be seen, these data are probably least supportive of bell shaped relationship in that, while low levels of national development are associated with rising inequalities and after a certain turning point there is a clear fall in regional inequality, regional inequalities marginally rise with very high levels of development. One should note however, that this may be in part due to the fact that the mid-section of the graph is very poorly estimated as indicated by the low levels of data available for this range and the consequent large confidence bands. The results using OECD Territorital Statistics are depicted in Figure 13. As with our region databases there is a clear bell-shaped relationship, although this is not as pronounced as with our most of our European data. In addition, point estimates appear to be less significant, especially for low level of GDP per head which may well be due to the low level of observations available for estimations.

4.4 Robustness check: controlling for additional explanatory variables

The preceding analysis assumes that regional inequalities are influenced by the level of national economic development only. This assumption is rather restrictive indeed and our results can potentially suffer from the omission of other (possibly) important determinants of regional inequalities. In this section we thus check whether the general relationship between regional inequalities and national economic development holds including additional explanatory variables. We draw on the existing empirical growth and trade literature in order to choose our variables. In practice, however, regional data on these topics are rarely available and/or of poor quality, we thus chose to focus on a limited number of variables and by considering the European NUTS2 regions for which data are most complete. Given the aforementioned limitations, the variables to be considered in this section will be a measure of national trade-openness, regional industrial specialization, and a measure of the degree of regional fiscal decentralization.[17]

The first additional explanatory variable to be considered is a measure of national trade openness. The inclusion of this variable can be seen as important given the fact that the model presented in section 2.2 assumes that spillovers are mainly national rather than international. This hypothesis may seem to be too restrictive, especially in the European context as argued earlier. A number of authors including, in particular, Gianetti (2002) directly relate the rise of European regional inequalities in the 1990ies to the setting-up of the Single Market Program and the rise in trade integration that followed. According to Gianetti's argument, in each European country, some regions have benefited more than other from the increased economic integration which may have triggered regional inequalities. Also, more general studies at the country/industry -level have shown that the acceleration of economic integration during the 1980ies and 1990ies in Europe have had a significant effect on GDP and productivity growth in the EU, see Bottasso and Sembenelli (2001) and Notaro (2002). If the influence of a rise in economic integration is significant, then it is reasonable to believe that our underlying model and econometric results provide only part of the story. The empirical literature on trade and growth generally uses the ratio of total trade (import + export) to GDP in order to measure trade openness, see Frankel and Rose (2002). Recently, however, Alcalá and Ciccone (2004) have criticized the use of such index to measure the impact of trade on cross-country productivity given that trade tends to raise the relative price of non-tradable goods. In order to circumvent this issue they propose instead two alternative indices: the *real openness index*, which is the sum of imports *plus* exports expressed in common currency (here the euro) relative to the GDP expressed in PPP terms and the *tradable GDP openness* which is defined as the sum of nominal export and import divided by the nominal value of GDP in the tradable sector.[18] In our estimations we will use the traditional openness indicators as well as the two alternative indicators proposed by Alcalá and Ciccone (2004).

The second variable to be considered is a measure of regional industrial specialisation. Here we use the country/year average of the so-called Krugman indicators which corresponds to the following expression:

$$K_{j,k,t} = 0.5\sum_{s} \left| x_{s,j,t} - x_{s,k,t} \right|$$

[17] Additional explanatory variables such as labour mobility and differences in regional educational level were also initially considered but were dismissed given that they are only available on regional basis for few countries and only for very short time spans. The Appendix provides more details as well as the statistical sources used for the additional explanatory variables considered in section 4.3

[18] The tradable sector is represented here by the manufacturing industry and agriculture.

where $x_{s,j,t}$ is the share of sector *s* in total employment of region *j* at a given year *t*. The indicator value oscillates between 0 and 1. The indicator will be low when two regions *j* and *k* have similar industrial structures (i.e. a similar distribution of employment shares across industries), and high otherwise. The use of such an indicator follows was made popular after the study by Kenen (1969) who first advocated that sectoral specialization may play an important role in determining regional economic fluctuations and growth patters. This assertion has been discussed widely in the literature, further work suggesting in fact that the level of specialization among the US states was roughly similar to the one in Europe, see, for instance, Krugman (1991, 1993), Peri (1998), Clark and van Wincoop (2002) for further discussion on this issue. In the same vein, Gianetti (2002) shows that regions with similar technological capabilities (directly linked to the specialization of regions in traditional sectors) have converged substantially while the rest of regions have displayed some tendency to diverge over the period considered.

The third additional variable to be considered is a measure of fiscal decentralisation. Fiscal decentralisation may also have been the cause of growing economic divergence. For instance, recent evidence for Spain shows that the Spanish regional devolution process has had slightly beneficial effects on the relative growth performance of regions achieving the greatest level of autonomy when compared with their growth rates at the height of Spanish centralism, see Rodriguez-Pose (1996) and Carrion-i-Silestre et al. (2004). Evidence in this direction has also recently been provided for other countries in the world such as China, Brazil, India, Mexico and the US, see Rodriguez-Pose and Gill (2003a) and Stansel (2005), for instance. These studies relates to the well- known Oates (1972) theorem on fiscal decentralization according to which, differences in preferences about public goods across jurisdictions will require a decentralized provision of such goods in order to improve the efficiency of public spending. Accordingly, further fiscal decentralization may enhance public spending efficiency and also make public investment choices more accountable and suitable to regional preferences and specific needs, see Sato (2003). Other authors, however, have found rather contradictory results finding little, see for instance Xie et al. (1999) for a study concerning the US, or even negative, see Zhang and Zou (1998) and Davoodi and Zou (1998) for the link between fiscal decentralization and growth. Iimi (2005) further argues that countries specific characteristics such as the lack of administrative capacity of local government, especially in the case of recent decentralization or the lack of coordination in public goods provision across different jurisdictional unit may hamper the expected positive effect of fiscal decentralization on growth. The question of the relationship between fiscal decentralization, national growth and regional inequalities thus appears to be an empirical one. In order to control for the possible influence of fiscal regional decentralization we use the indicator developed by the

World Bank which is based on data from the IMF's Government Finance Statistics. This indicator is the percentage of total expenditures accounted for by sub-national governments, see Table A2 in Annex for further details. Interestingly, this indicator accounts for regional, corresponding to the NUTS2 level, as well as local public spending decentralization which gives full account of the level of fiscal decentralization likely to have an impact on the extent of regional inequalities. It follows that the fiscal centralisation index used here does not necessarily match the regional units used here. One must note, in addition, that this indicator may not fully reflect the influence of fiscal decentralization given that countries differ in terms of the level of public spending in terms of GDP. The impact of public spending on the economic activity will thus be different depending on the relative size of the public sector. In order to correct for this we also use as an alternative control measure for fiscal decentralization the share of sub-national public expenditures in percentage of national GDP.

The fourth extra-explanatory variable is a measure of the impact of EU regional policy. The implementation of EU Cohesion policy through the allocation of structural funds, if they have had any significant impact on the level of regional income inequalities, should go against a potential rise in regional inequalities as they aim to foster the development prospects of the least developed regions. More specifically, since the end of the 1980s, European structural funds have largely benefited to those EU regions with a GDP per capita lower than 75% of EU average (the so-called Objective 1 regions). These regions, in turn, are mainly concentrated in the member states with the lowest GDP per capita. Originally, the main objective of these funds was to lower the potential negative impact of the European integration process on the least favoured and least competitive EU regions by focusing on key growth-related items such as transport infrastructure and human capital rather that to explicitly redistribute income across regions. Over the period 1989-1999 these funds have been substantial representing, on average, around 2% of the cohesion countries GDP against 0.12% for the rest of the EU and could potentially affect the level of regional inequalities between regions.[19] Also, substantial amounts are foreseen to be granted for the new entrants in the EU in 2004 but still little evidence is available concerning their impact on the level of income inequalities across regions.[20] Despite their importance, the effective impact of EU structural funds remains inconclusive with a number of authors suggesting that, at best, their impact was negligible, see Boldrin and Canova (2001) and Beugelsdijk and Eijffinger (2003). For contrasting evidence in this

[19] Sources: Annual reports of the Court of Auditors for data from 1976-1996; Commission's Annual report on allocated expenditure from 1997 on; annual reports on the Cohesion Fund.
[20] Note also that the European Union these allocated countries pre-accession funds to these countries with the aim of improving their administrative structures and national growth prospects with no specific targeting toward lowering regional imbalances.

regard see De la Fuente (2002). In order to control for the possible influence of EU regional policy we use an additional control variable the level of Structural Funds as percentage of national GDP.[21]

As an initial step we first ran simple OLS specifications including these additional explanatory variables in order to see whether their impact on regional inequality coincides with a priori expectations and thus whether they are likely to serve as good proxies of their intended purpose. In doing so we also included our national development measure and its value squared, and the results of this specification without any additional explanatory variables is given the first column of Table 4. As can be seen, national development has a negative impact on regional inequality. While the lack of significance on its squared value may indicate that there are non-linearities in the relationship, that as it is modelled in this specification the form of the non-linearity is substantially more restrictive than in for our semi-parametric specifications. In the second column we included our structural funds, fiscal decentralisation, and openness proxies. The estimated signs on these variables coincide with a priori expectations, although it is only significant for the structural funds proxy. In columns 3 and 4 we experimented with alternative proxies of fiscal decentralisation and openness as discussed above. Notably, the openness variables is now statistically significant and of the expected sign. In the fifth column of Table 4 we also included our dissimilarity index and, as can be seen, while it is of the expected sign, the coefficient is insignificant.

In Figures 14 through 17 we thus proceeded and re-estimated our semi-parametric specification including these additional control variables in various combinations. The results obtained in these figures must be compared to the one obtained previously in Figure 5 where we included the national level of GDP per capita only as explanatory variable. Accordingly, regardless of what fiscal decentralisation or openness variable we use, the estimated shape of the regional inequality-national development link remains bell-shaped. In Figure 17 we also included our dissimilarity index, although one must note that this meant reducing our sample period to start from the 1980s. Nevertheless, reassuringly one still observes the outlines of a bell-shaped curve.

[21] Another important component of EU cohesion policy is the Cohesion fund. While this fund may also have an impact on regional inequalities, this impact is less clear-cut given that it is attributed on a national basis (the criterion being that the EU country must have a GDP per head below 90% of the EU average) in order to boost growth mainly through public investment in transport and energy infrastructure and also for the environment.

5. Summary and Policy implications

In this paper we examine the link between national economic development and regional inequalities for European regions and find strong evidence for a bell-shaped relationship between these two elements. This evidence shows in particular that regional inequalities inevitably rise as economic development proceeds but then tend to decline once a certain level of national economic development is reached. While we try to provide an idea about the level of economic development needed in order to observe a decline in regional inequalities, one must reckon that our results are tied to the particular case study considered here, namely the European Union. Despite this, we believe that our results are sufficiently general and robust in order to provide a general idea about the relationship between national development and regional inequalities and correspond pretty well to the transition dynamics derived from a simple model of convergence with spillovers such as the one described by Lucas (2000). Several robustness checks are provided including other OECD countries and regions as well as alternative spatial units that tend to support our general results.

Our findings have also important policy implications, especially for EU Cohesion policy, which is aimed at boosting convergence and catching-up of lagging EU regions and at reducing regional inequalities across the EU. This is particularly true for the new EU member states given that EU funds allocated to these countries could represent up to 4% of their national GDP and could thus have substantial impact on the growth prospects of these countries. The evidence presented here implies that some degree of regional inequality is hardly avoidable, at least at the initial stages of development of countries starting from relatively low levels of GDP per capita such as the new EU member states that entered the EU in 2004. The main reason for this is that growth is essentially driven by innovation and technological progress which are unlikely to appear everywhere at the same time. It follows that some degree of heterogeneity in regional economic development will necessarily appear as countries are engaged into fast economic catching-up. Regional policy should thus focus on boosting national growth in order to guarantee greater prosperity across all regions at the expense of temporarily rising inequality, especially for the poorest new EU member states starting both from very low levels of economic development and regional inequalities. In this sense, our results tend to support the findings of a recent paper by de la Fuente (2004) who estimates that, in the case of Spain, who has been largely benefiting from EU aid since the late 1980ies, the allocation structural funds would have provided greater welfare through more concentration across regions in order to favour nation-wide growth. As suggested by de la Fuente (2004), the cost of re-shifting funds toward the most dynamic regions is likely to be mitigated by national-level interpersonal income redistribution mechanisms.

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Tables and Figures

Table 1: Level of national GDP and regional inequalities in Cohesion countries*								
	GDP per capita				***Regional inequalities***			
	1975	1986	1992	2000	1975	1986	1992	2000
Spain	0.83	0.75	0.82	0.83	1.05	1.03	1.06	1.02
Greece	0.72	0.66	0.65	0.69	1.03	0.68	0.75	0.83
Portugal	0.55	0.57	0.69	0.75	1.56	1.19	1.07	1.13
Cohesion	0.82	*0.70*	*0.77*	*0.79*	*1.16*	*1.00*	*1.00*	*1.00*
Rest of the EU15	1.09	*112*	*1.12*	*1.07*	*0.93*	*0.94*	*0.99*	*0.95*

* Figures are relative to the EU15 countries, GDP per capita is measured at PPS
Regional inequalities are measured using the standard deviation of the logarithm of regional GDP per capita
qualities are measured using the standard deviation of the logarithm of regional GDP per capita, the figure for Portugal is for 1977. Values for country groups are in weighted (population) average

Table 2: Summary Statistics for the EU15 countries, 1975-2000				
	GDP per capita		Regional inequalities	
	Mean	Standard Deviation	Mean	Standard Deviation
Austria	1.11	0.02	1.19	0.05
Belgium	1.11	0.03	1.18	0.05
Germany (Western only)	1.20	0.02	0.92	0.04
Spain	0.79	0.03	1.04	0.06
Finland	1.01	0.05	1.12	0.06
France	1.11	0.05	0.75	0.06
Greece	0.68	0.04	0.80	0.09
Italy	1.05	0.02	1.31	0.09
Netherlands*	1.11	0.04	1.01	0.09
Portugal**	0.64	0.07	1.17	0.20
Sweden	1.14	0.08	0.77	0.08
United Kingdom	1.04	0.02	0.75	0.03

Notes: Figures are comùputed relative to the EU25 average
* Regional inequalities computed excluding Groningen region
** Regional inequalities computed excluding Alentejo region

Table 3: Level of national GDP and regional inequalities in new Member States and candidate countries*				
	GDP per capita (EU25=100)		***Regional inequalities***	
	1995	2000	1995	2000
Average	*0.43*	*0.45*	*1.10*	*1.22*
Bulgaria	0.31	0.27	0.96	0.90
Czech Rep.	0.70	0.65	0.95	0.99
Estonia	0.34	0.42	1.52	1.54
Hungary	0.49	0.53	1.09	1.22
Lithuania	0.34	0.38	0.65	0.96
Latvia	0.30	0.35	1.46	2.21
Poland	0.41	0.46	1.43	1.35
Romania	0.30	0.25	0.83	1.06
Slovenia	0.68	0.73	0.60	0.58
Slovakia	0.44	0.48	1.53	1.38

* Figures are relative to the EU15 countries weighted average, weights given by population

GDP per capita is measured at PPS and regional inequalities are measured using the standard deviation of the logarithm of the regional GDP per capita

Table 4: Parametric estimations, EU15 1975-2000
dependent variable : Standard deviation of regional regional GDP per capita (GDPc)

	(1)	(2)	(3)	(4)	(5)
GDPc	-0.322*	-0.314*	0.378**	-0.533***	-0.775***
	(0.166)	(0.191)	(0.183)	(0.195)	(0.212)
$GDPc^2$	0.175	-0.032	-0.043	-0.281	-0.515
	(0.278)	(0.321)	(0.319)	(0.322)	(0.365)
Structural Funds	-	-0.036*	-0.046**	-0.053**	-0.024
		(0.020)	(0.021)	(0.020)	(0.027)
Fiscal decent.	-	-0.000	-	-0.001	-0.000
		(0.001)		(0.002)	(0.002)
Fiscal decent. % GDP	-		0.005		
			(0.004)		
Openness	-	0.194	0.209		
		(0.153)	(0.153)		
Real openness	-	-	-	0.651***	0.761***
				(0.183)	(0.186)
Dissimilarity	-	-	-	-	-0.502
					(0.467)
F-test country dummy	68.29	62.82	71.23	71.35	40.93
[P-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
R^2	0.76	0.77	0.77	0.78	0.77
# obs	310	287	287	287	240

Notes: (a) time dummies included; (b) standard errors in parentheses; (c) ***, ** and * indicate one, five and ten per cent significance levels respectively, all regressions include a constant term. Variables measured in terms of deviation from the sample average

Figure 1: Evolution of cumulative probability of switching from stagnation (*S_t*) to a growth regime (*F_t*)

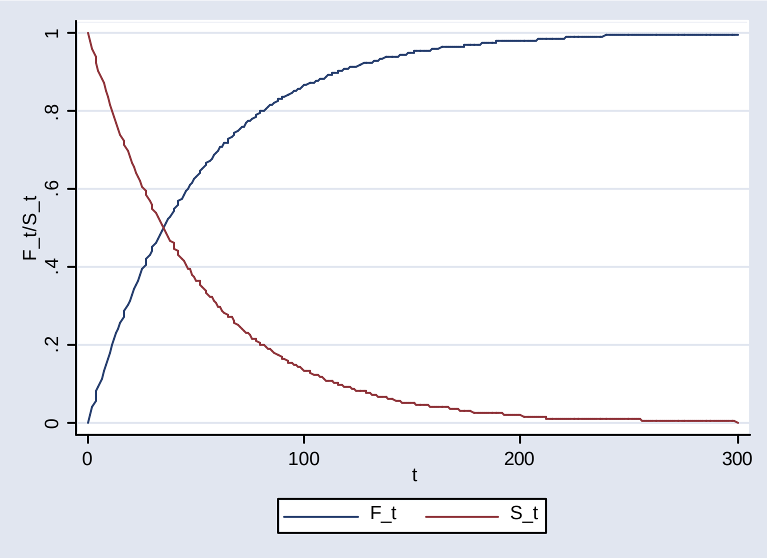


Figure 2: Average growth rate vs. average income level

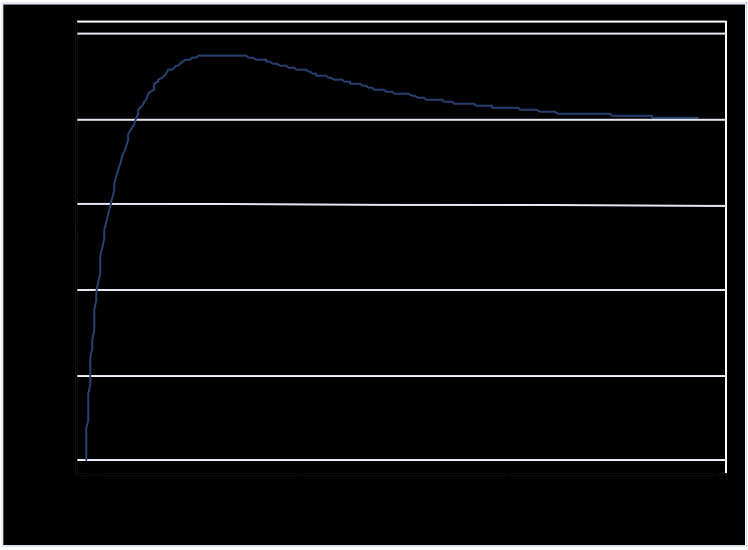


Figure3: National income per capita vs. regional inequalities.

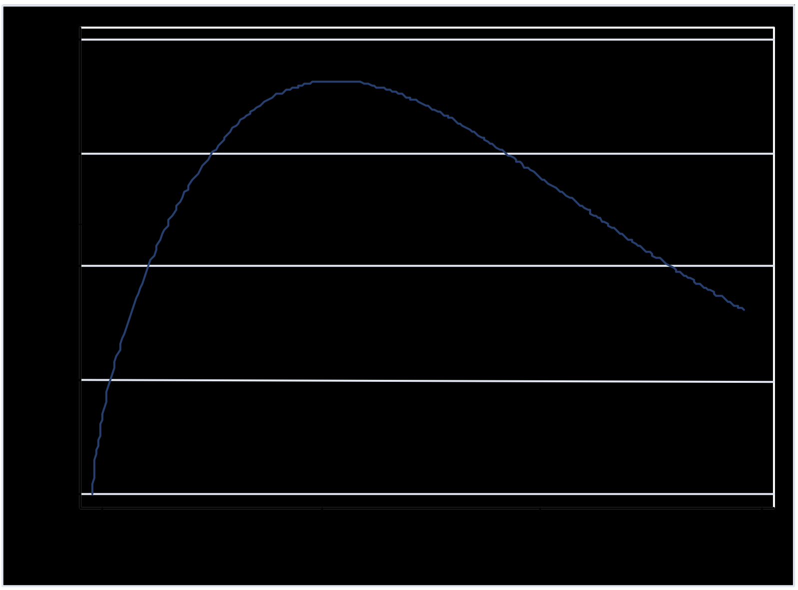


Figure 4: GDP per capita level in 1995 vs. change in regional inequalities in GDP per capita in the new EU Member States

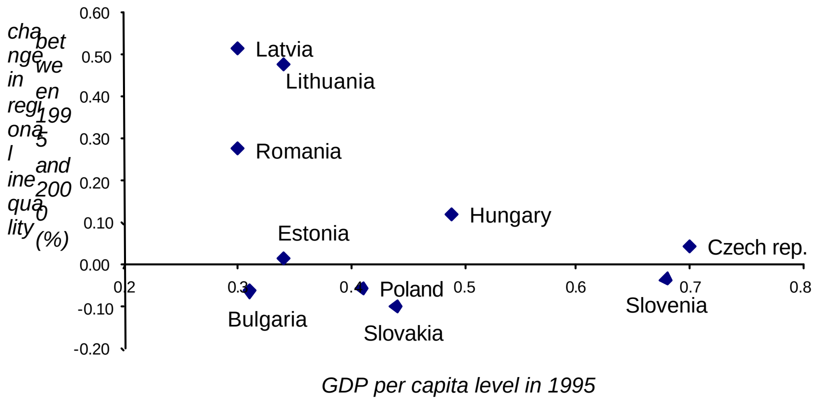


Figure 5: Results for EU15, 1975-2000

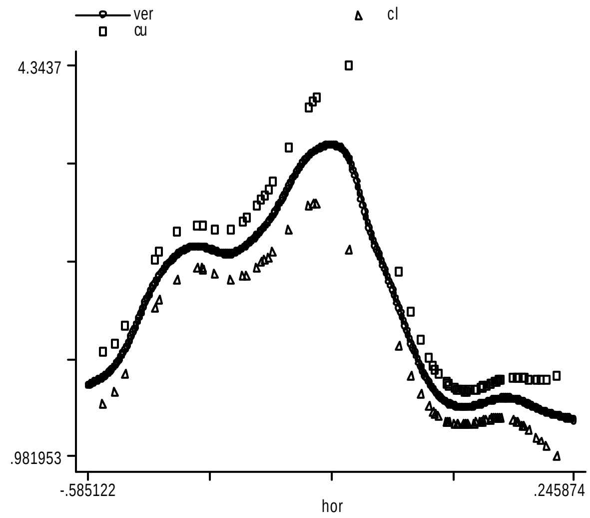


Figure 6: Results for EU15, 1975-2000 – dropping outliers

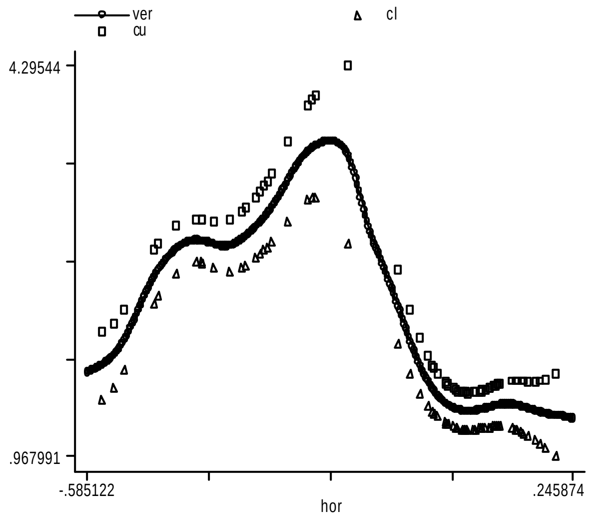


Figure 7: Results for EU15, 1975-87

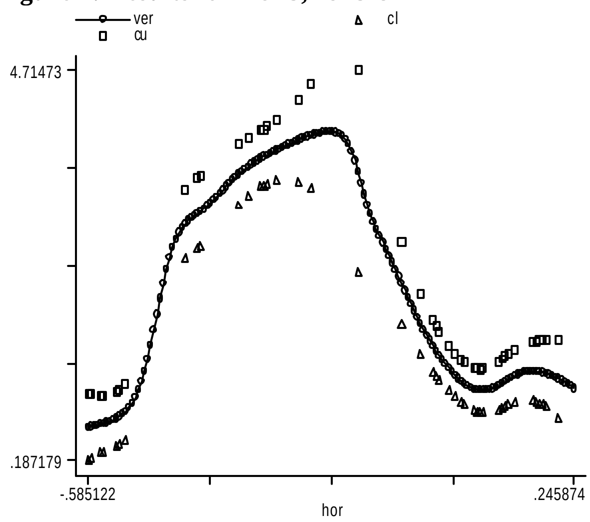


Figure 8: Results for EU15, 1988-2000

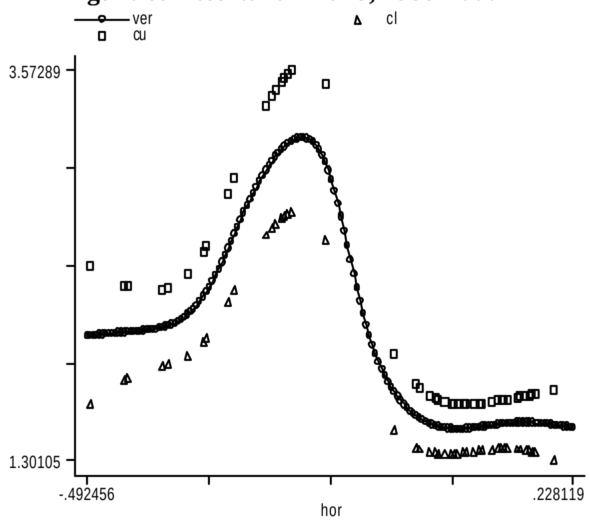


Figure 9: Results for EU15, 1991-2000
Including new German Landers

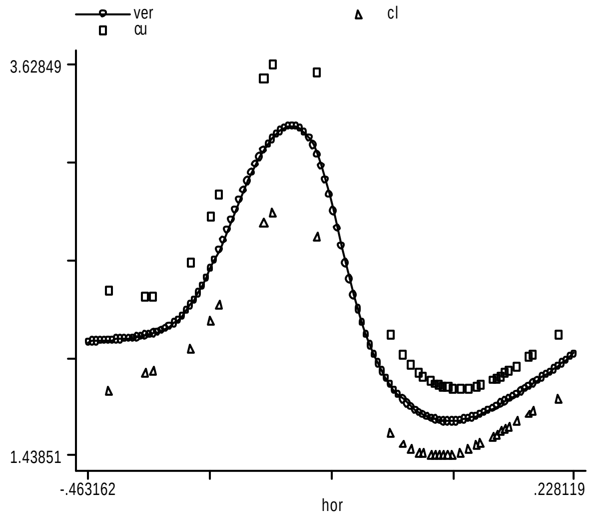


Figure 10: Results for EU25, 1995-2000

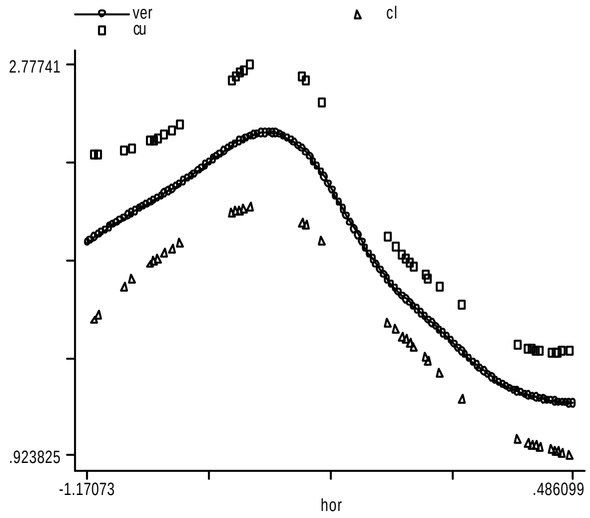


Figure 11: Results for EU25, 1995-2000
Inequality measure based on nuts2 regions only

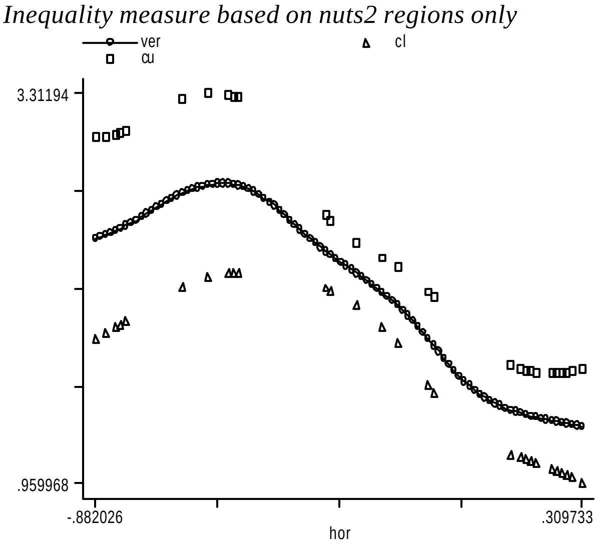


Figure 12: Results based on Functional Urban Areas 1977-1996

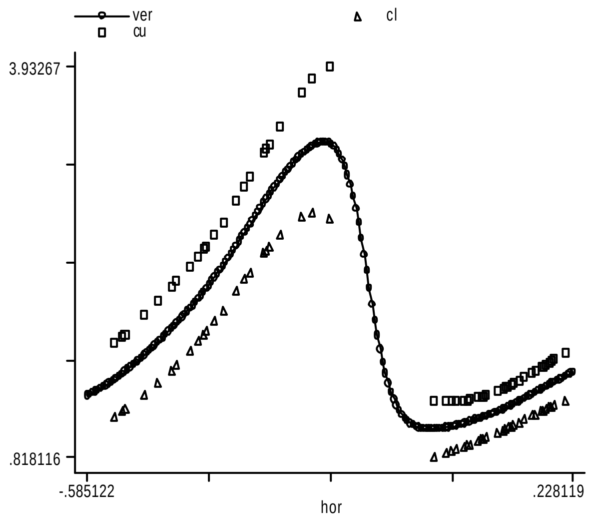


Figure 13: Results based on OECD Territorial Statistics 1977-1996

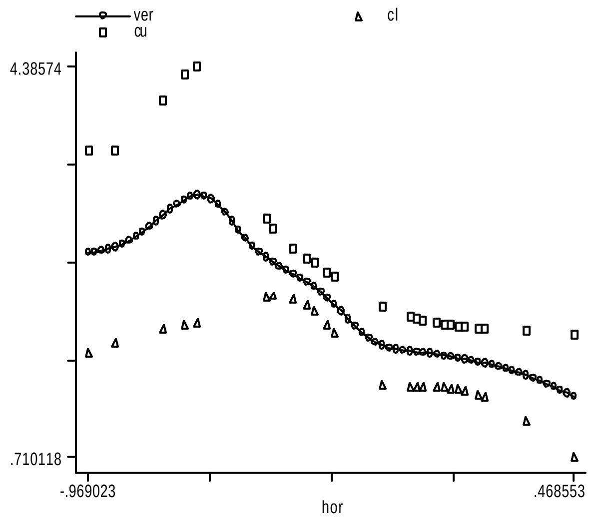


Figure 14: Results for the EU15, 1976-2000, controlling for fiscal decentr., regional aid and openness

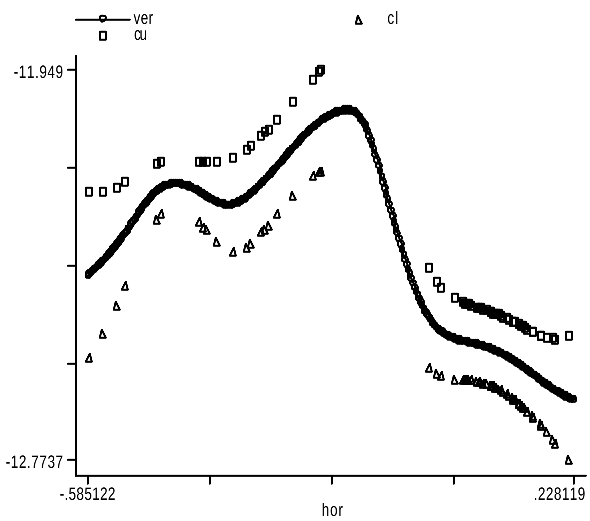


Figure 15: Results for EU15, 1976-2000, controlling for fiscal decentr. in % of GDP, regional aid and openness

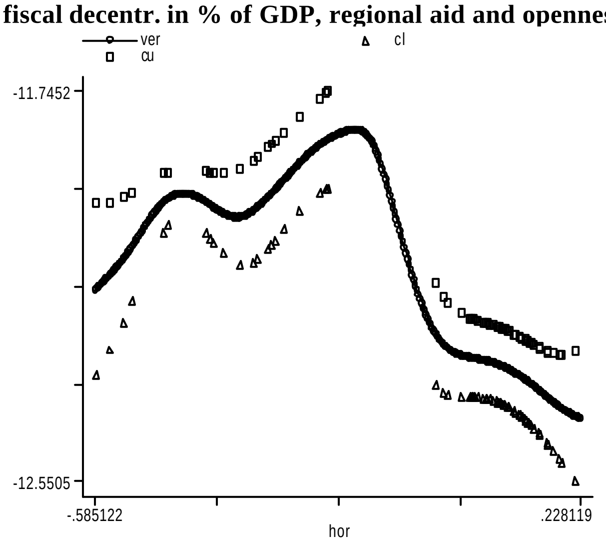


Figure 16: Results for EU15, 1976-2000, controlling for fiscal decentr., regional aid and Real Openness

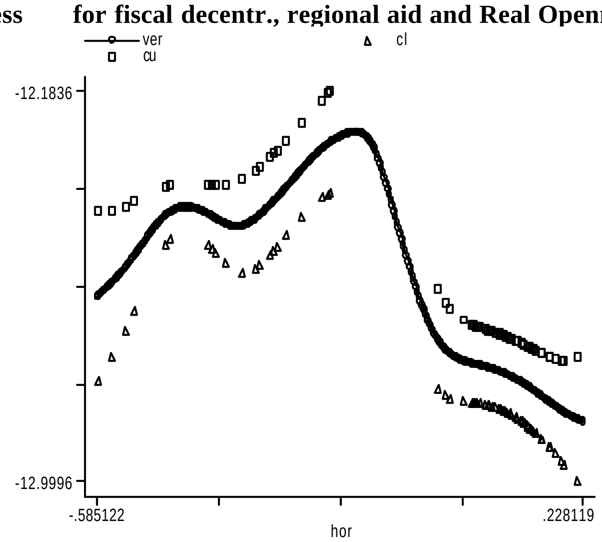
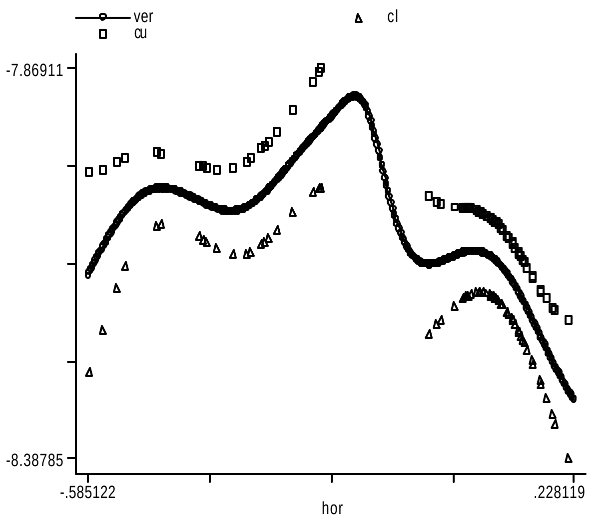


Figure 17: Results for EU15, 1980-2000, controlling for fiscal decentralization, regional aid, real openness and Industrial Dissimilarity



Appendix:

Table A1: Number of regions and dataset used

Country	Eurostat/Cambridge Econometrics database (NUTS2 regions)	Functional Urban Areas	OECD Territorial Statistics
Australia	-	-	8
Austria	9	-	9
Belgium	11	4	3
Canada	-	-	12
Czech Republic	8	-	8
Denmark	-	-	3
Finland	5	-	6
France	22	22	23
Germany	31 (42*)	28	11
Greece	13	-	4
Hungary	7	-	7
Italy	21	17	20
Japan	-	-	10
Mexico	-	-	32
Netherlands	12	4	4
Norway	-	-	7
Poland	16	-	16
Portugal	7	-	7
Slovak Republic	4	-	4
Spain	18	16	18
Sweden	8	-	8
United Kingdom	37	24	-
United States	-	-	51

* including new Landers

Table A2: Statistical sources of explanatory variables used in Section 4.3*

Indicator	Definition	Source
Traditional Openness index	$(\text{export}_{i,t}+\text{import}_{i,t})/\text{GDP}_{i,t}$	Ameco database, European Commission, Directorate General for Economic and Financial Affairs
Real openness index	$(\text{export}_{i,t}+\text{import}_{i,t})/\text{GDP}^{p}_{i,t}$ where $\text{GDP}^{p}_{i,t}$ is the GDP expressed in purchasing power standard	Ameco database, European Commission, Directorate General for Economic and Financial Affairs
Industrial dissimilarity index	$K_{i,t} = \frac{1}{0.5\, N_i (N_i - 1))} \sum_{k,k \neq j}^{N_i} K_{j,k}$ where N_i is the number of regions located in country i and $K_{j,k,t} = 0.5 \sum_{s} \left\| x_{s,j,t} - x_{s,k,t} \right\|$ Where $x_{s,j}$= share of sector s in total employment of region j	Cambridge Econometrics sectors s concern agriculture, construction, energy and manufacturing, market services and non-market services
Fiscal decentralization index	Sum of local and regional total expenditures, excluding current (C.3.2SN) and capital (C.7.1.1SN) transfers to other levels of government, divided by the sum of local, regional and national expenditures, excluding intergovernmental transfers.	World Bank
Fiscal decentralization index (% of national GDP)	Sum of local and regional total expenditures, excluding current (C.3.2SN) and capital (C.7.1.1SN) transfers to other levels of government, divided by National GDP	World Bank
EU Regional aid	Total EU payment for regional development from the European Regional development Fund (ERDF), the European Agricultural Guidance and Guarantee Fund (EAGGF), , and the European Social Fund (ESF) in % of national GDP	European Commission, Directorate General for Economic and Financial Affairs

* Indicators subscripts indicate country i and year t. Monetary variables are expressed in current euros