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Growth, integration, and regional disparities in the European Union

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Abstract. In this paper we challenge the ability of the conventional methods initiated by Barro and Sala-i-Martin in the early 1990s to detect actual convergence or divergence trends across countries or regions and suggest an alternative dynamic framework of analysis, which allows for a better understanding of the forces in operation. With the use of a SURE model and time-series data for eight European Union (EU) member states, we test directly for the validity of two competing hypotheses: the neoclassical (NC) convergence hypothesis originating in the work of Solow and the cumulative causation hypothesis stemming from Myrdal's theories. We also account for changes in the external environment, such as the role of European integration on the level of regional disparities. Our findings indicate that both short-term divergence and long-term convergence processes coexist. Regional disparities are reported to follow a procyclical pattern, as dynamic and developed regions grow faster in periods of expansion and slower in periods of recession. At the same time, significant spread effects are also in operation, partly offsetting the cumulative impact of growth on space. Similar results are obtained from the estimation of an intra-EU model of disparities at the national level, indicating that the forces in operation are independent of the level of aggregation. Our findings challenge the view of economic growth as the main driver for a reduction of regional disparities and contribute to the growing scientific evidence that points towards the need to rethink current EU-wide regional development policies.

1 Introduction

Economic theory has an ambiguous message concerning the relationship between growth and regional disparities. This uncertainty and the discussion around it started in the late 1950s. Following Solow (1956), proponents of the neoclassical (NC) paradigm argue that disparities are bound to diminish with growth—although, as Solow himself (1994) and Fingleton (2003) acknowledge, this may not necessarily be always the case—because of diminishing returns to capital. In a competitive environment, regional labour and capital mobility, as well as regional trade, will also work in favour of factor price convergence, reinforcing the negative relation between growth and regional disparities.

However, other schools of thought tend to agree with the basic claim of Myrdal (1957) that growth is a spatially cumulative process, which is likely to increase disparities. Despite significant differences among strands of research, whether one examines older theories of development (Fleming, 1955; Hirschman, 1958; Kaldor, 1956; Perroux, 1970; Rosenstein-Rodan, 1943), theories of urban growth (Henderson, 1983; 1986; 1988; 1999; Segal, 1976), the new economic geography school (Fujita et al, 1999; Krugman, 1991; 1993a; 1993b;

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Thisse, 2000), or the endogenous growth school (Romer, 1986), a similar argument arises: economic growth has a tendency to be associated with some sort of agglomeration and requires a minimum threshold of resources and activities in order to take place. Once it starts however, it is likely, depending on the strands of research, to be self-sustained, spatially selective, and cumulative in nature.

On empirical grounds, the message derived from recent analyses is also unclear. Most NC convergence analyses at a national and subnational level—such as those conducted by Barro and Sala-i-Martin (1991; 1992)—have tended to report moderate convergence rates, which hover at levels of 2% per annum. In contrast, other studies find either no convergence or outright divergence (Cuadrado-Roura, 2001; López-Bazo et al, 1999; Magrini, 1999; Puga, 2002; Rodríguez-Pose, 1999). In between these positions, the recent significant development of spatial econometric tools has allowed for much greater nuance in empirical analyses of the evolution of regional disparities in Europe. The greater capacity allowed by those methods to take externalities into account has resulted in a series of studies, whose results—while corroborating some of the above-mentioned strands—have introduced much finer distinctions in the convergence and divergence processes (for example, Ertur and Le Gallo, 2003; Fingleton and López-Bazo, 2003).

In this paper we reexamine from a critical theoretical and empirical viewpoint the convergence literature and aim to provide a new dynamic framework of analysis, which allows for a better understanding of the forces in operation described by the two sides involved in the debate.

The remainder of the paper is organised as follows. In section 2 we present a critique on the methodology used by the convergence literature. In section 3 we propose an alternative approach to analyse the relationship between growth and regional differences. Section 4 presents the estimated model and the empirical results for the EU, and section 5 presents the general conclusions of the paper.

2 A critique of the convergence literature

The basic NC β-convergence model, as proposed by Barro and Sala-i-Martin (1991; 1992), for the evaluation of convergence or divergence trends across countries or regions adopts the following form:

$$\frac{1}{T} \ln\left(\frac{Y_{i,t}}{Y_{i,t-T}}\right) = \alpha + \ln Y_{i,t-T}\left[\frac{1-\exp(\beta t)}{T}\right] + \varepsilon_{i,t-T} \,, \tag{1}$$

where $Y_{i,t}$ represents GDP per capita[(1)] of the country or region i, T is the period of analysis, β is the coefficient, and ε is the error term. A negative value for the slope coefficient β indicates convergence of GDP per capita across territorial units of analysis, in a given time period, whereas a positive value indicates divergence. This model has significant advantages—starting with its simplicity—for our understanding of the evolution of regional disparities, but it also has important disadvantages. These are outlined below.

(1) We acknowledge that resorting to the evolution GDP per capita as the sole indicator of regional disparities represents a gross simplification. Regional imbalances expand well beyond GDP-per-capita differences and include key economic and social aspects, such as employment, educational levels, infrastructure endowment, access to technology and innovation, and provision of social services, which are unfortunately overlooked by the great majority of analyses on economic convergence or divergence. Given that this paper represents a critique of traditional convergence approaches we will, however, stick to the usual approach of measuring regional disparities in GDP per capita, despite its flaws.

2.1 Cyclical effects

Perhaps the most serious disadvantage of the widely used NC β-convergence model is that it ignores the influence of cyclical effects on growth. To the extent that business cycles are not synchronised across units of analysis, something that can be expected for countries with different levels of development and a relatively low degree of economic integration (Dickerson et al, 1998), convergence or divergence trends depend heavily upon the choice of time period. Figure 1 illustrates the argument.

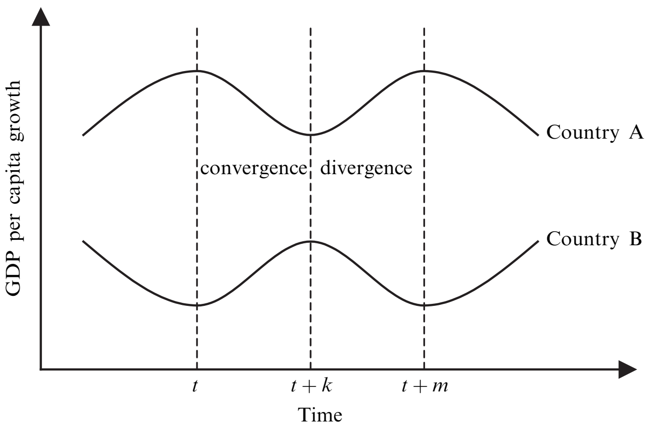

Figure 1. An example of ill-detected convergence or divergence trends because of unsynchronised business cycles.

Given two countries (or regions) with different economic cycles and different initial levels of development (country A being wealthier than B), and assuming that population remains constant over time, the choice of time period greatly affects the findings of an NC β-convergence model. If the time interval chosen is $[t, t+k]$, the model will report convergence (b-coefficient negative and significant). If the time interval chosen is $[t+k, t+m]$, divergence will be the result (b-coefficient positive and significant). Finally, if the time interval chosen is $[t, t+m]$, the model will show no tendency for either convergence or divergence (b-coefficient insignificant). Several other instances in which the outcome of the estimation depends on the choice of time interval chosen could be imagined.

Another caveat is that cyclical movements are heterogeneous, not just across countries, but also within countries. Hence the economic impact of cycles on economic convergence or divergence has both an international dimension, which refers to the specific effect of national economic behaviour on regions within a given country, and an intranational dimension which affects the economic trajectory of European regions according to their structural composition.

2.2 Relative importance of each region

Another equally serious disadvantage of the typical NC β-convergence model is that it tends to overlook the relative size or importance of each country or region, treating all observations as equal. Table 1 (over) and figure 2 (over) present an example with three regions, one of which is very small, in order to illustrate the argument. It becomes clear that the performance of a minuscule region in terms of size (region C) can significantly affect the diagnosis of the model and alter our perception of convergence or divergence trends. Although region A is richer and grows faster than region B, signalling a clear case of regional divergence (see dotted line in figure 2), the model may not produce a positive slope coefficient if the performance of region C is also

Table 1. An example of ill-detected convergence trends based on heterogeneous samples with respect to size.

Region	Population (million)	GDP per capita in period t (\$ million)	GDP per capita growth in period $[t, t+k]$ (%)	
			scenario 1	scenario 2
A	4.0	20	25	25
B	1.5	14	7	7
C	0.1	6	16	33
Weighted coefficient of variation		0.44	0.52	0.49

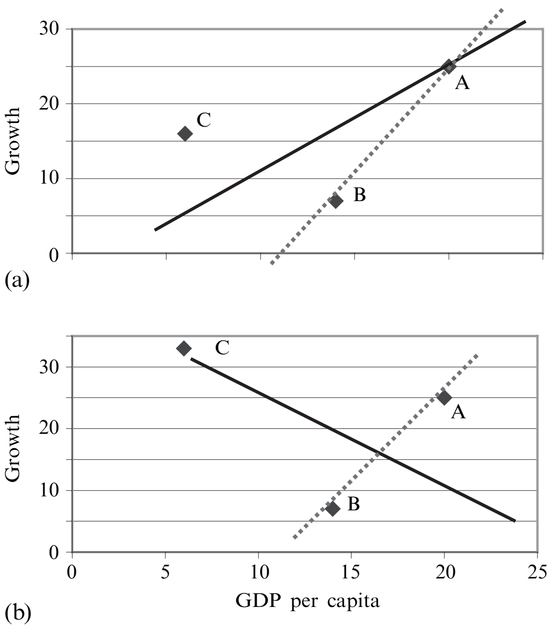

Figure 2. An example of ill-detected convergence trends based on heterogeneous samples with respect to size: (a) scenario 1 (divergence), (b) scenario 2 (convergence).

accounted for. Under scenario 2 the model fails to see a clear case of divergence, in which metropolitan region A grows faster than region B, because the tiny region C blurs the picture. This inability of β-convergence models to take the relative size of observations into consideration may lead to unrealistic results. Other measures of regional disparities do not suffer from this shortcoming. For comparative purposes, we report in table 1 the weighted coefficient of variation, which accounts properly for the relative importance of region C and produces a greater value for period $t+k$, indicating that regional divergence is the prevailing tendency in both scenarios.

2.3 Conditional model

The final critique relates to the use of β-convergence in conditional convergence models. Conditional convergence models usually include a number of economic, structural, or demographic characteristics of the countries or regions included in the analysis as independent variables and estimate their impact on growth. By doing this, however, they remove the influence of all these (usually important) structural variables and find tendencies of convergence among countries or regions that do not exist in reality. Some authors are careful enough to acknowledge that these models in fact do not measure convergence among regions, but convergence towards the 'steady state' (a concept derived from the NC school) of each region. Even in this case, the models tell us nothing about regional convergence, as different regions may have different 'steady states'.

These pitfalls significantly alter our perception of convergence and divergence trends and of the evolution of territorial imbalances, especially in those cases in which the size of the economic units included in the analysis is very different and lack of or imperfect economic integration implies that the units of analysis have different economic cycles. The analysis of the evolution of economic disparities across the EU by means of β-convergence models represents one of the most important examples of these downsides at work. The extreme difference in size between units of analysis has an important effect on our perception of convergence. At a national level, the population of Germany, the largest country in the EU, is almost 200 times the populations of Luxembourg and Malta, the smallest member states. Twelve of the current member states have less than one tenth of the population of Germany. These huge differences are also repeated in economic terms. The size of the German economy is 117 times that of Luxembourg and almost 25 times that of Ireland. If regions are included in the analysis, the differences widen. The population of the Åland islands in Finland is more than 3000 times smaller than that of Germany, and more than 700 times smaller than that of North Rhine-Westphalia in Germany, the largest region in the EU. The economic gap is roughly similar.

Results of β-convergence analysis are also affected by the fact that some of the smallest countries in the EU have also experienced the highest rates of growth. During the 1990s growth rates in Ireland and Luxembourg have been three and two and a half times the EU average, respectively. The largest countries of the EU, both in population and economic terms, have had, in contrast, relatively poor economic performances. Both Italy and France grew at below the European average between 1990 and 2000, whereas Germany was close to the average and the strong performance of the United Kingdom in the second half of the decade was overshadowed by slow growth in the early 1990s.

Another important caveat for the use of β-convergence models at the EU level concerns the wide differences in economic cycles across countries. Table 2 (over) presents the results of the simple correlation between the economic growth rates of individual member states and that of the EU as a whole at different stages of European integration. Despite the progressive harmonisation of European and national economic cycles as economic integration progresses, significant differences between national and European cycles exist. Growth cycles in EU member states show little correlation with European cycles. Luxembourg, Denmark, and Ireland are the extreme examples of lack of compliance between national and European cycles. No statistically significant association between national growth and European growth rates is found for any of the periods of economic integration. In the remaining EU countries, with the exception of France and Italy, national economic cycles also differ significantly from the European cycle at different stages of integration, with the UK cycle even becoming more diverse as integration progresses (table 2). Regional economic cycles within the EU, in contrast, tend to follow national cycles more closely (Cuadrado Roura et al, 1998).

Finally, these types of models do not take into account the heterogeneous behaviour and upward and downward mobility of EU regions, which are related mainly to restructuring processes, such as changes in migration, improvements in education and technology, and/or sectoral change (Armstrong, 1995; Cuadrado-Roura, 2001; Magrini, 1999; Paci and Pigliaru, 1999; Terrasi, 1999).

Table 2. Correlation between national and EU-15 economic cycles in different stages of European integration (source: elaborated from Eurostat data).

	Customs union 1977–86	Transition to the Single Market 1986–93	Single Market 1993–2000
Austria	0.459	0.443	0.803**
	(0.214)	(0.320)	(0.017)
Belgium	0.375	0.895***	0.973***
	(0.320)	(0.006)	(0.000)
Denmark	0.664	0.026	0.542
	(0.051)	(0.956)	(0.165)
Finland	0.231	0.857**	0.871***
	(0.549)	(0.014)	(0.005)
France	0.629***	0.933***	0.933***
	(0.000)	(0.002)	(0.001)
Germany	0.928***	0.083	0.979***
	(0.000)	(0.860)	(0.000)
Greece	0.800***	0.321	0.900***
	(0.010)	(0.482)	(0.002)
Ireland	0.388	0.378	0.683
	(0.303)	(0.403)	(0.062)
Italy	0.829***	0.957***	0.914***
	(0.006)	(0.001)	(0.002)
Luxembourg	0.621	0.518	−0.427
	(0.074)	(0.234)	(0.291)
Netherlands	0.008***	0.392	0.891***
	(0.008)	(0.384)	(0.003)
Portugal	0.300	0.900***	0.875***
	(0.433)	(0.006)	(0.004)
Spain	0.247	0.872	0.905***
	(0.522)	(0.010)	(0.002)
Sweden	0.406	0.835**	0.942***
	(0.279)	(0.019)	(0.000)
United Kingdom	0.697**	0.752	0.447
	(0.037)	(0.051)	(0.266)

*** and ** denote significance at 1% and 5% levels, respectively. Levels of significance are given in parentheses below coefficients.

3 A model of regional disparities and growth

In view of the problems linked to the analysis of the evolution of territorial disparities by means of β-convergence models mentioned above, in the following section we propose an alternative dynamic approach to the relationship between growth and regional differences, which will later be applied to the measurement of disparities within the EU.

3.1 Existing literature

Until the revival of growth and convergence literature in the late 1980s and early 1990s, the debate on regional imbalances was influenced mainly by Williamson (1965), who claimed that relatively advanced countries are characterised by a negative relation between the level of regional differences and the level of development. Equation (2) depicts this inverse relation for a measure of regional disparities (r) and GDP per capita (Y), under the condition that Y is greater than a threshold level Y^*

characterising advanced countries.[2]

$$r = \theta(Y), \qquad \theta_Y < 0, \quad \forall Y \geqslant Y^*, \tag{2}$$

This relation, which depicts long-term processes, is in line with NC postulates as well as with explanations connecting diminishing disparities with decreasing rates of concentration in metropolitan centres. From this perspective, regional imbalances in more developed countries are expected to be lower thanks to a combination of factors, such as a more equal spatial allocation of political power (Friedmann, 1969), diseconomies of agglomeration prevailing after some level of concentration (Petrakos and Brada, 1989) technological diffusion, core–periphery spread effects, and the existence of transport infrastructure that increases the locational choice of private capital. In brief, the combination of market forces and policy factors in advanced economies is likely to yield, in the long-run, lower spatial disparities.

Not all scholarly research, however, shares Williamson's approach. Berry (1988) has claimed that regional imbalances expand or contract during the economic cycle, depending on whether the economy is in an expanding or a declining phase. This position, which directly links high rates of economic growth with increasing disparities, is in line with the argument about the spatially cumulative nature of growth made by Myrdal (1957), as well as with the discussion on the impact of agglomeration economies on the regional allocation of resources (Henderson, 1983; 1986; 1988; 1999; Krugman, 1991; 1993a; Thisse, 2000). It is also not far from Kaldor's (1956) viewpoint that the increasing returns provoked by the division of labour make economic growth a path-dependent process. The rationale of this claim is, in outline, that expansion cycles begin in advanced regional centres, in which the interaction of agglomeration effects and market size provides a lead over other regions. These effects may be related to the quality of human resources, the science base of the region and its interaction with industry, the quality of the service sector, the links between economic and political decisionmaking, or the intrasectoral or intersectoral formal and informal relations among neighbouring firms. What Berry suggests in his analysis, is that economic processes tend to be associated, in the short to medium term, with increasing spatial disparities, as leading regions are in a better position to take advantage of the opportunities generated by economic boom.

The relation between regional imbalances and economic growth has been recently tested by Petrakos and Saratsis (2000) using Greek data for a period of twenty-six years (1970–95). Equation (3) shows a version of the estimated model, in which r is a measure of regional disparities[3] and g is the annual growth rate of national GDP.

$$r_t = \varphi(g_t) > 0, \qquad \varphi_g > 0, \quad t = 1, ..., 26\,. \tag{3}$$

The estimated slope coefficient was found to be positive and statistically significant, providing empirical support for the hypothesis that periods of economic expansion have been accompanied in the case of Greece by a noticeable expansion of regional disparities, because the evidence implies that recovery begins in the more advanced regions of the country. This finding concurs with Berry's (1988) position and has some points in common with the cumulative causation theory of Myrdal (1957).

(2) According to Williamson, relation (2) is a bell-shaped function of Y, which implies that, for any value below the threshold level Y^*, it becomes a positive function of Y. Similar bell-shaped relations have also been found by El-Shakhs (1972), Petrakos and Brada (1989), and Wheaton and Shishido (1981).

(3) The measure of disparity used is the coefficient of variation, which was estimated for the fifty-one NUTS III regions of Greece.

Similarly, a number of studies dealing with the study of economic disparities in Europe have highlighted that European economic integration—that is, the Single European Market and Economic and Monetary Union—is contributing to the concentration of economic activity in core areas and, thus, to an increase in regional imbalances. The reasons for this increasing concentration of economic activity are related to the locational behaviour of capital, to the degree of periphericity, and the accessibility of the various regions to major European markets, to variations in productive structure, as well as to existing differences in levels of technological and human capital development (Amin et al, 1992; Brülhart and Torstensson, 1996; Camagni, 1992; EC, 1999; Midelfart-Knarvik et al, 2000; Rodríguez-Pose, 1998). Most of these arguments have been made from a theoretical perspective. The number of empirical studies on the impact of integration on intranational disparities is still rather small.

3.2 Towards a synthetic dynamic framework

Although more than four decades have passed since Solow (1956) and Myrdal (1957) set the theoretical grounds for the debate on the relationship between economic growth and regional disparities, subsequent theoretical and empirical work has not managed to reconcile these two views in one model and provide direct evidence in favour of one or the other.[4] The majority of the existing convergence analyses, thanks to the inherent shortcomings mentioned earlier, has been unable to incorporate in a model these two competing hypotheses and to test directly for their validity. The questions thus still remain largely unanswered. Are advanced countries bound to experience over time decreasing levels of disparities, as the NC model and Williamson claim? Are economic cycles a driving force of regional disparities, as Berry argues? Are the two seemingly opposite views compatible? Do changes in the external environment, such as the process of EU integration, have an impact on the direction and the level of disparities?

We aim to answer these questions by constructing a general model of regional imbalances, growth, and integration, which is presented in equation (4).

$$r_{i,t} = f(g_{i,t}, y_{i,t}, s_{i,t}), \qquad f_g > 0, \quad f_y < 0, \quad f_s >< 0,$$
$$i = 1, ..., N, \qquad t = 1, ..., T. \tag{4}$$

The dependent variable of the model (r) is a measure of regional disparity within each country i over a time period t. The first independent variable (g) measures national GDP growth rates, the second (y) measures GDP per capita, and the third (s) is a measure of national integration within the group of countries under consideration.

According to our hypothesis, an economic-cycle-driven process of regional disparities implies, ceteris paribus, that higher national growth rates will result in a higher level of regional disparities ($f_g > 0$). This means that, in the short to medium term, market processes will (at least initially) trigger cumulative effects, bringing about greater differences. Recent explanations of this initial cumulative character of market processes include the new economic geography emphasis on the interplay of agglomeration economies, backward and forward linkages, critical threshold, and market size (Krugman, 1991; 1993a), and the endogenous growth focus on increasing returns to scale of investment in knowledge-intensive activities (Romer, 1986).

In our framework we introduce long-term development processes, represented by variable y, in an inverse causal relation with regional disparities ($f_y < 0$). This can be justified either on the basis of the traditional NC arguments, or on the basis of

[4] Camagni (1992) has made the claim that disparities tend to increase in the short to medium term and to decrease in the long run, without providing any empirical evidence in support of his argument.

diseconomies of agglomeration that may prevail in the long term, after the initial economies of agglomeration have become negative externalities. In other words, we expect, ceteris paribus, more developed countries and regions to benefit from greater processes of spread, ultimately leading to lower spatial imbalances than in less developed countries.

The proposed setting of the model implies that, in principle, both short-term processes (for periods of time less than one short business cycle) and long-term processes (for periods of time that expand beyond one short business cycle) are in operation at the same time, with forces exerting conflicting influences on internal regional structures. This specification allows for the possibility that both processes have significant temporal impacts, the magnitude of which can be estimated empirically and separately.

We do not have a priori expectations about the impact of European integration on internal regional disparities. Although a section of scholarly literature has discussed the possibility of weaker or less-developed member states being put under greater pressure because of increasing competition at the European level (Padoa-Schioppa, 1987), there has so far been limited discussion on whether this pressure primarily affects more or less advanced regions internally. Petrakos and Saratsis (2000) have claimed that one of the reasons for the decline of regional imbalances in Greece over the last two decades has been the inability of the more advanced and more exposed regions to face stronger competition in increasingly integrated international markets. If this is the case, economic integration may be associated with decreasing internal differences, when the advanced economies within the country are incapable of competing. In the cases in which advanced regions benefit more or lose less from internationalisation, integration may be associated with increasing internal disparities.

4 The model of intranational regional disparities

4.1 The specification of the model

Given the limited number of observations over time and the limited number of member states with complete regional GDP per capita time series in the EU, we resort to the use of seemingly unrelated regression equations (SURE). This specification has the advantage of increased degrees of freedom, while allowing, at the same time, for the estimation of different coefficients for each, or some, of the right-hand variables of the model.(5) The SURE model—specified for eight EU countries and for a period of seventeen years (1981–97)(6)—can be compactly written as

$$\boldsymbol{Y}_i = \mathbf{X}_i \boldsymbol{B}_i + \boldsymbol{e}_i, \qquad i = 1, 2, ..., 8,$$

where each vector $\boldsymbol{Y}_i$ is of dimension (17×1), matrix $\boldsymbol{X}_i$ is of dimension (17×4), and vector $\boldsymbol{B}_i$ is of dimension (4×1).

In a regular SURE estimation the disturbance $(\boldsymbol{e})$ variances are supposed to be constant over time, but different for each equation. Two disturbances in different equations, but at the same time period, will be correlated, if contemporaneous correlation exists.

(5) Pooling techniques were also an option. Fixed and random effects models, random coefficients models, as well as dynamic panel models were conducted with the existing data. However, the regression results were in general inferior and are therefore not reported in the paper.

(6) Because of problems of data availability and comparability, the time period for the analysis is limited to 1981–97. This time constraint has the problem that it takes into account a period when regional convergence was much lower than in the three preceding decades (Armstrong, 1995; Barro and Sala-i-Martin, 1991; Cheshire and Carbonaro, 1995; Molle and Boeckhout, 1995), with the possible implications such a change in overall economic trajectory of EU regions may have for the results of the analysis.

Thus, the covariance for equations (1) and (2), for instance, would be:

$$\text{covar}(e_{1,t}\, e_{2,t}) = \text{E}[e_{1,t} e_{2,t}] = \sigma_{12} ,$$

for a given time period t.

Two disturbances in different equations, and for different time periods [for instance, equation (1) in time period t, and equation (2) in time period $t+1$] are uncorrelated:

$$\text{covar}(e_{1,t}\, e_{2,t+1}) = \text{E}[e_{1,t} e_{2,t+1}] = 0, \qquad \text{for time periods } t \text{ and } t+1.$$

The covariance matrix, Ω, of the joint disturbances for the regular SURE would be:

$$\Omega = \text{E}[\mathbf{e}\mathbf{e}^{\text{T}}] = \mathbf{\Sigma} \otimes \mathbf{I}_T ,$$

where for the tth observation, for instance, the $M \times M$ covariance matrix of the disturbances, $\mathbf{\Sigma}$ is given by

$$\mathbf{\Sigma} = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \cdots & \sigma_{1M} \\ \sigma_{21} & \sigma_{22} & \cdots & \sigma_{2M} \\ & \vdots & & \\ \sigma_{M1} & \sigma_{M2} & \cdots & \sigma_{MM} \end{bmatrix},$$

and $\mathbf{I}_T$ is an identity matrix (see Greene, 2002).

In this paper each cross-sectional unit represents a time series for a particular country. It is likely that these time series will exhibit serial correlation. It is for this reason that the regular SURE model is extended to allow for the presence of autocorrelation, and it is assumed that:

$$\boldsymbol{Y}_i = \mathbf{X}_i \boldsymbol{B}_i + \boldsymbol{u}_i ,$$

and

$$u_{i,t} = \rho_{i,t} u_{t-1} + v_t ,$$

where v_t is uncorrelated across observations (see, for instance, Greene, 2002; Judge et al, 1985). The autocorrelation coefficients, as estimated by LIMDEP,(7) are equal to $(1 - \frac{1}{2}\text{DW}_i)$, where DW_i is the Durbin–Watson statistic using the single-equation, equation-by-equation ordinary least squares residuals.

The calibration of the model for each country will have a different measure of fit, given by the adjusted R^2 for each separate equation. However, a measure of fit for the whole system of equations is also estimated here. The estimation process of adjusted R^2 for a whole SURE system is given in standard econometrics textbooks, based on McElroy's (1977) formulation.(8) However, Buse (1979) gives a more extensive presentation of the estimation method, especially for the case in which the disturbances are autocorrelated.

The estimated system of regressions is given by equation (5):

$$r_{i,t} = \beta_{0,i} + \beta_{1,i} g_{i,t} + \beta_{2,i} y_{i,t} + \beta_{3,i} s_{i,t} + u_{i,t} , \tag{5}$$

$$u_{i,t} = \rho_i u_{i,t-1} + v_{i,t}, \qquad i = 1, ..., 8, \qquad t = 1, ..., 17, \qquad N_{i\times t} = 136,$$

where $r_{i,t}$ is a measure of regional imbalances for each of the eight countries in our sample ($i = 1, ..., 8$) over the period 1981–97 ($t = 1, ..., 17$), $g_{i,t}$ is a measure of national growth performance, $y_{i,t}$ measures the national level of development of each

(7) LIMDEP 8.0 was used for the empirical estimation of the model.

(8) An introductory presentation can be found, for instance, in Greene (2002) or Judge et al (1985).

country, $s_{i,t}$ measures the degree of economic integration of each country with the EU, and N is the total number of observations.

4.2 The variables

The dependent variable $r_{i,t}$ is the population-weighted coefficient of variation estimated for each country on the basis of regional data provided at the NUTS II level for the entire period under consideration:

$$r_{i,t} = \frac{1}{\bar{x}_{i,t}} \left\{ \sum \left[(x_{i,j,t} - \bar{x}_{i,t})^2 \left(\frac{p_{i,j,t}}{p_{i,t}} \right) \right] \right\}^{1/2},$$

Table 3 provides information for $r_{i,t}$ for the eight member states of the EU, with more than one region and for which complete series of regional GDP data are available for the entire period 1981 – 97. These countries are in alphabetical order: Belgium, France, Greece, Italy, the Netherlands, Portugal, Spain, and the United Kingdom. Figure 3 (over) shows the evolution of the population-weighted coefficient of variation for some of these countries.(9)

Table 3. Weighted coefficient of variation ($r_{i,t}$) for GDP per capita at the NUTS II level.

Countries	1981	1990	1997
France	0.261	0.315	0.321
United Kingdom	0.303	0.307	0.310
Italy	0.265	0.258	0.271
Portugal	0.332	0.268	0.232
Spain	0.180	0.201	0.212
Belgium	0.160	0.163	0.171
Greece	0.131	0.122	0.158
Netherlands	0.266	0.103	0.123

On the basis of this information a number of interesting observations can be made: first, there are significant differences in the levels of disparities among EU members in terms of GDP per capita. France, the United Kingdom, and Italy seem to experience relatively higher regional differences, and Belgium, Greece, and the Netherlands relatively lower. Second, if the adjustment of the Dutch regional accounts is not taken into consideration, disparities have increased in seven out of the eight countries included in the analysis during the period under consideration, Portugal being the only exception [see footnote (9)]. Third, figure 3 provides evidence of—in addition to the linear upwards or downwards trend—an observable cyclical behaviour in the evolution of $r_{i,t}$ in most countries, which indicates the influence of economic cycles on regional disparities and provides support for our basic hypothesis in equation (5).

Independent variables $g_{i,t}$ and $y_{i,t}$ are measured by real GDP growth rates and real GDP per capita in the period 1981 – 97 (European Economy, 2000), respectively. Finally, independent variable $s_{i,t}$ which is a proxy for European integration, is measured for

(9) The sharp declines in the weighted coefficient of variation ($r_{i,t}$) in the Netherlands and Portugal during the 1980s respond to different factors in both countries. In the Netherlands the fall is purely the result of changes in the national accounting system: the GDP of its richest region, Groningen, fell sharply after it was decided to assign revenues from North Sea oil and gas pits to the whole of the country, instead of just to the province of Groningen. In Portugal the sharp fall in the coefficient of variation corresponds to the wild fluctuations in the GDP of the region of Alentejo during the 1980s. As a consequence, results for Portugal should be viewed with caution.

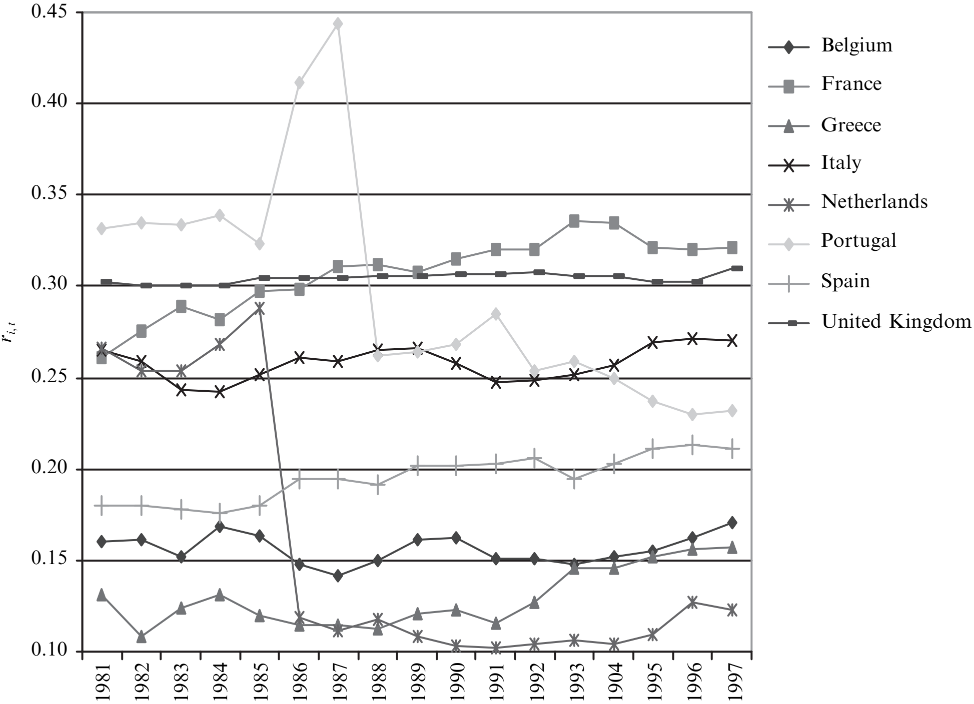

Figure 3. Weighted coefficient of variation ($r_{i,t}$) for GDP per capita in NUTS II regions (1981 – 97).

each country by the ratio of its intra-EU trade:

$$s_{i,t} = \frac{X_{i,t}^{\mathrm{EU}} + M_{i,t}^{\mathrm{EU}}}{X_{i,t} + M_{i,t}},$$

where the assumption is that higher ratios of intra-EU trade imply a higher ratio of integration among member states.

4.3 The results of the model

Equation (5) is estimated using a SURE – autocorrelation-corrected model and the results are reported in table 4 (over). In order to test for cross-border validity of our hypotheses and also to improve the robustness of the model, we have imposed restrictions on β_1 and/or β_2 coefficients. As a result, we have estimated three alternative models. The first makes the assumption that the impact of growth on disparities is the same for all countries; the second makes the same assumption for GDP per capita levels; and the third makes the same assumption for both variables.

The results of the estimation confirm the hypotheses presented in equation (5). We observe that in all three models the coefficients of growth ($\beta_{1,i}$) are positive and statistically significant, whereas the coefficients of GDP per capita ($\beta_{2,i}$) are negative and statistically significant. The overall explanatory power of the model, given by the adjusted R^2, is satisfactory, ranging from 54% to 60%. As a result, our analysis provides evidence to support the claim that growth performance and the overall level of development significantly affect the evolution of regional imbalances in each member state of the EU. Ceteris paribus, economies with a faster rate of growth will tend to experience a higher increase in regional disparity, whereas countries with a higher GDP per capita will tend to experience lower levels of disparity. It becomes clear that, in the countries under examination, both cumulative causation and neoclassical types of processes are present, exerting their influence on regional differences in opposite directions.

The impact of economic integration on regional disparity varies from country to country. The coefficient of integration ($\beta_{3,i}$) is in all models positive and significant in the case of France and Spain, negative and significant in the case of Belgium, the Netherlands, and Portugal, and insignificant in the case of Greece, Italy, and the United Kingdom. A positive and significant coefficient here implies that, as a country becomes more integrated within the EU, its internal imbalances tend to increase. These results are difficult to interpret and further research on the link between trade integration and disparities is needed before any firm conclusions can be reached. In any case, it is worth noting that France and Spain, the two countries with a positive and significant coefficient, are relatively large countries in the EU context and also share an increasing coefficient of variation and increasing imbalances during the 1981 – 97 period. On the other hand, Belgium, the Netherlands, and Portugal, the three countries with a negative and significant coefficient, are by contrast relatively small. These observations justify (at least) two hypotheses with respect to the impact of integration on regional disparities. The first (and rather unlikely) questions a possible 'size effect', conditioning this impact on country size, whereas the second, focusing on the examples of France and Spain, draws attention to a possible 'cumulative' effect, by which integration increases disparities in countries experiencing already increasing disparities. In other words, the opening of borders to trade is likely to amplify internal trajectories, by making the wealthier regions more capable of competing in integrated markets, while leaving the poorer regions increasingly dependent on public employment and state and European transfers, rather than on viable entrepreneurial activities, as a consequence of their lack of competitiveness in more integrated markets (Rodríguez-Pose and Fratesi, 2004).

This divergent trajectory of well-off and lagging regions thus helps explain the results of table 4, as in periods of faster growth the contrast between the dynamism of well-off regions, with competitive market-oriented sectors, and the lethargy of lagging regions, with an economy largely dependent on non-market-oriented services and transfers, will be greater than in periods of slow growth or economic decline. Indeed, in periods of slow growth, open and more competitive regions are likely to grow at a slower pace than poorer and less open regions, as the latter will be more sheltered from the downturn because of their greater reliance on non-market-oriented sectors. This procyclical process of divergence in periods of higher growth and convergence in periods of lower growth will be more evident in countries with relatively large internal imbalances. In Italy, Britain, or Spain, where the level of internal disparity is greater than in the Netherlands, Greece, or Germany (excluding the new Länder), the procyclical cycle of convergence/divergence is likely to have a greater momentum, as the significant contrast between the core regions (for example, Madrid, Catalonia, Lombardy), with a large pool of competitive firms, and regions in the periphery (for example, Basilicata, Calabria, Extremadura), relatively sheltered from the market, will contribute to the relative decline of the sheltered regions in periods of economic expansion exceeding the relative catch-up of the economic downturns.

5 A model of intra-EU disparities at the national level

At this point, we consider it important to raise a question about the geographical level of aggregation at which the forces of concentration and dispersion are discussed before we determine regional imbalances. Are intra-EU disparities among members states also affected by economic cycles? Are our findings at the national level also applicable at the European level?

Table 4. SURE (seemingly unrelated regression equations) and autocorrelation-corrected regression equations).

Parameter	Model 1[a]		Model 2[b]		Model 3[c]	
	parameter estimate	t-value	parameter estimate	t-value	parameter estimate	t-value
Belgium						
β_{01}	0.308	8.49***	0.310	8.56***	0.283	7.92***
β_{11}	0.011	2.76***	0.013	3.42***	0.008	2.15**
β_{21}	−0.008	−2.13	−0.011	−2.86***	−0.008	−2.16**
β_{31}	−0.211	−4.29***	−0.215	−4.37***	−0.172	−3.56***
ρ_1	0.337		0.337		0.337	
Adjusted R_1^2	0.509		0.510		0.313	
France						
β_{02}	−0.009	−0.27	−0.008	−0.23	0.002	0.06
β_{12}	0.011	2.76***	0.006	1.62	0.008	2.15**
β_{22}	−0.015	−3.57***	−0.011	−2.86***	−0.008	−2.16**
β_{32}	0.522	9.19***	0.524	9.21***	0.495	9.00***
ρ_2	0.166		1.666		1.666	
Adjusted R_1^2	0.788		0.780		0.713	
Greece						
β_{03}	0.117	2.96***	0.118	2.99***	0.113	2.98***
β_{13}	0.011	2.76***	0.010	2.52**	0.008	2.15**
β_{23}	−0.012	−2.86***	−0.011	−2.86***	−0.008	−2.16**
β_{33}	0.022	0.35	0.019	0.31	0.031	0.51
ρ_3	0.747		0.747		0.747	
Adjusted R_2^2	0.506		0.507		0.507	
Italy						
β_{04}	0.275	11.68***	0.275	11.68***	0.269	11.62***
β_{14}	0.011	2.76***	0.013	3.07***	0.008	2.15**
β_{24}	−0.009	−2.39**	−0.011	−2.86***	−0.008	−2.16**
β_{34}	−0.035	−0.85	−0.037	−0.88	−0.020	−0.48
ρ_4	0.524		0.524		0.524	
Adjusted R_4^2	0.311		0.320		0.276	
Netherlands						
β_{05}	0.978	2.92***	0.968	2.89***	0.966	2.94***
β_{15}	0.011	2.76***	0.005	0.56	0.008	2.15**
β_{25}	−0.016	−2.03**	−0.011	−2.86***	−0.008	−2.16**
β_{35}	−1.183	−2.43**	−1.161	−2.39**	−1.178	−2.48**
ρ_5	0.386		0.386		0.386	
Adjusted R_5^2	0.428		0.435		0.411	
Portugal						
β_{06}	0.580	7.25***	0.579	7.37***	0.547	7.18***
β_{16}	0.011	2.75***	0.014	2.31**	0.008	2.15**
β_{26}	−0.007	−1.34	−0.011	−2.86***	−0.008	−2.16**
β_{36}	−0.424	−3.54	−0.423	−3.61***	−0.364	−3.35***
ρ_6	0.165		0.165		0.165	
Adjusted R_6^2	0.260		0.249		0.219	
Spain						
β_{07}	0.131	14.63***	0.129	14.44***	0.134	15.13***
β_{17}	0.011	2.76***	0.012	2.99***	0.008	2.15**
β_{27}	−0.010	−2.58**	−0.011	−2.86***	−0.008	−2.16**
β_{37}	0.102	6.97***	0.105	7.23***	0.102	7.26***
ρ_7	0.417		0.417		0.417	
Adjusted R_7^2	0.860		0.860		0.854	

Table 4 (continued).

Parameter	Model 1[a]		Model 2[b]		Model 3[c]	
	parameter estimate	t-value	parameter estimate	t-value	parameter estimate	t-value
United Kingdom						
β_{08}	0.292	22.03***	0.293	22.08***	0.283	21.69***
β_{18}	0.011	2.76***	0.011	2.76***	0.008	2.15**
β_{28}	−0.011	−2.85***	−0.011	−2.86***	−0.008	−2.16**
β_{38}	0.019	0.74	0.018	0.72	0.035	1.41
ρ_8	0.179		0.179		0.179	
Adjusted R_8^2	0.219		0.225		0.236	
Model adjusted R^2		0.595		0.601		0.548

*** and ** denote statistical significance at 1% and 5% levels, respectively.
[a] Model 1 is estimated with the constraint:

$$\beta_{1,1} = \beta_{1,2} = \beta_{1,3} = \beta_{1,4} = \beta_{1,5} = \beta_{1,6} = \beta_{1,7} = \beta_{1,8}.$$

[b] Model 2 is estimated with the constraint:

$$\beta_{2,1} = \beta_{2,2} = \beta_{2,3} = \beta_{2,4} = \beta_{2,5} = \beta_{2,6} = \beta_{2,7} = \beta_{2,8}.$$

[c] Model 3 is estimated with the constraints:

$$\beta_{1,1} = \beta_{1,2} = \beta_{1,3} = \beta_{1,4} = \beta_{1,5} = \beta_{1,6} = \beta_{1,7} = \beta_{1,8}, \text{ and,}$$
$$\beta_{2,1} = \beta_{2,2} = \beta_{2,3} = \beta_{2,4} = \beta_{2,5} = \beta_{2,6} = \beta_{2,7} = \beta_{2,8}.$$

Figure 4 (see over) depicts the population-weighted coefficient of variation (r_t) of GDP per capita of the fifteen member states of the European Union for the period 1960–2000, on the right y-axis. The figure also includes the GDP growth rate of the EU in the same period, on the left y-axis. We first observe that disparities among member states have decreased considerably over the period under examination. Second, disparities seem to follow a cyclical pattern of change, which is related to the pattern of economic performance of the EU, with imbalances increasing during the crises of the mid-1970s and early 1990s and decreasing during the expansions of the 1960s, 1980s, and late 1990s. Third, disparities remained higher in the 1960s and the early 1970s, when GDP growth rates were also high, and declined in the 1980s and the 1990s, when growth rates became significantly lower.

In order to examine whether our findings are also valid at the EU level, we estimate equation (6) using generated least squares, which allows for the correction of autocorrelation in the residuals:

$$r_t = \gamma_0 + \gamma_1 g_t + \gamma_2 y_t + \gamma_3 s_t + u_t\,, \tag{6}$$
$$u_t = \rho u_{t-1} + e_t\,, \qquad N = 41\,.$$

The dependent variable r_t is the population-weighted coefficient of variation of the GDP per capita of member states, presented in figure 4. The independent variables g_t and y_t are the GDP growth of the EU-15 (figure 4) and the GDP per capita of the EU-15, respectively, for the period 1960–2000. Finally, s_t represents the share of total trade that takes place within the EU. The results of the estimation are reported in table 5 (see over).

The results show that γ_1, the coefficient of GDP growth, is positive and significant, providing evidence that aggregate economic growth in the EU tends to have, ceteris paribus, a cumulative character, favouring advanced countries and increasing intra-EU

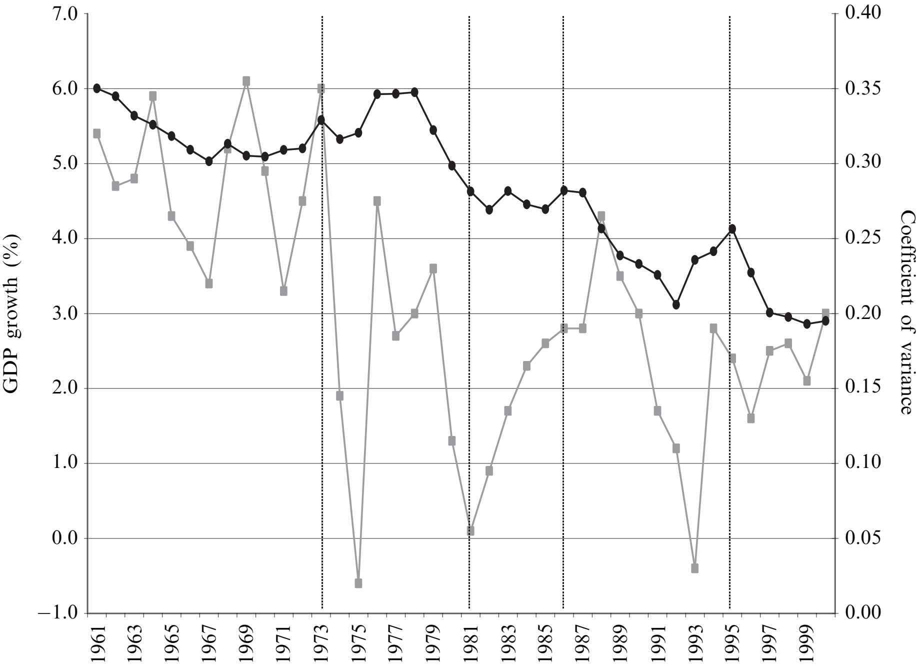

Figure 4. GDP growth (solid line) and country-based weighted coefficient of variance (shaded line) in the EU, 1960 – 2000.

differences in the period 1960 – 2000. We also observe that γ_2, the coefficient of GDP per capita, is negative and significant, providing evidence that spread effects associated with higher levels of GDP per capita are also in operation during the same period. This apparently contradictory mixture of a cumulative character of economic growth at the EU level (γ_1) combined with the existence of relatively powerful spread processes (γ_2) could help explain the trajectory of international convergence with intranational divergence observed in the EU over the last couple of decades (Esteban, 1994; Puga, 2002; Rodríguez-Pose, 1998). It also concurs with Fingleton's (2004) evidence that faster economic growth in core areas, while generating spillovers that could be reaped by the periphery, tends to generate greater, rather than lower, regional imbalances. The coefficient of integration (γ_3) is negative, but insignificant, implying that this model cannot provide any evidence for the impact of EU integration on intra-EU disparities.

Table 5. Generated least squares, autocorrelation-corrected parameter estimates.

Parameter	Parameter estimate	*t*-value
γ_0	0.315	6.64***
γ_1	0.016	2.39***
γ_2	−0.0008	−3.79**
γ_3	−0.83	−1.02
ρ	0.907	
Adjusted R_1^2	0.830	

*** and ** denote statistical significance at 1% and 5% levels, respectively.

6 Conclusions

In this paper we have tried to shed some additional light on the evolution of disparities across states and regions in the EU and have proposed a theoretical and empirical model, which allows for short-to-medium-term processes related to economic cycles and long-term processes related to diverse levels of GDP per capita to have an independent impact on regional imbalances. Our results indicate, first, that disparities at the national and the EU level exhibit a procyclical behaviour in the short term, by increasing in periods of expansion and decreasing in periods of slow growth. Second, they show that long-term processes embodied in the level of development tend to favour a more equal allocation of activities and resources over space. Finally, our results are inconclusive about the impact of economic integration on regional disparities. Although, at first sight, integration seems to amplify existing intranational trends, further analyses are needed before any firm conclusions can be reached.

These findings have implications for theory and policy. On theoretical grounds, our paper has provided evidence that both concentration and dispersion processes are in operation at both the national and the EU level, and possibly at any level of aggregation. This implies that the arguments presented by the two sides of the forty-year old debate are both correct and empirically valid. This is true as much for the mainstream and highly celebrated NC model, as for the 'cumulative' approach. There is only a difference of time horizon. NC effects tend to be stronger in the long term, whereas cumulative effects follow the economic cycle and are more effective in the short to medium term. The question of the relative strength of these two opposite forces of spatial change at different levels of aggregation remains open and should be the subject of further research.

From a policy perspective, our findings provide new evidence for the increasing number of voices that suggest the need to revise current EU regional development policies (Boldrin and Canova, 2001; Puga, 2002; Rodríguez-Pose and Fratesi, 2004). They challenge the widely held belief that economic growth is paramount for the reduction of regional imbalances (compare EC, 1999) and come to the support of the idea of building a more flexible framework where not only growth, but also economic cycles and the level of disparities within any given country, should be taken into consideration, if development policies are likely to improve their impact. The evidence that intranational and intra-EU disparities have a procyclical character and tend to increase in periods of economic expansion implies that, no matter what other factors may affect the evolution of disparities, economic growth will always generate new imbalances. Our findings, thus, suggest that, during the period of analysis, economic growth has not been a force in curbing regional imbalances and that regional policies should adopt a more procyclical rather than an anticyclical dimension in order to improve their chances of success.

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