KNOWLEDGE ECONOMY, REGIONAL COHESION AND AGGREGATE COMPETITIVENESS: A CONTRADICTION?

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Abstract

This paper aims to shed some further light on the empirical aspect of the possible contradiction between "regional cohesion and aggregate competitiveness". It does so with reference to the NUTS-2 regions of the European Union. The empirical analysis is conducted in terms of a model that emphasises knowledge creation and adoption in the process regional growth. Taken as a whole, we think that the empirical results are important for the ongoing debate about the dilemma between regional convergence and overall competitiveness.

The econometric results suggest a "development gap" across the regions of the European Union. Further inspection of the data indicates certain areas of policy intervention in a way to overcome the possible contradiction between 'regional cohesion and aggregate.

A classification of areas based on the notions of persistence, divergence and the conditions identified in this paper may provide a useful framework for policy development at the regional level. There is a need to rethink regional policy along the lines of the implementation of more innovative and region-specific development strategies. Hence, new analytical tools are needed. The relatively fragmented nature of the spatial patterns of mobility and persistence suggests that broad administrative regions are a poor basis for the implementation of policy

***Keywords*:** Regional Cohesion, Regional Policy , EU, divergence.

JEL: C21; O18; R11

1. INTRODUCTION

'Europe 2020', aims to make the European Union (EU) the most competitive and dynamic economy in the world. The transformation to a knowledge and service economy is profound as the earlier changeover from agriculture to industry. However, it might be argued that this aim is in sharp contrast to another major aim of the EU, that of regional cohesion/convergence. This contradiction has received surprisingly little attention thus far. Although some theoretical attempts have been made (e.g. Mancha-Novarro and Garrido-Yserte, 2008), nevertheless empirical studies are rather rare. This paper attempts to approach this issue empirically using a model that attributes the process of regional cohesion and overall competitiveness to the degree that the regions of the EU are able to *absorb* technology. To complete this introduction, mention must be made to the structure of this paper. The next section provides an overview of the issue of regional cohesion and competitiveness. These considerations are introduced in the ambit of a single model in section 3. The model is submitted to the usual econometric tests yielding the main findings in section 4. Section 5 concludes the paper.

2. THE OVERALL CONTEXT

'Economic and social cohesion', is mentioned in the Preamble of the Treaty of Rome and has become one of the major goals of the EU. This is formulated in the Single European Act (title XIV, currently title XVII, Articles 2 and 4). According to Article 158 of the Rome Treaty 'reducing disparities between the levels of development of the various regions and the backwardness of the least favoured regions or islands, including rural areas' is one of the primary objectives of EU development policies. This objective can be justified on the ground that 'imbalances do not just imply a poorer quality of life for the most disadvantaged regions and the lack of life-chances open to their citizens, but indicate an under-utilisation of human potential and the failure to take advantage of economic opportunities which benefit the Union as a whole' (European Commission, 1996, p. 13). Regional cohesion is seen as vital to the success of several other key policy objectives, such as the single market, monetary union, and EU competitiveness (European Commission, 2004). The strongest argument for regional policies lies in the long-run persistence and even widening of regional disparities. Market forces and social trends are increasing the geographical concentration of activities. Differences in output, labour productivity and income across the regions of the EU are far more extreme than in similar economies such as the US or Japan. The richest regions on the EU are eight times richer than the poorest regions (European Commission, 2004). The primary dimension of income disparities remains East-West, with a weaker North-South dynamic and core-periphery at both EU and national levels. As a result, the EU has implemented a range of development policies and projects (and continues to do so) to achieve regional convergence, such as the Mediterranean Integrated Programs the direction of funds towards less-advanced areas of Europe from sources, such as the European Regional Development Fund (ERDF), the European Social Fund (ESF) – the two 'Structural Funds' – and the 'Cohesion Fund'. The structural funds are now the most important financial instruments for supporting the renewed Lisbon strategy and in some countries were able to increase their GDP by almost 4% (European Commission, 2004). Cohesion policy aims to promote a more balanced territorial development; a policy broader than the 'conventional' regional policy, which is specifically linked to the ERDF. The Structural Funds cover a wide range of areas – technological Research and Development (R&D), the information society, support for business, infrastructure development (transport, telecoms, healthcare and education), energy, risk prevention, the environment, employment, tourism, culture, etc. There are many potential recipients, such as business (especially SMEs), associations, public bodies and individuals. It is up to each country to divide the funds between the EU's 'Convergence Objective' and regions covered by the 'Competitive and Employment Objective'. Countries then use the funds to finance thematic programmes covering the whole country (for instance on environment, transport, etc) or programmes channelling funds to particular regions. Regional policy in the EU has to tackle with an 'inconsistent triangle' (Mancha-Novarro and Garrido-Yserte, 2008): budget restrictions, the aspirations of the new member-states as the main beneficiaries of the European regional policy and the vindication of the cohesion countries (Ireland, Spain, Portugal and Greece) of maintaining their financial resources. The current economic crisis has revealed structural weaknesses in several European regions, irrespective of their level of economic and social or sectoral development. Indeed, some sectors are more vulnerable to crisis than others. For instance, regions with a high share of export-oriented activities, such as tourism, face the challenge of decreasing demand and job-losses. Consequently, the degree of vulnerability of the EU regions is unevenly distributed across Europe. This puts the issue of regional cohesion in Europe in a fresh premise. The enlargement of the EU to 25 Member States, and later to 27, together with the intensification of cooperation between the EU and Norway and Switzerland, presents an unprecedented challenge for the competitiveness and internal cohesion of the Union.

Given this context, the next section attempts to construct an appropriate framework to examine empirically the possible contradiction between the aim of regional cohesion and overall competitiveness.

3. SETTING THE EMPIRICAL CONTEXT

According to the 'conventional' neoclassical model adduces that technology diffusion promotes regional convergence. An implicit assumption of this model is that all regions are able to absorb technology to the same degree, so that the higher the technological gap the higher the effect on growth, ceteris paribus. It may be argued, however, that large gaps do not necessarily promote convergence in this way. A significant technological gap is associated with unfavourable conditions for the adoption of new technological innovations;

an iterative process, building upon the results of R&D activities and in turn inform, and being informed by, new research and innovations in product and processes. Assume that the ability of a region to implement technological innovations (¶) is *endogenously* determined, as a decreasing function of the 'technological proximity', expressed in terms of the *initial* technological gap: $¶_i = f(b_{lf_{i,0}})$, with $f' < 0$, or in a non-linear specification: $¶_i = °b_{lf_{i,0}}^{-®}$ with $°, ® > 0$. Thus, the rate of adoption is not constant but varies across regions, according to the size of the gap. For a given value of $°$, a high technological gap implies a low capacity to absorb technology. The parameter $°$ can be interpreted as a constant underlying rate of diffusion, which would apply to all regions if there were no infrastructure/ resource constraints upon technological adoption. However, the existence of such constraints causes the actual rate to diverge from $°$, depending on the value of *π*, which determines the extent to which the existing gap impacts on the rate of diffusion. Alternatively, the higher the technological gap, the slower the rate of technological adoption ($¶_i$). Assuming that the growth rate of output per-worker (y_i) is an increasing function of $¶_i$: $g_{y_i} = h(¶_i)$ with $h' > 0$, then $g_{y_i} = h(f(b_{lf_{i,0}}))$, with $h' \cdot f' < 0$. Consider a two-region's economy $(i = 1, 2)$ with $b_{lf_{1,0}} - b_{lf_{2,0}} > 0$, and $¶_1 - ¶_2 < 0$, implying that $g_{y_1} - g_{y_2} < 0$. If $(\Delta ¶_{1,2})_t \to \infty$, then $(\Delta b_{lf_{1,2}})_t \to \infty$, as $t \to \infty$ the two regions move towards different directions. Regions with relatively large technology gaps may fall progressively behind. In this example catch-up is feasible only if ¶ increases from $¶_1$ to $¶_1'$, or more generally: $\frac{\partial ¶_i}{\partial t} > 0$. If $(\Delta ¶_{1,2})_t \to 0$, then $(\Delta b_{lf_{1,2}})_t \to 0$, and region 1 converges with region 2.

An aggregate growth and regional cohesion component is normally involved in regional policies. In other words, regional policies are concerned with stimulating growth and competitiveness in the economy as whole (e.g. at the national or the European level) and with narrowing interregional disparities. Nevertheless, these might contradict each other, given that maximising labour productivity of per-capita income at the national level may increase regional income differentials. Indeed, as Richardson (1973) aptly notes, the sum of maximised regional incomes is equal to maximised national income only in a world of perfect competition. The assumption of perfect competition, however, is not applicable to regional economics, since space itself limits competition. Contradictions between the aims of different regions are also common. Measures taken by policy-makers in one region may prevent the achievement of objectives in other regions. It is quite common for regions to compete each other in lobbying the general government for preferential treatment in the allocation of public investment schemes, provision of subsidies and incentives to encourage private investment; the usual tools of regional policy.

Usually, regional policy is directed towards lagging regions. In terms of the model developed in this section, regional policy should aim to increase the adoptive abilities of lagging regions, i.e. the regions with a high initial technological gap. However, a high technological gap might indicate that they lack the necessary conditions to allow for an effective adoption of technology. Investment in regions with high adaptive abilities will increase their growth rates and the growth of the economy as a whole. Regions with low adaptive ability will, however, experience a fall in their growth rates, leading to regional divergence. A 'trade-off' between competitiveness, expressed in terms of aggregate growth, expressed in average terms as $g_{y_i} = \frac{\sum_{i=1}^{n} g_{y_i}}{n}$, and regional convergence seems to be inevitable. Nevertheless, it is possible to identify cases in which the two aims can be achieved simultaneously. For example, transfer payments in poor regions together with investments in advanced regions will increase both regional convergence and overall competitiveness. Which specific measure will be applied depends on the available resources, budget constraints, the time length or the 'tolerable' level of regional inequalities and the weight that policy-makers attach to regional cohesion.

The general framework, discussed in this section will be tested empirically in an extensive regional context, viz. the NUTS-2 regions of Europe[1]. Regional cohesion is approximated using two alternative tests, *absolute* and *conditional* convergence:

[1] Nomenclature des Unités Territorial les Statistiques.

$$g_i = a + b_1 y_{i,0} + \pounds_i \qquad (1)$$

$$g_i = a + b_1 y_{i,0} + b_{\mathbf{X_i}} \mathbf{X_i} + \pounds_i \qquad (2)$$

where $g_i = (y_{i,T} - y_{i,0})$ is the growth rate and $\pounds_i$ is the error-term. The rate of convergence is calculated as $= -[\ln(b_1 + 1)]/T$, where T is the number of years in the period. Absolute convergence is signalised by $b_1 < 0$. Conditional convergence is based upon the argument that different regional characteristics will lead to different steady-states. A test for conditional convergence, with variables representing technology, is more suitable to accommodate the empirical analysis.

Technical change originates either from within the region, namely indigenous innovation (Θ_i), or technological spillovers from adopting innovations created elsewhere (Ξ_i). In the former case, technical change may be approximated in terms of the 'Human Resources in Science and Technology' (HRST), i.e. persons who have completed a tertiary education in a field of science or technology and/or are employed in science and technology. The second source of technical growth is approximated as the percentage of total employment in technologically dynamic sectors, which indicates a capacity for technology adoption, since these are taken to apply high technology. These two variables are in accordance with the notion of 'smart growth', i.e. strengthening knowledge and innovation as drivers of future growth. The Lisbon strategy, and its successor 'Europe 2020', aims to make Europe the most competitive and dynamic knowledge-based economy in the world capable of sustainable growth (promoting a more resource efficient, greener and more competitive economy) with more and better jobs and greater social and territorial cohesion (inclusive growth).

A target set is the EU as whole to reach R&D intensity above 3%, responding to the new world-wide division of labour and globalisation. This target is set by the Barcelona Council in 2002 and maintained in the 'Europe 2020' strategy. R&D spending in Europe, however, is below 2%, compared to 2.6% in the US and 3.4% in Japan, mainly due to low levels of private investment. It would take more than 50 years for Europe to reach the US level of innovation performance. Only 10% of the EU regions were able to reach this target. In 2007, only 19 out of 287 NUTS-2 regions, corresponding to only (6.6%) were able to meet the target of 3%. These include regions Pohjois-Suomi, Länsi-Suomi and Etelä-Suomi in Finland, Stockholm, Östra Mellansverige, Västsverige and Sydsverige in southern Sweden, seven regions in Germany (Dresden, Oberbayern, Darmstadt, Karlsruhe, Unterfranken, Stuttgart and Berlin), two in France (Île-de-France and Midi-Pyrénées) and Austria (Wien and Steiermark) and one in the Netherlands (Noord-Brabant). In some of these regions, capital-cities are located (e.g. Paris, Vienna, Berlin, Stockholm and Helsinki), providing support to the argument that R&D expenditure are higher in the urban areas of Europe.

Therefore, a 'technologically-conditioned' model of regional growth and convergence can be expressed in terms of the following dynamic regression equation:

$$g_i = a + b_1 y_{i,0} + b_2 \ln \Theta_{i,0} + b_3 \ln \Xi_{i,0} + \pounds_i \qquad (3)$$

The time dimension of variables describing technology refers to the initial time. From an econometric point of view, this helps to avoid the problem of endogeneity. Moreover, Pigliaru (2003) claims that models which include measures of technology require data on total factor productivity. In the absence of such data, econometric estimation requires that the technological variables ought to be included in initial values. Broadly speaking, it is anticipated that $b_2 > 0$, since high levels of innovation are normally associated with high levels of growth and vice versa. However, it is not automatically the case that this condition promotes convergence. If poor regions have a low level of $\Theta_{i,0}$, then no significant impacts on growth are anticipated and, hence, it may be difficult to converge with advanced regions. The latter case is the more likely. The $\Xi_{i,0}$ variable reflects two distinct features, namely the initial level of 'technological adoption' and the degree to which existing conditions in a region allow further adoption of technology. A low level of $\Xi_{i,0}$ combined with a high rate of growth may indicate, ceteris paribus, that less advanced regions are able to adopt technology, which is transformed into high growth rates and, subsequently to converge with the advanced regions. Conversely, a low value for $\Xi_{i,0}$ may indicate that although there is significant potential for technology adoption, infrastructure conditions are not appropriate to technology adoption and, therefore, there are no significant impacts on growth. If the latter effect dominates then convergence between technologically lagging and advanced regions is severely constrained.

4. ECONOMETRIC APPLICATION

In this paper we exploit data on Gross Value Added (GVA) per-worker since this measure is a major component of differences in the economic performance of regions and a direct outcome of the various factors that determine regional competitiveness (Martin, 2001). EUROSTAT is the main source for data used in this paper. The regional groupings used in this paper are those delineated by EUROSTAT and refer to 267 NUTS-2 regions. Even a cursory analysis of the EU-27 data (Figure 1) suggests that the inverse relationship between growth rate and initial level of labour productivity is not so obvious. The presence or absence of regional convergence, however, cannot be confirmed by visual inspection alone. Therefore, the models of absolute and conditional convergence are estimated econometrically (Table 1). Estimation of equation (1) suggests that the regions of the EU converge at a low rate (0.65% per-annum)

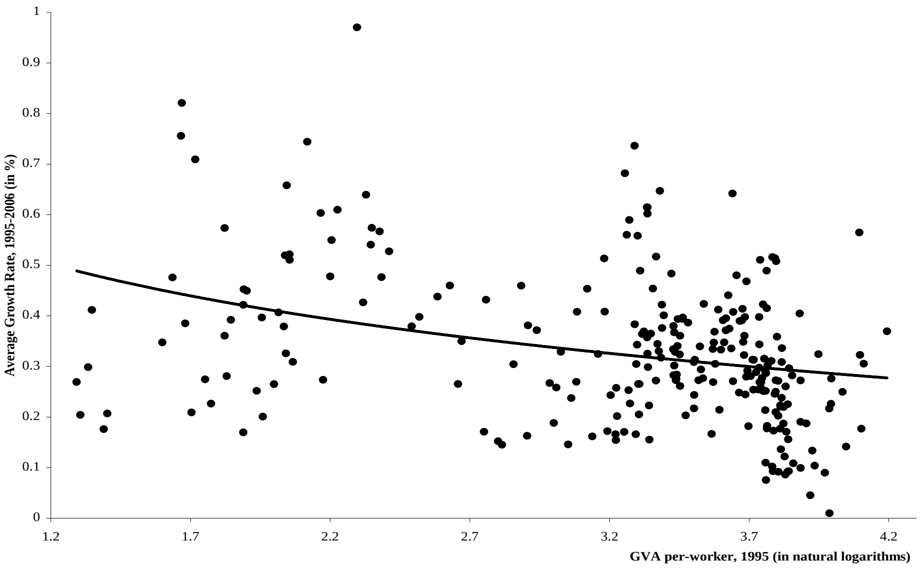

Figure 1: Absolute Convergence

Table 1. Regional Convergence, GVA per-worker, EU regions: 1995-2006

Depended Variable: g_i, n = 267 NUTS-2 Regions, OLS	Equation (1)	Equation (3)
a	0.5714**	0.6144**
b_1	-0.0747**	-0.0825**
b_2		0.0014
b_3		0.0203*
Implied	0.0065**	0.0071**
LIK	147.552	148.832
AIC	-291.104	-289.663
SBC	-283.929	-275.314

Notes: ** indicates statistical significance at 95% level of confidence, * 90% level. AIC, SBC and LIK denote the *Akaike*, the *Schwartz-Bayesian* information criteria and Log-Likelihood, respectively.

A positive coefficient is estimated for the variable describing technology creation, which does not necessarily promote convergence as such, since regions with relatively high initial level of innovation exhibit relatively higher rates of growth. A positive value for the $\Xi_{i,0}$ variable is also estimated. This suggests that, on average, regions with low values of $\Xi_{i,0}$ at the start of the period grow slower than regions with high values, ceteris paribus. If technologically backward regions were successful in adopting technology, which subsequently is transformed into faster growth, then the estimated coefficient b_3 would be negative. Since $b_3 > 0$, this indicates that infrastructure conditions in lagging regions are inhibiting this process of technology adoption. Technology adoption, although it might be the best 'vehicle' for lagging regions, nevertheless, this is a process which might be difficult, especially during the early stages of development when conditions are least supportive. Normally, conditional convergence implies a slower rate of convergence. Nevertheless introducing the technological variable increases the estimated rate of convergence (0.71%). *If* regions did not vary in their initial level of technology creation and adoption, there would be a strong tendency for 'poor' regions to grow faster than 'rich' ones.

The superiority of the model described by equation (3) is supported by both the criteria for model selection applied here, namely the *Akaike* (AIC) and the *Schwartz-Bayesian* (SBC) information criteria[2] and the value of the Log-likelihood (LIK), which increases with the introduction of the technological variables.

The empirical analysis is extended further by estimating a model that incorporates the possibility of 'club-convergence'. Although, there are several approaches for identifying convergence-clubs nevertheless, the empirical analysis is based upon application of Baumol and Wolff's (1988) specification: $g_i = a + b_1 y_{i,0} + b_2 y_{i,0}^2 + £_i$. A pattern of club-convergence is established if $b_1 > 0$ and $b_2 < 0$. Members of a convergence-club are identified as those regions which exhibit an inverse relation between the growth rate and initial level of GVA per-worker and exceed a threshold value of initial GVA per-worker, calculated as: $y^* = -b_1 / 2b_2$. Of particular importance, from a policy point of view is the impact of the technological variables. Thus, introducing these variables in a club-convergence context yields the following regression equation:

$$g_i = a + b_1 y_{i,0} + b_2 y_{i,0}^2 + b_3 \ln \Theta_{i,0} + b_4 \ln \Xi_{i,0} + £_i \qquad (4)$$

The obtained results are reported on Table 2.

Table 2**. Club-Convergence**

Depended Variable: g_i, n = 267 NUTS-2 Regions, OLS	Equation (4)
a	-0.1226
b_1	0.4486**
b_2	-0.0922**
b_3	-0.0124
b_4	0.0439**
Implied y^*	2.43**

Note: ** indicates statistical significance at 95% level of confidence, * 90% level.

The coefficients b_1 and b_2 have the appropriate signs suggesting the existence of two groups across the EU-27 regions; one which includes regions with $y_{i,0} - y^* > 0$ and another including regions with $y_{i,0} - y^* < 0$. The former group corresponds to the convergence-club while the latter constitutes a diverging-club. Turning to the impact of the other explanatory variables, a statistically significant coefficient at the 95% level is obtained for the adoptive variable only. The $\Theta_{i,0}$ variable indicates a negative relationship with growth for the overall period, which can be interpreted as a source of convergence. The condition $b_4 > 0$, however, suggests a substantial barrier to the diffusion of technology across the regions of the EU-27. In the lagging, and remote geographically regions of the EU, the adoption process is not immediate and these regions generally access innovations at a later stage. If this time-lag remains then regional disparities in the EU, and the centre-periphery pattern, will take a persisting character.

In this light, regional policy should first identify which regions in a diverging-club are characterised by relative high adoptive levels. These regions have more possibilities to innovate if they are connected to central regions, as Rodríguez-Pose and Crescenzi (2008) argue. Improving conditions in these regions will, therefore, increase their growth rates, enabling them, in a subsequent period, to join the initial convergence-club. This will cause positive effects to the degree of competitiveness of the EU-27, as a whole, improving at the same time the *long-run* process of regional convergence. In this context, a critical question arises: which particular conditions should be the target of regional policy? Accordingly, it may be adequate, but with much caution, to associate the prevailing conditions in the diverging group with a series of structural elements that characterize the regions

[2] As a rule of thumb, the best fitting model is the one that yields the minimum values for the AIC or the SBC criterion.

in this group. Although it is beyond the scope of this paper to go into detail, nevertheless it is worth mentioning that the list of these elements includes the usual suspects such as science, technology, which constitute the focus of the econometric specification, R&D and conditions related to the structure of the regional economy.

5. CONCLUSIONS AND POLICY IMPLICATIONS

In this paper an attempt was made to approximate the contradiction between regional cohesion and overall competitiveness empirically. Taken as a whole, we think that the empirical results are important for the ongoing debate about the dilemma between regional convergence and overall competitiveness. Such a study is, by its very nature, limited; it simplifies a complex reality. 'Spatial development is increasingly understood as a complex, multi-dimensional phenomenon and the illusion about the existence of simple, short-cut strategies is progressively abandoned' (Camagni and Capello, 2010, p. 12). Nevertheless, an important point to grasp, from a policy perspective, is that it is possible to overcome the potential contradictions between the aims of regional policy, if policy-makers implement appropriate policy measures. A policy tool identified in this paper is related to the impact of technology adoption in the process of regional growth and cohesion. Technology adoption, however, is not a simple and automatic process. Instead, it requires that lagging regions should have the appropriate infrastructure to *adopt* the technological innovations; an argument commonly attributed to Abramovitz (1986). What, then, should be the 'areas' for policy intervention? Regional policies should promote high-technology activities, and R&D, including universities, scientific and research institutions. They should also support clusters, modernize the framework of copyright and trademarks, improve access of SMEs to Intellectual Property Protection, speed up setting of interoperable standards, and improve access to capital by reducing transaction costs of doing business. Policy makers should also identify bottlenecks and develop strong industrial and knowledge base, in conjunction with encouragement of 'knowledge partnerships' and links between business, research, innovation and education. Improvements in education will help employability and reduce poverty. A greater capacity for R&D as well as innovation across all sectors, combined with increased efficiency will foster job creation and improve competitiveness. In this context, adjustments of school curricula, based on creativity, innovation and entrepreneurship might also proved an effective policy tool.

Finally, there is a need to rethink regional policy along the lines of the implementation of more innovative and *region-specific* development strategies. Hence, new analytical tools are needed. The relatively fragmented nature of the spatial patterns of mobility and persistence suggests that broad administrative regions are a poor basis for the implementation of policy. Consequently, policy may need to be targeted towards specific localities rather than broad areas such as those, for example, covered by the current regional grouping of the EU. A classification of areas based on the notions of persistence, divergence and the conditions identified in this paper may provide a useful framework for policy development at the regional level.

REFERENCES

Abramovitz, M. "Catching Up, Forging Ahead and Falling Behind", *Journal of Economic History*, 46, 1986, pp. 385-406.

Baumol, W. and Wolff E. "Productivity Growth, Convergence and Welfare: A Reply", *American Economic Review*, 78 5, 1988, pp. 1155-1159.

Camagni, R. and Capello, R. "Macroeconomic and Territorial Policies for Regional Competitiveness: An EU Perspective", *Regional Science Policy and Practise*, 2 (1), 2010, pp. 1-19.

European Commission. *First Report on Economic and social Cohesion*, Luxemburg: Office for Official Publications of the European Communities, 1996.

European Commission. *Third Report on Social Cohesion*, Luxembourg: Official Publication Office, 2004.

Martin, R. "EMU versus the Regions? Regional Convergence and Divergence in Euroland", *Journal of Economic Geography*, 1 (1), 2001, pp. 51-80.

Mancha-Novarro, T. and Garrido-Yserte, R. "Regional Policy in the European Union: The Cohesion-Competitiveness Dilemma", *Regional Science Policy and Practice*, 1 (1), 2008, pp. 47-66.

Pigliaru, F. "Detecting Technological Catch-up in Economic Convergence", *Metroeconomica*, 54, 2003, pp. 161-178.

Richardson, H. *Elements of Regional Economics*, London: Penguin, 1973.

Rodríguez-Pose, A. and Crescenzi, R. "Research and Development, Spillovers, Innovation Systems and the Genesis of Regional Growth in Europe", *Regional Studies*, 42, 2008, pp. 51-67.