MEASURING EXTERNALITIES IN REGIONAL GROWTH: AN EMPIRICAL APPROACH

by

Miguel A. Márquez, Julián Ramajo and Geoffrey J.D. Hewings

REAL 03-T-9   March, 2003

Measuring externalities in regional growth: an empirical approach

Miguel A. Márquez,* Julián Ramajo* and **Geoffrey J.D. Hewings****

***Universidad de Extremadura, Badajoz, Spain-EU and **REAL, University of Illinois, Urbana, USA**

Abstract

This paper focuses on the dynamic effects under which the regional economic processes are accomplished, breaking them down into two broad types: neighborhood (horizontal) and economy-wide (vertical) externalities. So, by means of a proposed dynamic space-time empirical model, it is allowed to obtain the vertical and horizontal competition structure within a regional economic system. Co-integration/error correction modeling techniques are used to support the existence of the competition structure over both the short- and long-term. As an application, we show the dynamic effects on the evolution of the regional performance of Spanish regions over the period 1972-2000. Our results indicate that some macroeconomic forces are operating into this Spanish system: positive and negative externalities at both economy-wide and neighborhood levels. Findings show that a new taxonomy of the Spanish regions could provide some guidance as to the measures regional economic policy.

1. Introduction

Are there externalities in the regional growth process? If so, are these externalities driven by competition or cooperation between the regions? Another related question is the degree to which regional growth is spatially articulated, i.e., localized over time. In this article an empirical framework is proposed to estimate and interpret the significant macroeconomic effects that occur within a regional economic system. Two principal macroeconomic effects are identified: first, economy-wide (a-spatial or vertical) effects and secondly, neighborhood (spatial-adjacent or horizontal) effects. These dominant macroeconomic effects are the signaling devices that synthesize the influences of the underlying (and non-observable in our study) forces that are driving the evolution of the system.

Additionally, a competitive perspective arises; by understanding these two sets of effects, the vertical and horizontal competition structure within a regional economic system can be outlined. The empirical strategy considers competitive growth (Richardson, 1973) of regional economies, wherein a region increasing its share of some macroeconomic aggregate does so at the same time one or more other regions have to reduce their shares. Under these conditions, the national growth process is assumed to be given or determined exogenously, and a top-down approach is

adopted: the feedback effects of the regional growth on the national level performance are ignored. At the same time, the notion of regional competition follows Parr (1978, p. 122):

"*Broadly speaking regional competition may be regarded as the market process by which economic activities or employed factors of production are allocated through time among the regions of a nation. Phrasing this in terms of national income, regional competition represents the process by which the gross national product (GNP) is distributed among regions. The overall competitiveness of a particular region can thus be measured by the region's share of the GNP, although a more useful view of a region's competitiveness might be the extent to which it is able to maintain or increase its share of the GNP through time*".

However, as Krugman (1994) has noted, this concept of dynamic regional competition can be misconstrued, because while the regions compete with each other in terms of share, all the regions could be gaining in absolute terms. The competitiveness of a regional economy and its prospects for continued prosperity should be appraised and determined in the context of the evolution of the regional economic system[1], and here is where the regional competition structure that is articulated in the empirical methodology could prove to be valuable. The region's share of GDP as an indicator of regional competitiveness is very simple, but it is also an overall competitiveness indicator that measures competition within a regional system in a very clear, albeit indirect way.

The Dendrinos and Sonis (1990) model has been used in a number of studies to explore the dynamic interaction between regional economies. The present paper builds on this model through the adoption of a dynamic space-time perspective wherein co-integration analysis is employed to test the hypothesis that for a regional economic system as a whole, the regional shares behave as if they are independent versus the alternative that they are determined by global and/or neighborhood forces. This approach combines a time-dynamic perspective with the typical *modus operandi* of spatial econometrics, where a scheme of interaction directly related with the geographical location of the regions is specified. In addition, the co-integration method proceeds by separating the long- and short-term effects, gaining some insights into the space-time economic development of a regional system. At the level of the region, this enables us to bring together the net effects of the economy-wide (vertical) interaction and the net effects of

---

[1] According to Puga (2002), recent work on regional income in Europe shows that inequalities are within rather than across Countries.

neighborhood (horizontal) interaction over time. The economy-wide effects would be regarded as spin-off effects that operate beyond adjacent regions (nation-region relationships or vertical interactions). In these vertical effects, the geographical level of resolution is higher, since all the regions within the system are considered. On the other hand, neighborhood (horizontal) effects provide a more bounded analysis which takes into account the influence of geographical proximity as a relevant factor to explain the evolution of a regional economy. Although spatial proximity is not a necessary condition to admit the presence of horizontal competition, it is hypothesized that proximity may be reflective or can be considered to capture agglomeration economies or diseconomies. These local or neighborhood effects provide a complementary perspective to the more global processes associated with national-level influences.

The paper is organized as follows; section 2 provides a theoretical framework for our empirical methodology. The modeling issues are presented in section 3, where the proposed model is estimated, using data for regions of Spain for the period 1972-2000, and the results are discussed. These outcomes suggest a new taxonomy of Spanish regions. In Section 4 a summary interpretation is provided followed by some concluding remarks. In addition, some regional policy considerations are discussed and suggestions for further analysis are provided.

2. Conceptual background and motivation

The theoretical arguments pointing to the existence of forces that drive regional growth with the possibility of uneven regional development are embodied in many of the "new growth theory" models and "new economic geography" models[2]. The modern formulation of endogenous growth theory from a macroeconomic growth approach was provided by Romer (1986, 1990) and Lucas (1988, 1993). From these works it is possible to underline that endogenous growth theory is founded on the existence of increasing returns and positive externalities, and the models can be formulated by considering the existence of factor accumulation over time that reinforces the internal pattern of development of the regional system.

---

[2] These models are contrary to traditional neo-classical growth models, which rest "*on a much narrower vision of the dominant forces in an economy. (...) Imbalances merely reflect lags in the adjustment towards equilibrium (...) or imperfections in market process*" (Richardson and Townroe (1986, p. 654)). They support the idea of regional convergence, that is, regional growth without interregional disparities.

Most recently, regional agglomeration processes have appealed to earlier ideas centered on cumulative causation mechanisms, allowing for the consideration of centripetal (agglomeration economies) and centrifugal (agglomeration diseconomies) forces. These forces were used by Krugman (1991), whose work together with Krugman and Venables (1995) and Venables (1996) contributed to formation of the "New Economic Geography" (Arthur, 1990, Grossman and Helpman, 1991), establishing the basis of a growing number of researches in this field (see for example, Ottaviano and Puga, 1998, Puga and Venables, 1999, and Fujita *et al.* 1999).[3]

These viewpoints highlight the relationship between economic growth processes and spatial concentration. Further, they contemplate the possibility of divergence, that is, growth could lead to a spatial divergence in regional incomes (per capita), increasing interregional welfare differences. However, there are differences in the causes and the origins of the forces under which regional economic processes evolve over time. The earlier ideas of Myrdal and Hirschman consider the role of external economies in explaining differential increases in regional growth, whereas both external diseconomies and/or deficient capacity could limit these increases. The proponents of endogenous growth theory consider endogenous factors like technical change and human capital in order to explain the existence of technical progress and its spatial differentiating influence over time. In this environment, the mainspring behind increasing returns to human and physical capital is the presence of agglomeration effects.

On the other hand, the "New Economic Geography" takes into account explicitly the geographic aspects of regional growth, emphasizing the role played by economies of scale, transportation costs and the tension between centripetal and centrifugal forces in order to explain the spatial economic structure. The difference between the dynamic agglomeration economies of the "endogenous growth theory" and the ones of the "New Economic Geography" may be ascribed to the fact that while the former are based on localization or Marshall-Arrow-Romer (MAR) economies (e.g., Romer, 1986), the latter find their support in urbanization or Jacobs (1969) economies. According to Henderson *et al.* (1995), the MAR economies are dynamic localization economies where the proximity among the same activities results in knowledge spillovers, while in Jabobs' economies, the origin of these externalities is in diversity: the close proximity among

---

[3] Nevertheless, as commented before, the rise of spatial external economies of agglomeration (forces of agglomeration) had been manifested previously by Myrdal (1957), Hirschman (1958), Oates et al. (1971),

different activities over time are the sources of the knowledge spillovers. Thus, we can identify Jacobs' economies with dynamic urbanization economies.

In the present context, these forces (dynamic agglomeration economies) will be considered as dynamic externalities, because their external character comes from the measurement of the interactions among regions as economic units within a regional system over time. These externalities could be the consequence of internal economies and/or external economies (Parr (2002, p. 12)): "*agglomeration economies or diseconomies deriving from internal economies may co-exist with agglomeration economies or diseconomies driving from external economies, these possibilities, resulting in a variety of spatial structures. (...) an agglomeration economy based on an internal economy of scope, scale or complexity can be said to have a counterpart based on a corresponding external economy.*" The origin of these externalities is not of concern here since the objective is, to measure the net macroeconomic effects that these externalities generate within a regional economic system.

Maier (2000) showed the important role played by agglomeration effects in regional growth: without agglomeration forces, the regional shares converge toward a steady state under which economic homogenization takes place, but with agglomeration forces, there is no balanced growth and an heterogeneous panorama unfolds leading to the existence of regional divergence and/or regional stagnation within the regional system. Maier (2000p. 132) yields the main implications of the agglomeration effects: "*Agglomeration effects bring about spatial structure, path dependence of growth process, "lock-in" phenomena, and long term implications of historical events*".

Therefore, although the existence of agglomeration effects among regional economies working over time and influencing the functioning of an economy is contemplated, their detection and quantification could provide new insights into understanding regional growth. To date, the assembled empirical evidence of the way these agglomeration effects work within a regional system is modest. Consequently, it would be desirable to build new empirical research around measures that adequately recognize external effects, and it is in this domain wherein the contribution of this paper is placed.

Richardson (1973) and Dixon and Thirlwall (1975) in the context of cumulative causation; and Friedmann (1966, 1973), whose core-periphery model extended Myrdal and Hirschman's ideas.

Since the existence of significant centripetal (agglomeration) or centrifugal (dispersion) forces (see Fujita and Thisse, 1996, 2002) in the regional evolution of economies can be detected at different levels, it is necessary to establish a framework to carry out a convenient analysis. The approach adopted here is similar to one used by Poot (2000) who considered *"local and economy-wide effects of territorial competition"*. Hence, economy-wide and local effects form the bases for two types of agglomeration effects. In the present paper, the concept of "local" will be adapted to the regional environment, being identified with the effects generated from the geographically adjacent regions that shape the neighborhood.

In short, our primary framework and calculations focus on the concept of dynamic regional competition, including the comparison over time of the regional performance within a regional system. Since regional competition is a phenomenon over time, and a time series approach is required for its evaluation, attention has to be directed to both the short-term (transitory competition) and long-term (durable competition) analysis of the effects that generate the competitive structure of the regional system. The long-term economic processes in regions are generally informed by gradual and slow developments, that make reference to the region's economic history (including a variety of physical and social capital endowments) that determine the potential capacity of the region. Convergence issues are generated by these longer-term implications. On the other hand, short-term changes may be generated by ephemeral events that may or may not influence long-run trajectories of growth. Hence, there is a need to employ methods that allow for the co-existence of both long-term and short-term effects that drive the evolution of the regional system.

In the next section, a simple empirical strategy is presented to facilitate the identification of the significant negative or positive effects of the dynamic externalities and to build upon them a procedure that incorporates both "localized" and "global" competition. The empirical study is designed under the assumption of the existence of effects acting in both the long- and short-term.

3. Empirical analysis and discussion

In this section, a methodology will be described to test the significance of the impact of both supra-regional effects, referring to the influence of the national aggregate, and neighborhood effects, referring to the competition-coordination among adjacent regions.

3.1. Data

In order to illustrate our empirical approach, the Spanish economic system is investigated. Spain is a decentralized state composed of 17 regions and Ceuta and Melilla (two Spanish North African cities), and they constitute the so-called Autonomous Communities. The Autonomous Communities have achieved the status of self-governed territories, sharing governance with the Spanish central government within their respective territories.

In the present work, the analysis will use only the 15 peninsular regions in Spain (see figure 1), not taking into account the regions without geographical connection (Balearic Islands, Canary Islands, Ceuta and Melilla). This peninsular Spanish economic system has a marked economic core-periphery pattern, with an unequal economic geography. Traditionally, the economic periphery is comprised of[4] Castilla-León, Castilla-La Mancha and Extremadura (regions around Madrid) while Madrid (in the center), País Vasco (in the North), Cataluña and Valencia (both in the East) make up the economic core. Galicia, Andalucía and Murcia are also considered as "peripheral" regions; while Navarra, La Rioja, and Aragón may be considered as "core" regions. Finally, Asturias and Cantabria are historical "core" regions, but experiencing a significant industrial restructuring processes.

<<insert figure 1 here>>

Time series on Gross Added Value (GAV) in the 15 peninsular regions in Spain provides the main data source. The database of the HISPALINK[5] project (HISPADAT) was employed in this analysis; regional gross added value at market prices in 1995 constant pesetas (GAV) for the period 1972 to 2000 were used. The national aggregate that was used in the application was obtained as the sum of the GAVs of the 15 considered Spanish regions.

Keeping the location of the regions in mind (figure 1) figure 2 represents the time evolution of every regional share over the period 1972-2000. Likewise, figure 3 displays a comparative graph of the shares in selected years of the period, 1972, 1980, 1990 and 2000.

<<insert figures 2 and 3 here>>

---

[4] See Figure 1.
[5] For a more detailed information concerning the HISPALINK project and the HISPADAT database, see Pulido and Cabrer (coords.) (1994) and Cabrer (coord.) (2001).

All the regional shares in figure 2 appear to be non-stationary. The augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979, 1981) and PP (Phillips and Perron, 1988) tests for the presence of unit roots in the regional shares and in the logarithms of the total GAV (the sum of the regional gross added values) were applied. The null hypothesis of these unit root tests is that the variable analyzed has a unit root against the alternative that it does not.

<<insert table 1 here>>

Table 1 reports results for the application of these tests; the results indicate that all of the series (except one case) can be regarded as I(1) variables[6]. In addition, the null hypothesis of a unit root in each series is clearly rejected using differenced data (there is not a second unit root). The conclusion to be drawn is that the series are each integrated of order I(1), except in the case of the regional share of Cantabria, which shows a stable behavior around the mean (that is, it is integrated of order I(0)).

3.2. Empirical framework

To estimate the influence of the national aggregate (global effect caused by vertical externalities) over each of the 15 Spanish regions, a specification referred to as a *regional curve* is used. The specification is assumed to be of the form:

$$s_{it} = \beta_{0,i} + \beta_{2,i} \log GNP_t + \varepsilon_{it} \qquad i=1,2,...,15 \quad t=1972,1973,...,2000$$

where s_{it} denotes the share of the production of the region i (in our case GAV_i) in the national economy at time period t, (GAV), $s_{it} = GAV_{it}/GAV_t$. This is a very simple specification that, in a context of regional competition, only explores the role of general macroeconomic factors. In this equation, β_0 is the share that is unexplained by the increase at national level. The sign of parameter β_2 in each regional curve indicates whether the corresponding regional share increases or diminishes when the national gross added value increases.

Logically, since the addition property is verified in this zero-sum game ($\sum_i s_i = 1$ is equivalent to $\sum_i ds_i = 0$, where d denotes the derivative operator), not all the regions can have positive parameters, with some regions losing share ($\beta_2 < 0$) while the shares of others improve

---

[6] At the 5% level of significance.

($\beta_2 > 0$). These considerations only address relative changes in regional competition, since all regions could be improving in absolute terms. Different economy-wide effects can be distinguished:

a) "Complementarity" (efficiency) effects ($\beta_2 > 0$). Here national impulses positively changes a region's share; externality-based agglomeration economies are generating more positive impacts in the region than in other regions.

b) "Substitution" (inefficiency) effects ($\beta_2 < 0$). Here, the national impulses negatively affect the regional share. Externality-based diseconomies are affecting the regional share in a negative form compared to other regional shares.

c) "Neutral" (equilibrium) effects ($\beta_2 = 0$). This result presents the case where externality-based agglomeration economies and/or diseconomies cancel each other. The region's competitive position vis a vis the nation is unchanged.

Starting from this basic specification, which has a time character in the main, the spatial dimension is introduced by adding a spatial lag for the variable s, Ws, where W represents a typical contiguity matrix (Anselin, 1988), with components defined as: $w_{ij} = 1$ if regions i and j share common border (they are neighbors), $w_{ij} = 0$ if they do not share it and, by convention, $w_{ii} = 0$[7]. Then, the final long-run specification is

$$s_{it} = \beta_{0,i} + \beta_{1,i}[Ws]_{it} + \beta_{2,i} \log GNP_t + \varepsilon_{it} \qquad (1)$$

In this case at regional level, if parameter β_1 is positive or negative, region i increases or diminishes its relative proportion (measured as its share), but now due to the interaction with its adjacent regions. Therefore, this parameter measures the net degree of complementarity or competition between every region and its adjacent regions (*neighborhood effect or horizontal externality*). This provides a spatial view and the effects can be interpreted as follows:

---

[7] With reference to the specification of the matrix W, it was row-standardized (see Anselin (1988)). Thus, we will use a row standardized weights matrix W^s, defined as $w_{ij}^s = w_{ij} / \sum_j w_{ij}$, where the interpretation of the parameters are facilitated by the fact that the sum of the elements of a row is equal to one.

a)   Competition effects ($\beta_1 < 0$). A region improves (diminishes) its share by receiving (generating) spillovers from (to) its neighbors: net diseconomies are present at the regional level. The neighboring regional shares affect the regional share in a manner that is significantly negative. Some economic activities could be taking place in the neighbor regions at the expense of this region.

b)   Co-ordination or co-operation ($\beta_1 > 0$). In this case net agglomeration economies exist: positive spillovers could be improving the share of the region under analysis. The regional share is being affected in a significantly positive manner by the neighboring regional shares.

d)   Neutral effects ($\beta_1 = 0$). There are no significant net effects between a region and its neighbors. This null parameter should not be interpreted to mean that the neighborhood does not affect the regional share, but rather that it does so in a non significant net sense. The tension region-neighborhood under this possibility is considered to be in equilibrium.

Neighborhood effects put regions in direct competition with its neighbors. The interaction among global and neighborhood effects is founded on territorial aspects stemming from the sharing of locational information. Inter-related forces causing these effects have in common their influence on regional economic processes, acting from above, but also from below.

The introduction of the time factor in this empirical structure is fraught with difficulties[8]. Tests used in the investigation established that each of the series [$\log GNP_t$ and regional shares (s_{it})], except in the case of the variable $s_{CB,t}$, are indeed integrated of order I(1). Accordingly, equations of this type have to be understood as long-term regressions, and they must be estimated taking into account this fact. The next step is to test for the presence of co-integration relationships; if the existence of co-integration is identified, the estimated effects (β_1 y β_2) have to be interpreted as long-term estimates[9].

---

[8] In Marquez and Hewings (2002), the long-term and short-term geographical competition is separated by means a re-parameterization of the dynamic linear regional relationships in terms of levels (long term geographical information) and differences (short-term geographical information). In this work it is assumed that there is only one cointegration vector, and according to Maddala and Kim (1998), this assumption facilitates use of the Engle-Granger method, that requires uniqueness of the cointegration vector. In our case, the number of cointegration relationships will be contrasted.

[9] Equation (1) can be most easily interpreted as identifying the extent to which regional shares are explained in the long run by factors operating at national level and factors acting at neighborhood level.

In the presence of co-integration, changes in the regional shares (short-term information) are a function of the level of disequilibrium in the co-integration relationship. In this sense, the empirical specification that is used in order to estimate the short-term effects associated with the proposed model could be represented by a corresponding error-correction model (ECM, Engle and Granger, 1987). Hence, the short-term equations are formulated as:

$$\Delta s_{it} = \delta_{0,i} + \delta_{1,i}\Delta s_{i,t-1} + \delta_{2,i}[W\Delta s]_{i,t-1} + \delta_{3,i}\Delta \log GNP_{t-1} + \delta_{4,i}\hat{e}_{i,t-1} + \delta_{5,i}[W\hat{e}]_{i,t-1} + u_{it} \quad (2)$$

where $\hat{e}_{i,t-1}$ (error-correction term) denotes the residuals (lagged a period) of the long-term relation estimated in each of the equations of type 1.

These residuals concern the short-run response of the dependent variable to the adjustment of the regional share back towards long-run equilibrium. Equation (2) is a recursive space-time model[10] that incorporates in the specification the dependent variable with a time lag of order 1 ($\Delta s_{i,t-1}$) and a spatial lag ($[W\Delta s]_{i,t-1}$). It is worthwhile to point out the inclusion in the basic ECM formulation (Engle and Granger, 1987) of a *spatial error-correction term*, $[W\hat{e}]_{i,t-1}$, since this represents the adjusting mechanism in region i resulting from the existence of a net imbalance in its neighborhood. Thus, this short-term adjustment coefficient characterizes the proportion by which the long-run disequilibrium in the regional share is being corrected in each short-term period by neighboring factors. Whereas the error-correction term ($\hat{e}_{i,t-1}$) corrects in each short period long-run imbalances in a regional share caused by disequilibrium in the own region, the spatial error-correction term, $[W\hat{e}]_{i,t-1}$, corrects in each short period long-run imbalances in the said regional share caused by disequilibrium in its neighborhood.

3.3. Results and discussion

Equations (1) and (2) are estimated individually for each region[11]. Equation 1 requires the specification of the "neighbor" structure, namely, the interaction among regions as defined by a spatial weights matrix (W). In this case, W expresses for each region (row) those regions (columns) that belong to its neighborhood. Formally, $w_{ij}=1$ if regions i and j are neighbors, and

---

[10] The increase of the share of the region i at the moment t is determined by variables lagged a period (the dependent variable, shares of the neighbors, and the variable representing the whole system).

$w_{ij}=0$ otherwise. This ensures that interactions between regions with common borders are considered (see figure 1).

<center><<insert table 2 here>></center>

Equations of type (1) must be estimated within the context of non-stationary variables, avoiding the possibility of spurious estimates. Hence, the next step is to test for the presence of co-integrating relationship among the variables that appear in each equation by means of both the maximal eigenvalue and the trace tests proposed by Johansen (1988,1991). Test results for co-integration are listed in the fourth column of table 2 for each region. The null hypothesis of the absence of co-integration among the variables in each equation is rejected; results support the view that each equations of type (1) for every region represents a stable long-run relationship equilibrium.

As soon as the stability of the expanded regional curves (equations 1) has been contrasted, they are estimated taking into account that they are co-integrated relationships. In this sense, an alternative view of the variables $[Ws]_{it}$ and $\log GNP_t$ as a form of endogeneity as well as the serial correlation in the error term ε_{it} have to be considered.

The estimation of equation (1) has been realized using the fully modified estimator derived in Phillips and Hansen (1990). The fully modified estimation considering the problem of the correlation between these variables ($[Ws]_{it}$ and $\log GNP_t$) and the error term in equations of type (1) provides a way to obtain inference over the estimated parameters [this is not the case with ordinary least squares (OLS)] and, in addition, it is more appropriate in finite samples (as the one used in this work)[12].

<center><<insert table 3 and figure 4 here>></center>

The results of the regression analysis where the parameters β_1 and β_2 are estimated for each region are disclosed in columns 2 and 3 of table 2. Table 3 and figure 4 show these results from a qualitative point of view. Table 3 provides a taxonomy of the Spanish regions highlighting the way in which economy-wide and neighborhood effects influence growth in the long term, and

---

[11] It is interesting to emphasize that both equations are more general than those used in the standard spatial econometrics, where parameters $\beta_{1,i}$ and $\delta_{2,i}$ are the same in all the regions. These hypotheses were tested in our work and, in both cases, the null hypotheses of similarity were clearly rejected.

generally, this is the relevant way to view significant changes in competitive position[13]. Economy-wide effects are the major sources of positive or negative growth in the shares of this Spanish regional system, since they imply competition at global scale; all geographical levels of resolution within the system are considered. The interpretation of the co-integrating equations as long-run relations implies that permanent forces are leading the Spanish regional system; the long-run regional shares are being driven by these forces.

Results indicate that more national growth elasticities (β_2 in table 2) are significant than neighborhood elasticities (β_1 in table 2). When the total gross added value increases, the regions that have positive percentage changes in their shares (see Figure 4) are Galicia, Madrid, La Rioja, and the regions in the Mediterranean Arc (Cataluña, Valencia, Murcia and Andalucía). This fact might suggest in this case that the benefits of competition at global level are bounded geographically by some macro-regional context (located in the Mediterranean Arc).

On the other hand, Asturias, Castilla-León, País Vasco and Castilla-La Mancha comprise a group of regions that have negative percentage change in shares when the total gross added value increases. In addition, there is a third group of regions that are not sensitive to the general macroeconomic circumstances, these being Extremadura, Cantabria, Navarra and Aragón.

The initial interpretation of these results would suggest little evidence of 'convergence forces' operating in this Spanish regional system: in general, peripheral regions show negative economy-wide effects, while core regions are being affected by positive externalities[14].

The positive or negative dynamic externalities causing the effects can be seen, in a very wide sense, as an "efficiency measure" of a region's economy. The dynamic economy-wide effects that are detected can be employed to illustrate not only the constraints that regions face in their evolution in the long term, but also in identifying targets for further actions. Consequently, the

---

[12] Similar results were obtained when equations of type (1) were estimated separately by OLS.

[13] Even though the short-term process also can cause outcomes with consequences to the long-term regional competitiveness.

[14] The analysis of the Spanish regional convergence in *per capita* terms was undertaken by Sala-i-Martin (1996, 1997), who revealed the existence of convergence in the period 1955-1990, whereas at the beginning of the 1980s, this convergence process seems to stop. According to Cuadrado-Roura (2001), for the period 1972-2000, it would be expected that β convergence would be found for the Spanish regions. It might be noted at this point, however, that our results can be regarded as complementary rather than competitive, since our approach is concerned with the growth of relative productive capacity, whereas the analysis of growth of output per capita focuses on the changes in economic welfare.

competition between core and peripheral regions depends on the outcome of the two opposing forces that are acting in the Spanish regional system. País Vasco has the worst position in table 3; this region is facing diseconomies at both economy-wide and neighborhood levels. On the other hand, Galicia, La Rioja and Murcia are regions that have the best position in table 3.

Another interpretation could be that regional growth is collaborative, from a global perspective, but competitive when viewed from a neighborhood perspective. That is, regions in the Mediterranean Arc are cooperating among each other *versus* the rest of the regions, although Andalucía, Cataluña and Valencia have significant negative coefficients at the local level.

<<insert tables 4, 5 figure 5 here>>

With respect to the estimation of equations of type 2 (short-term relationships), the result of the estimations of the short-term equations is the set of regressions presented in table 4. These findings can be interpreted as evidence for the fact that, in general, the regional shares are being driven by their respective long-run equilibria : most of the error-correction terms are significant, and this means that changes in the regional shares are being corrected in the short term by the deviations from the long-run equilibrium.

The significance of the lagged error-correction term in any equation of type (2) implies the existence of a long run relationship contained in the corresponding equation of type (1). For the spatial error-correction term, only the coefficient for Aragón is significant at the 5% level (Cataluña and Navarra at the 10% level), implying that long-run imbalances in the share of Aragón caused by disequilibrium in its neighborhood are being corrected in each short period. Table 4 is complemented with a graphical analysis of the results (figure 5) and the taxonomy shown in table 5. Indeed, even though the long-term effects generally have the most relevant implications for the evolution of the regional shares, results tend to confirm the general view of external effects over both the short- and long term.

At the economy-wide level, the results tend to confirm the general view of external effects over both the short- and long term. They are general forces that underpin the spatial structure of the Spanish economic system. The analysis of data at the economy-wide level reveals that Madrid is the only region that presents a significant positive coefficient. Subsequently, Madrid has positive economy-wide effects in both the long and short term. On the other hand, Castilla-León has

negative economy-wide effects in both long and short term while Extremadura does not have significant economy-wide effects.

At the neighborhood level, the findings tend to support the existence of significant long- and short-term net effects from the neighbors over the corresponding region. Asturias is the only region with a significant coefficient in both the long and short term.

4. Summary

This paper is a contribution to regional macroeconomic analysis that focuses on the dynamic effects under which the regional economic processes operate by considering them at two spatial scales - neighborhood and economy-wide. Using a dynamic space-time formulation, the analysis uncovered what could be labeled as some form of vertical and horizontal externalities. Although both externalities are related to long run dynamic sources of growth, they are also considered in the short-run. This perspective argue for competition among regions as a process that consists of two broad components, that are generated by the long-term evolution of horizontal (neighborhood in a spatial sense) and vertical effects.

An important implication of this investigation is the detection of the macro-effects by incorporating them into a definite geographic realization. Any intervention must take into account the location of these macro-effects before a specific policy if promulgated; further, it may turn out that the spatial manifestation of these effects may be very different depending on the macro aggregate being considered. In this paper, the analysis was limited to an aggregate of the macro aggregates (gross product) while it is clear that different components of government spending, for example, will have very different initial spatial impacts.

However, the empirical model provides a way to take into account both spatial and temporal information relative to the evolution of the regional economic shares within a regional economic system. The space-time empirical approach combined a time-dynamic perspective with a scheme of interaction that exploited the role of the geographical location of the regions in the context of co-integration processes. Further, the incorporation in the basic ECM formulation of a *spatial error-correction term* could provide new insights in the context of the co-integration.

An application of the empirical model to regional shares within a Spanish regional system facilitated identification of the location and nature of these Spanish effects. These outcomes revealed a "bird's-eye" or vertical view in contrast to the "horizontal" or neighborhood effects. In this context, the spatial structure assumes a preeminent role, since the analysis considers regions as economic-geographic units. The analysis reveals a distinctive regional imprint, suggesting that, in general, regional imbalances in the Spanish regional system are strongly influenced by the macro-effects that are operating within this system. While the distinction between economy-wide and neighborhood effects within a regional system that have been revealed represent an important contribution to identifying the structure of the system, the next important task will be formulating and testing theoretical explanations that account for this uneven pattern of regional competition.

5. References

Anselin, L. (1988): *Spatial Econometrics: Methods and Models*, Dordrecht, Kluwer Academic Publishers.

Arthur, B. W. (1990): "Silicon Valley locational clusters: do increasing returns imply monopoly?", *Mathematical Society Sciences*, 19, 235-251 .

Bernard, A. B. and Durlauf, S. N. (1996): "Interpreting Test of the Convergence Hypothesis", *Journal of Econometrics*, 71, 161-173.

Bertola, G. (1999): "Convergence ... an Overview", in Baldwin, R. E., Chen, D., Sapier, A. and Venables, A. (Eds.), *Market Integration, Regionalism and Global Economy*, Cambridge, UK: Cambridge University Press, 275-295.

Cabrer, B. (Ed.) (2001): *Análisis Regional: El proyecto Hispalink*, Madrid: Ediciones Mundi-Prensa.

Cheshire, P. C. and I.R. Gordon, (1998): "Territorial Competition: Some Lessons for Policy", *Annals of Regional Science*, 32, 321-346.

Cuadrado-Roura, J., Garcia-Greciano, B., and Raymond, J. (1999): "Regional Convergence in Productivity and Productivity Structure: The Spanish Case", *International Regional Science Review*, 22, 35-53.

Cuadrado-Roura, J.R. (2001): "Regional convergence in the European Union: From hypothesis to the actual trends", *Annals of Regional Science*, 35, 333-356.

Dall'erba, S. (2001): "European regional development policies and trade-off efficiency-equity", *mimeo*.

Dendrinos, D. and Sonis M. (1990): *Chaos and Socio-Spatial Dynamics*, Springer-Verlag, New York.

Dickey D.A. and Fuller W.A. (1979): "Distribution of the estimators for autoregressive time series with a unit root", *Journal of the American Statistical Association*, 74, 427-431.

Dickey D.A. and Fuller W.A. (1981): "Likelihood ratio tests for the estimators for autoregressive time series with a unit root", *Econometrica*, 49, 1057-1072.

Dixon, R. and Thirlwall, A. P. (1975): "A model of regional growth rate differences on Kaldorian lines", *Oxford Economic Papers*, 27, 201-214.

Durlauf, S. N. and Quah, D. T. (1998): "The New Empirics of Economic Growth", Centre for Economic Performance (LSE), Discussion Paper, 384.

Engle R. and Granger C. (1987): "Co-integration and Error Correction, Representation, Estimation and Testing", *Econometrica*, 55, 251-276.

Evans, P. and Karras, G. (1996a): "Do economies converge? Evidence from a Panel of U.S. States", *Review of Economics and Statistics*, 76, 1-11.

Evans, P. and Karras, G. (1996b): "Convergence Revisited", *Journal of Monetary Economics*, 37, 249-265.

Fingleton, B. (1999): "Estimates of time to economic convergence: an analysis of regions of the European Union", *International Regional Science Review*, 22, 5-35.

Friedmann J. (1966): *Regional development policy: a case study of Venezuela*, Cambridge, Mass.: MIT Press.

Friedmann J. (1973): *Urbanization, planning and national development*, Beverly Hills: Sage.

Fujita M., Krugman P. and Venables A. (1999): *The Spatial Economy: Cities, Regions and International Trade*, Cambridge, MA: MIT Press.

Fujita M,. and Thisse J.F. (1996): "Economics of Agglomeration", *Journal of the Japanese and International Economies*, 10, 339-378.

Fujita, M., and Thisse, J-F. (2002) *Economics of Agglomeration*. Cambridge, University Press.

Gelfand A.E., Ghosh S.K., Knight J.R. and Sirmans C.F. (1998): "Spatial-temporal modeling of residential Sales Data", *Journal of Business and Economic Statistics*, 16, 312-321.

Grossman G.M. and Helpman E. (1991): *Innovation and Growth in the Global Economy*, Cambridge, MA: MIT Press.

Haaparanta P. (1998): "Regional concentration, trade, and welfare", *Regional Science and Urban Economics*, 28, 445-463.

Haddad E.A. and Hewings G.J.D. (2000): "Trade and Regional Development: International and Interregional Competitiveness in Brazil", in B. Johansson, C. Karlsson, and R. Stough. (Eds) *Theories of Endogenous Regional Growth*, Heidelberg, Springer-Verlag, 181-208.

Henderson V., Kuncoro A., and Turner M. (1995): "Industrial Development in Cities", *Journal of Political Economy*, 103, 1067-1090.

Hirschman A.O. (1958): "The strategy of economic development", New Haven: Yale University Press.

Jacobs J. (1969): *The Economy of Cities*, New York: Vintage.

Johansen S. (1988), "Statistical analysis of cointegration vectors", *Journal of Economic Dynamics and Control*, 12, 231-254.

Johansen S. (1991): "Estimation and hypothesis testing of cointegrating vectors in gaussian vector autoregressive models", *Econometrica*, 59, 1551-1580.

Krugman P. (1991): "Increasing Returns and Economic Geography", *Journal of Political Economy*, 99, 483-499.

Krugman P. (1994): "Competitiveness: a dangerous obsession", *Foreign Affairs*, March/April, 28-44.

Krugman P. and Venables A. (1995): "Globalization and the Inequality of Nations", *Quarterly Journal of Economics*, CX: 857-967

Lovering J. (1999): "Theory led by policy: the inadequacies of the 'new regionalism' (illustrated from the case of Wales)", *International Journal of Urban and Regional Research*, 23, 379-395.

Lucas R.E. Jr. (1988): "On the mechanics of economic development", *Journal of Monetary Economics*, 22, 3-42.

Lucas R.E. Jr. (1993): "Making a miracle", *Econometrica*, 61, 251-272

Mackinnon D. and Phelps N.A. (2001): "Devolution and the territorial politics of foreign direct investment", *Political Geography*, 20, 353-379.

Maddala G.S and Kim I. (1998): *Units Roots, Cointegration, and Structural Change*, Cambridge University Press.

Maier G. (2000) "History, Spatial Structure, and Regional Growth: Lessons for Policy Making", in B. Johansson, C. Karlsson, and R. Stough. (Eds) *Theories of Endogenous Regional Growth*, Heidelberg, Springer-Verlag, 111-134.

Márquez M.A. and Hewings G.J.D. (2003): "Geographical Competition Between Regional Economies: the Case of Spain", *Annals of Regional Science*, forthcoming.

Myrdal G. (1957): *Economic theory and underdeveloped regions*, London: Duckworth.

Nijkamp P. and Poot J. (1998): "Spatial perspectives on new theories of economic growth", *Annals of Regional Science*, 32, 7-37.

Oates W. E., Howrey E.P. and Baumol W. J. (1971): "The analysis of public policy in dynamic urban models", *Journal of Political Economy*, 79, 142-153.

Ottaviano G.I.P. and Puga D. (1998): "Agglomeration in the Global Economy: a Survey of the 'New Economic Geography'", *World Economy*, 21, 707-731.

Paluzie E. (2001): "Trade policy and regional inequalities", *Papers in Regional Science*, 80, 67-85.

Parr J.B. (1978): "Regional competition, Growth Pole Policy, and Public Intervention", in Buhr, W., Friedrich, P. (Eds.): *Konkurrenz Zwischen Kleinen Regionen*, Nomos, Baden-Baden, 122-136.

Parr J.B. (2002): "Missing elements in the analysis of agglomeration economies", *International Regional Science Review*, forthcoming.

Phillips P.C.B. and Hansen B.E. (1990): "Statistical inference in instrumental variables regression with I(1) processes", *Review of Economic Studies*, 57, 99-125.

Phillips P.C.B. and Perron P. (1988): "Testing for a unit root in time series regression", *Biometrika*, 75, 335-346.

Poot J. (2000): "Reflection on Local and Economy-Wide Effects of Territorial Competition", in P.W.J. Batey and P. Friedrich. (Eds.), *Regional Competition*, Heidelberg, Springer-Verlag, 205-230.

Puga D. (2002): "European Regional Policies in Light of Recent Location Theories", *Journal of Economic Geography*, 2: 373-406.

Puga D. and Venables A. (1999): "Agglomeration and Economic Development: Import Substitution vs Trade Liberalisation", *Economic Journal*, 109, 292-311.

Pulido A. and Cabrer B. (Eds.) (1994): "*Datos, Técnicas y Resultados del Moderno Análisis Económico Regional*". Madrid: Ediciones Mundi-Prensa.

Quah D. (1996): "Regional Convergence Clusters Across Europe", Centre for Economic Performance, Discussion Paper 1286, London.

Richardson H.W. (1973): "*Regional Growth Theory*", New York: Wiley.

Richardson H.W. and Townroe P.M. (1986): "Regional policies in developing countries", in Nijkamp, P. (Ed.), *Handbook of Regional and Urban Economics*, Vol. I, North-Holland, Amsterdam, 647-678.

Rebelo S. (1991): "Long-Run Policy Analysis and Long-Run Growth", *Journal of Political Economy*, 99, 500-21.

Romer P. (1986): "Increasing returns and long run growth", *Journal of Political Economy*, 94, 1002-37.

Romer P. (1990): "Endogenous technological change", *Journal of Political Economy*, 98, 71-102.

Sala-i-Martin X. (1996): "The Classical Approach to Convergence Analysis", *Economic Journal*, 106, 1019-1036.

Temple J. (1999): "The New Growth Evidence", *Journal of Economic Literature*, 37, 112-156.

Venables A. (1996): "Equilibrium Location of Vertically Linked Industries", *International Economic Review*, 37, 341-359.

Regional abbreviations: Andalucía (AN), Aragón (AR), Asturias (AS), Cantabria (CB), Castilla-León (CL), Castilla-La Mancha (CM), Cataluña (CT), Valencia (CV), Extremadura (EX), Galicia (GA), Madrid (MA), Murcia (MU), Navarra (NA), País Vasco (PV) and La Rioja (RI).
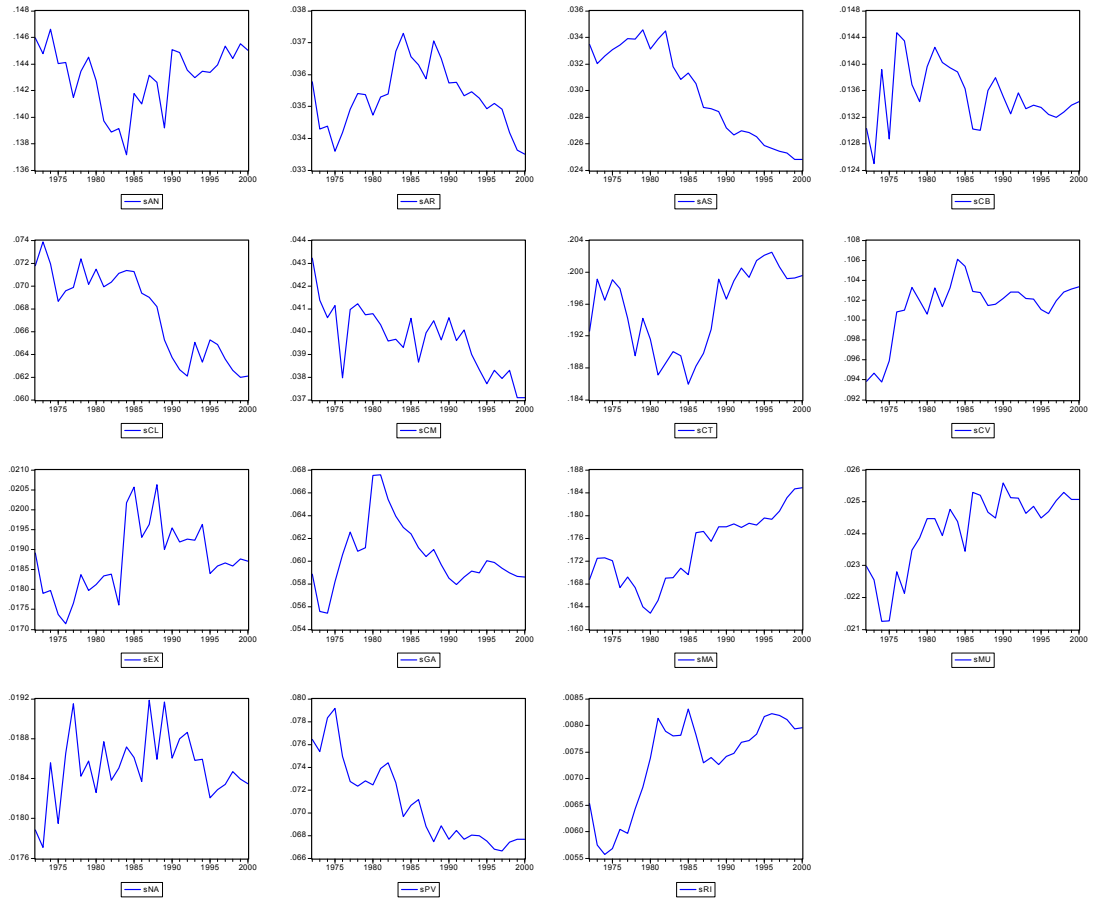
Figure 1: Spanish Peninsular Regions
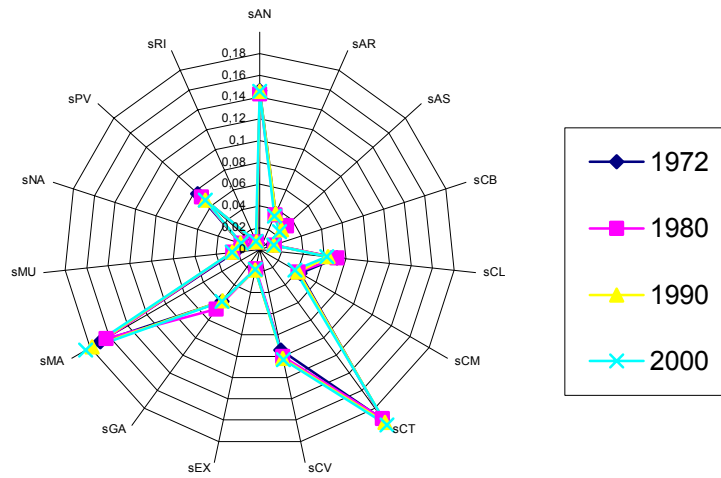
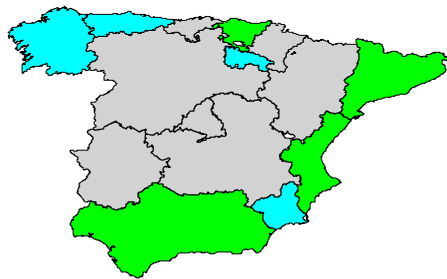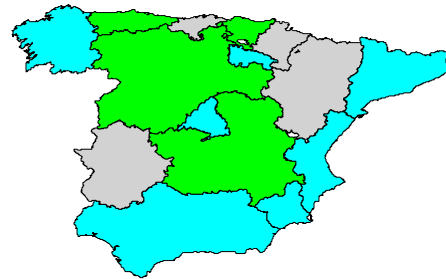Figure 2: Evolution of the regional shares

Figure 3: Comparative analysis of the regional shares for selected years: 1972, 1980, 1990, 2000
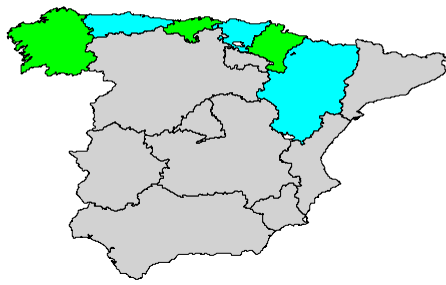

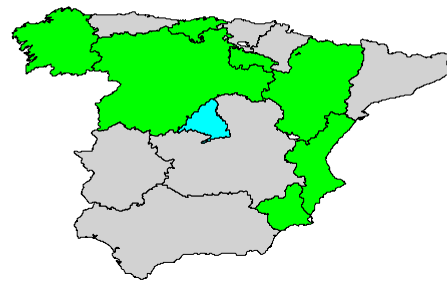NEIGHBOURHOOD EFFECT   ECONOMY-WIDE EFFECT

NOTE: -Green color indicates a significant negative coefficient. –Blue color indicates a significant positive coefficient. –Gray color indicates a non-significant coefficient.

Figure 3: Classification of the long-term effects

NEIGHBOURHOOD EFFECT   ECONOMY-WIDE EFFECT

NOTE: In this Figure, effects associated to the co-integration residuals are not taken into account. -Green color indicates a significant negative coefficient. –Blue color indicates a significant positive coefficient. –Gray color indicates a non-significant coefficient.

Figure 5: Classification of the short-term effects

Table 1: Unit root tests

Nomenclature	Definition	ADF test (levels / first difference)		PP test (level/first difference)	
sAN	share Andalucía	-2.66*	-7.38***	2.62	-7.63***
sAR	share Aragón	-1.27	-5.44***	-1.45	-5.53***
sAS	share Asturias	-2.09	-4.91***	-1.98	-5.55***
sCB	share Cantabria	-3.89***	-8.48***	-3.86***	-8.99***
sCL	share Castilla-León	-2.53	-6.38***	-2.61	-6.31***
sCM	share Castilla-La Mancha	-1.45	-9.01***	-2.93*	-10.0***
sCT	share Cataluña	-1.49	-6.23***	-1.54	6.22***
sCV	share Valencia	-2.69*	-5.03***	-2.74*	-5.03***
sEX	share Extremadura	-2.52	-7.01***	-2.51	-7.89***
sGA	share Galicia	-1.80	-4.66***	-1.70	-4.38***
sMA	share Madrid	-0.41	-5.50***	-0.36	-5.49***
sMU	share Murcia	-1.52	-6.61***	-1.51	-7.11***
sNA	share Navarra	-2.56	-4.72***	-2.61	-4.76***
sPV	share País Vasco	-1.46	-6.21***	-1.36	-4.89***
sRI	share La Rioja	-1.11	-4.62***	-1.25	-4.63***
log GNP	log national GAV (15 regions)	1.08	-3.34**	-0.14	-3.40**

NOTE: *, ** and *** denote significance at the 0.1, 0.05 and 0.01 level respectively.

Table 2: Local-global effects in the long term (Equation 1: $s_{it} = \beta_{0,i} + \beta_{1,i}[Ws]_{it} + \beta_{2,i}\log GNP_t + \varepsilon_{it}$)

REGION	Local effect [*Ws*]	Global effect log *GNP*	Results of co-integration analysis (Johansen) (Max. eigenvalue/Trace)
Andalucía	-1.3361[**] (-1.976 / 0.05)	0.0039[*] (1.901 / 0.07)	35.10 / 55.07
Aragón	0.4424 (0.676 / 0.51)	-0.0007 (-0.656 / 0.52)	35.44 / 51.25
Asturias	0.3777[***] (2.744 / 0.01)	-0.0133[***] (-10.016 / 0.00)	43.88 / 59.58
Cantabria	0.1456 (1.353 / 0.188)	0.0018 (0.990 / 0.332)	44.50 / 62.29
Castilla-León	1.0976 (1.307 / 0.20)	-0.0164[***] (-9.634 / 0.00)	32.51 / 57.86
Castilla-La Mancha	0.3005 (1.029 / 0.31)	-0.0058[***] (-4.562 / 0.00)	38.53 / 63.41
Cataluña	-2.2600[***] (-7.277 / 0.00)	0.0213[***] (8.210 / 0.00)	36.40 / 52.21
Valencia	-1.9435[***] (-4.958 / 0.00)	0.0126[***] (5.803 / 0.00)	38.31 / 50.82
Extremadura	-0.2310 (-1.134 / 0.27)	0.0002 (0.110 / 0.91)	39.40 / 59.230
Galicia	2.2152[***] (5.126 / 0.00)	0.0332[***] (4.397 / 0.00)	39.21 / 57.64
Madrid	-0.8437 (-1.515 / 0.14)	0.0167[**] (2.549 / 0.02)	54.76 / 72.62
Murcia	0.3815[*] (1.679 / 0.10)	0.0038[***] (4.257 / 0.00)	32.49 / 53.78
Navarra	-0.1932 (-1.260 / 0.22)	-0.0007 (-0.959 / 0.35)	37.55 / 64.97
País Vasco	-3.4001[***] (-3.673 / 0.00)	-0.0126[***] (-7.553 / 0.00)	41.49 / 55.42
La Rioja	0.8604[**] (2.489 / 0.02)	0.0102[***] (3.450 / 0.00)	44.93 / 64.31

NOTES: In parentheses, beneath the estimated coefficients, appear the *t* statistics and the associated *P*-values. With respect to Johansen tests for the null hypothesis of absence of co-integration, critical values are 22.04 ($\alpha = 0.05$) and 19.86 ($\alpha=0.1$) in the case of the maximal eigenvalue test; on the other hand, 34.87 ($\alpha=0.05$) and 31.93 ($\alpha=0.1$) in the trace test. *, ** and *** indicate significant at 10%, 5% and 1%, respectively.

Table 3: Qualitative analysis of the local-global effects in the long term

		Local effect		
		-	**0**	**+**
Global effect	**-**	PAÍS VASCO	CASTILLA-LEÓN CASTILLA-LA MANCHA	ASTURIAS
	0		EXTREMADURA ARAGÓN CANTABRIA NAVARRA	
	+	ANDALUCÍA CATALUÑA VALENCIA	MADRID	GALICIA LA RIOJA MURCIA

NOTE: (**-**)= significant negative coefficient; (**+**)=significant positive coefficient; (**0**)=non-significant coefficient.

Table 4: Local-global effects in the short term (Equation 2:
$\Delta s_{it} = \delta_{0,i} + \delta_{1,i}\Delta s_{i,t-1} + \delta_{2,i}[W\Delta s]_{i,t-1} + \delta_{3,i}\Delta \log GNP_{t-1} + \delta_{4,i}\hat{e}_{i,t-1} + \delta_{5,i}[W\hat{e}]_{i,t-1} + u_{it}$)

	Local effects		Global effects	
REGION	$[W\Delta s]_{t-1}$	$[W\hat{e}]_{t-1}$	$\Delta \log GNP_{t-1}$	$\hat{e}_{t-1}$
Andalucía	0.0104 (0.014 / 0.99)	0.2375 (0.311 / 0.76)	0.0275 (1.380 / 0.18)	-0.5990*** (-3.239 / 0.00)
Aragón	0.9043*** (2.754 / 0.01)	-0.5654** (-2.462 / 0.02)	-0.0123** (-2.034 / 0.05)	0.0237 (0.189 / 0.85)
Asturias	0.5258*** (2.958 / 0.01)	-0.3062 (-1.366 / 0.19)	-0.0009 (-0.094 / 0.93)	-0.3016 (-1.552 / 0.14)
Cantabria	-0.2496* (-1.907 / 0.07)	-0.0725 (-0.517 / 0.61)	-0.0070* (-1.867 / 0.08)	-0.9950*** (-5.705 / 0.00)
Castilla-León	-0.4137 (-0.523 / 0.61)	-0.3555 (-0.408 / 0.69)	-0.0270** (-2.034 / 0.05)	-0.6015*** (-2.925 / 0.01)
Castilla-La Mancha	-0.0505 (-0.117 / 0.91)	0.0326 (0.087 / 0.93)	0.0095 (0.884 / 0.39)	-0.8731*** (-3.856 / 0.00)
Cataluña	0.1216 (0.226 / 0.82)	0.7426* (1.704 / 0.10)	0.0141 (0.570 / 0.58)	-0.7311*** (-3.279 / 0.00)
Valencia	0.4165 (0.797 / 0.43)	1.1899 (1.340 / 0.19)	-0.0325* (-2.008 / 0.06)	-0.9337*** (-2.784 / 0.01)
Extremadura	0.2212 (1.3184 / 0.20)	-0.2980 (-1.570 / 0.13)	0.0057 (0.771 / 0.45)	-0.4796*** (-2.775 / 0.01)
Galicia	-0.9984*** (-2.851 / 0.01)	-0.2428 (-0.564 / 0.58)	-0.0530*** (-3.632 / 0.00)	-0.7586*** (-5.335 / 0.00)
Madrid	-0.3609 (-0.628 / 0.54)	0.5408 (0.692 / 0.50)	0.0531* (1.7246 / 0.10)	-0.5084** (-2.615 / 0.02)
Murcia	-0.0159 (-0.101 / 0.92)	-0.1313 (-0.846 / 0.41)	-0.0120* (-1.853 / 0.08)	-0.4758*** (-2.909 / 0.01)
Navarra	-0.2656** (-2.157 / 0.04)	0.2510* (1.986 / 0.06)	0.0028 (0.888 / 0.39)	-0.8330*** (-3.546 / 0.00)
País Vasco	1.9944* (1.948 / 0.07)	0.1348 (0.136 / 0.89)	0.0068 (0.437 / 0.67)	-0.7516*** (-3.445 / 0.00)
La Rioja	-0.0897 (-0.564 / 0.58)	-0.0786 (-0.526 / 0.60)	-0.0089*** (-2.808 / 0.01)	-0.2305** (-2.074 / 0.05)

NOTES: In parentheses, beneath the estimated coefficients, appear the *t* statistics and the associated *P*-values. *, ** and *** represent 10%, 5% and 1%, level of significance, respectively.

Table 5: Qualitative analysis of the local-global effects in the short term

		Local effect		
		-	**0**	**+**
Global effect	**-**	CANTABRIA GALICIA	CASTILLA-LEÓN VALENCIA MURCIA LA RIOJA	ARAGÓN
	0	NAVARRA	ANDALUCÍA CASTILLA-LA MANCHA CATALUÑA EXTREMADURA	ASTURIAS PAÍS VASCO
	+		MADRID	

NOTE: effects associated to the co-integration residuals are not taken into account. (**-**) denotes significant negative coefficient; (**+**) denotes significant positive coefficient; (**0**) denotes non-significant coefficient.