

## Interpersonal transfers: Do they impact the growth of poor and rich European regions?

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**ABSTRACT:** The purpose of this paper is to investigate how national interpersonal transfer policies affect regions' economic growth. Reviewing the economic literature, we found only incidental evidences and contradictory conclusions. Our objective is to provide some statistical evidence of the relation between interregional interpersonal redistribution towards poor European regions and their relative growth. Using some recent developments in the field of spatial data analysis, we found that interpersonal transfers do not seem to affect negatively the economic growth of poor European regions, while it is not possible to assert their impact on rich regions.

**JEL classification:** R1, R11, H24.

**Key words:** Income transfers, regional growth, spatial dependence.

### Transferencias interpersonales: ¿Impactan en el crecimiento de las regiones pobres y ricas de Europa?

**RESUMEN:** El propósito de este artículo es investigar cómo las políticas de transferencias interpersonales a nivel nacional afectan el desarrollo económico de las regiones. Tras una revisión de la literatura económica, encontramos solamente evidencias fortuitas y conclusiones contradictorias. Nuestro objetivo es proporcionar evidencia estadística acerca de la relación entre la redistribución interpersonal interregional hacia regiones europeas pobres y su crecimiento relativo. Usando algunos desarrollos recientes en el campo del análisis de datos espaciales, encontramos que las transferencias interpersonales no parecen afectar negativamente el desarrollo económico de regiones europeas pobres, mientras que no es posible afirmar su impacto en regiones ricas.

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**Palabras clave:** Transferencias de ingresos, crecimiento regional, dependencia espacial.

## 1. Introducción

In modern countries, interpersonal redistribution is widely implemented. The tax system organizes a redistribution of resources between households, lowering disparities of disposable income. This interpersonal redistribution gives rise to an important interregional redistribution: net transfers flow to or from regions, typically increasing the purchasing power in lagging regions while reducing that of more prosperous regions.

To what extent rich regions should share their affluence with less fortunate ones is a subject of political contention in many developed countries. Large or growing interregional income disparities tend indeed to generate political tensions. In a context of sluggish growth and intense international competition, rich regions belonging to federal states like Belgium, Germany or Canada complain that excessive transfers curb regional government efforts to strengthen the economic development. In Belgium, for instance, where interregional disparities are not only economic but also cultural (and linguistic), claims from the Northern Flemish region for a split of the country often ground on such considerations. In this view, substantive transfers not only hinder economic performances of the rich but also tend to slow the catching up of poor regions.

The purpose of this paper is to investigate if national interpersonal transfer policies affect regions' economic growth. Our objective is to provide some statistical evidence of the relation (if any) between interregional interpersonal redistribution towards poor European regions and their relative growth. Ideally, we should not have limited the study to the interpersonal transfers and rather considered the whole financial flows between regions. However, the highly complex interplay of regional policies, interpersonal and institutional solidarity, intergovernmental financial grants and other fiscal equalization mechanisms makes the homogenized computation of actual amount of interregional transfers hardly possible on an international basis<sup>1</sup>. Hence, our approach is partial but should nevertheless shed some light on an increasingly debated topic: is a transfer policy able to achieve equity and growth simultaneously?

The layout of this paper is as followed. Section 2 gives a brief outline of the main results of the economic literature. We shall see that the literature provides only incidental evidences and contradictory conclusions. Section 3 and Section 4 are then devoted to the empirical analysis. We found that interpersonal transfers do not seem to affect negatively the economic growth of poor European regions, while it is not possible to assert their impact on rich regions.

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<sup>1</sup> See Wishlade *et al.* (1996) or Begg (2003).

## **2. Interpersonal solidarity and economic growth: a short review of the literature**

The relationship between income redistribution and economic growth is the subject of a large literature. Implicitly or explicitly, many of the discussions refer to the trade-off between the goals of growth and (interpersonal) equity, made popular by Okun (1975). In this view, income inequality is said «to reflect a system of rewards and penalties that is designed to encourage effort». On the contrary, taxes and transfers reduce incentives to work, savings and investments, resulting in market rigidities, forgone work effort in the present and reduced investment and growth in the future.

The trade-off argument, long a prominent feature of most economics textbooks, is now widely contested. In particular, one major theme of the endogenous growth theory is precisely that such a trade-off does not exist. Within this framework, the general presumption is a positive association between equality and growth. This results from emphasis put in new growth models on the importance of human capital, of intergenerational transmission of both human and physical capital and of externalities in production. Reviewing the vast literature on inequality and growth, Aghio, Caroli and García-Peñalosa (1999, p. 1656), conclude «that when capital markets are imperfect, there is a scope for redistributive policies which are also growth-enhancing»<sup>2</sup>.

Although numerous studies have investigated the connexion between income redistribution and economic growth, to our knowledge, relatively few have dealt with underlying regional implications. Of course, the impact of interregional transfers on regional growth has long and extensively been scrutinized in spatial economics. However, the bulk of this literature focuses on interregional transfers in the form of public investment or the providing of productive public services: education, Research and Development (R&D) financing, infrastructure, in particular transportation facilities, etc. The reason is probably that regional redistribution based on personal transfers does usually not belong to the framework of analysis of regional policy. Moreover, as Dupont and Martin (2006, p. 3) point out, reducing regional disparities does not necessarily lead to a reducing of inequalities among individuals. This in turn raises interesting questions on the relation between spatial disparities and individual inequalities. Let's note that the purpose of our contribution, i.e. assessing the impact of interpersonal redistribution on regional economic growth, actually amounts to discuss this relation, but maybe in a somewhat unusual and admittedly partial fashion.

Due to its financial importance, the European so-called cohesion policy has yielded an important body of researches aimed at assessing its impact on the European Union (EU) regions' growth and convergence. However, Ederveen et al. (2002) note that the large number of case studies, model simulations and some (though surprisingly few) econometric studies offer no consensus about the cohesion policy on convergence. «Researches draw different conclusions from different studies, ranging from a dismal impact on economic growth of lagging regions to widely positive assessments of pro-

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<sup>2</sup> Cited by Saunders (2001), p. 273.

jects, yielding rates of return that are unheard of in the private sector», they observe (p. 48).

Interregional transfers that take place to diverse extent within most European countries have also spurred some empirical works investigating their efficiency and equitableness. One may cite among others De la Fuente and Vives (1995), Garcia-Milà and McGuire (2001) or De la Fuente (2002), who evaluate the effectiveness of interregional transfers (and EU grants) in Spain, Ferreira Dias and Silva (2004) who assess the impact of interregional transfers on the convergence of Portuguese regions or Decressin (1999) and Auteri and Constantini (2003), who analyse the transfers to the Italian Southern regions. However, this literature as well as other similar researches hardly depict a consistent picture. A quite general outcome is that interregional transfer policies do not come up with the high expectations they have raised (Ederveen *et al.*, 2002). Reasons are possibly double: either because transfers would be poorly effective at improving the overall economic performance of lagging regions or even because they would actually cause aggregate welfare losses (De la Fuente, 1995). Another line of empirical research dealt with income convergence in the line of the Barro and Sala-I-Martin's seminal work<sup>3</sup>. A recurrent result of these estimations is that the speeds at which regions of different countries converge over time periods are «surprisingly» similar (Sala-I-Martin, 1996, p. 1342). Hence, if the speed of regional convergence is similar for countries characterized by widely different regional cohesion policy, the effects of such a regional policy could hardly be very substantive.

Interregional transfers have also been subject to a substantial amount of theoretical work. One contribution is the design of optimal transfers instruments, another one is the analysis of the complex interplay of conflicting agents' behaviours and its impact on the regional economy. The New Economic Geography (NEG) proved to be in this respect a particularly valuable approach. The contribution of the NEG in assessing the mixed results of the financing of regional transportation infrastructure offers a good illustration. Another example is the NEG highlighted equity and efficiency trade-off at the regional level. Because some economic agents are not (or not very) mobile, an equity motivation asks for a more uniform distribution of economic activities across regions. Conversely, from an efficiency perspective, positive agglomeration gains, mainly due to economies of scale, plead for a greater concentration. A cohesion policy intended to achieve a more balanced economic development across regions can therefore be achieved only at the expense of the aggregate growth. On the other hand, due to the cumulative, non-linear nature of the agglomeration process, it is difficult to anticipate (and evaluate) the effects of such cohesion policies (Puga, 2002 and Baldwin *et al.*, 2002).

Some authors have nevertheless attempted to assess the effects of non-capital transfers, but the results also offered disparate and mixed, even conflicting evidences. Desmet (2002), for instance, argues that transfers linked to unemployment benefits or public employment contribute to the long-run persistence of uneven regional development, essentially by raising the real wages in poor regions without a correspon-

<sup>3</sup> Barro and Sala-I-Martin (1991, 1992 and 1995). See De la Fuente (1997) for a selective review.

ding rise of productivity. This so-called paradox of immiserizing transfers does not apply to capital subsidies, which increase the likelihood of a lagging region taking off<sup>4</sup>. Martin (1998 and 1999) notes that a financial transfer should succeed in lowering regional income inequalities, but at the expense of the aggregate growth rate. In his view, the transfer policy induces some firms to relocate to the beneficiary region. This lower induced concentration results in turn in less local spillovers and higher transaction costs. Conversely, Futamura (1998), whose study may easily be reinterpreted in regional terms, suggests that current transfers do not necessarily hinder efficiency while capital transfers do. This surprising conclusion results from the following: as the transfer depends on the capital stock differential between the poor and the rich regions, both regions have an incentive to reduce their capital stock in order to increase or lower the amount of transfer respectively received or granted.

At the end of this short review, it becomes apparent that our topic has still to be settled. On a regional scale, the impact of the interpersonal solidarity induced income transfers on the regional economic growth has been relatively little-studied and remains a much debated issue. Both theoretical and empirical researches offered mixed or incidental results.

In the following sections, we intend to make a modest contribution to this debate by trying to estimate the impact of interpersonal transfers on the economic growth of European regions.

### 3. A first specification of the model

The question we try to answer is simple. Does the tax-transfer system help convergence between poor regions and rich regions or does it slow the «catching-up» of lagging regions? Or, to put it straightforward, does granting or receiving transfers have an impact on regional economic growth rates?

If the question looks simple, the answer is not. It is evident that fast growing regions are mainly contributors to transfers and slowly growing mainly beneficiaries from transfers. A simple correlation will then indicate that for contributors higher paid transfers are related to a higher growth while for beneficiaries higher received transfers are related to a lower growth. This observation is naïve. A right answer should take into account all factors affecting growth to see if «all those factors being taken constant» higher transfers impact growth. To answer this question, we begin to test a simple *ad hoc* model, whose formulation takes the following form:

$$g_r = \alpha + \beta_1 Y_{0,r} + \beta_2 g_c + \beta_3 REL_r + \beta_4 T1_r + \beta_5 T2_r + \varepsilon_r \quad [1]$$

where  $g_r = (\ln Y_{T,r} - \ln Y_{0,r})/T$  is the annual regional growth rate for region  $r$  ( $r = 1, \dots, R$ ), with  $Y_{0,r}$  indicating the *per capita* gross domestic product (GDP),  $\alpha$  and  $\beta$  are

<sup>4</sup> Note that Desmet (2002) only considers how transfers affect the chance of a region of attracting new technologies in the long run.

the unknown parameters to be estimate and  $\varepsilon_r$  stands for the error term with the usual properties.

The determinants of economic growth have been proved to be numerous, varying across searchers and across papers. Among this vast array of results, the initial level of income systematically seems to matter in nearly all regressions run in the literature (Sala-I-Martin, 1996). Routinely introduced to test the concept of conditional convergence first defined by Barro and Sala-I-Martin (1992), the initial level of income is usually found to have a significant negative impact on growth<sup>5</sup>. The initial level is denoted  $y_{0,r}$  with  $y_{0,r} = \ln Y_{0,r}$ .

Regional growth dynamics can not be considered independently from neighbouring economic performances. Spatial economics has amply demonstrated the importance of geographic location on regional growth. To attempt to take account of it in a very simple way, we introduce in the regression the growth rate  $g_c$  of the country to which the region belongs. It is expected to somehow capture any regional spill-over effects occurring within a country. We do not know a priori the sign of the coefficient associated with  $g_c$ , as the theory predicts positive effects as well as depressing effects, depending on factors such as transport cost or production factors mobility<sup>6</sup>.

The growth rate of a region depends on numerous structural elements that influence its performance in a constant way relatively to the national one. To try to capture all those elements, we introduce the variable  $REL_r$ , an indicator of the relative wealth of the region with respect to the nation<sup>7</sup>. It is expected that regardless of the importance of the transfers received, a relatively poorer region in a richer country will enjoy a lower growth due to the permanence of structural elements that impede its economic development.

Finally,  $TI_r$  and  $T2_r$  are the variables whose coefficients interest us.  $TI_r$  ( $T2_r$ ) is equal to the interpersonal transfer indicator if a region  $r$  is a beneficiary of (contributor to) interregional transfers and zero if not.

Assessing the impact of interregional income transfers on regional economic growth comes up against a major difficulty, namely the assessments of the flows themselves. As Wishlade *et al.* (1999) point out, the difficulty of measuring interregional transfers induced by the complex interplay of national taxes, public spending and social security expenditures are both conceptual and statistical. At the conceptual level, it is often unclear how a particular tax or a particular expenditure should be re-

<sup>5</sup> Two others variables that are also widely used in the growth literature are the average investment rate and an indicator of the level of human capital (for instance, primary or secondary enrolment rate). However, the lack of an extensive homogeneous dataset prevents us from testing such variables.

<sup>6</sup> The national average is computed as followed:  $g_c = \sum g_r (p_r/p_c)$  where  $g_c$  is the GDP *per capita* growth rate in country  $c$  (to which the region  $r$  belongs) and  $p_i$  ( $i = r, c$ ) is the population in region  $r$  and in country  $c$ , respectively.

<sup>7</sup> This indicator is computed as the ratio of the regional against national primary income *per capita*:

$$REL_r = \frac{prim_r/p_r}{prim_c/p_c}$$

where  $prim_i$  ( $i = r, c$ ) denotes as above the primary income of region  $r$  and country  $c$ , respectively and  $p_i$  ( $i = r, c$ ) is the population in region  $r$  and in country  $c$ , respectively.

gionally allocated. Moreover, even if and when a particular type of revenue or expenditure can be split between regions in theory, there may well be statistical difficulties in practice (p. 116). Accordingly, relatively few studies have been undertaken to assess the extent of interregional income transfers and among those, even less have tried to realize the exercise at a multinational level. National specific solidarity mechanisms and regional redistribution practices make it difficult to arrive at a common definition of interregional flows. According to Begg (2003, p. 55), there is even little to be gained by trying to shoehorn data constructed on such varying bases into a single empirical measure.

In this contribution, we chose to restrict our definition of interregional transfers to those arising from the sole interpersonal solidarity mechanisms. More precisely, we derived an index grounded on the comparison of regional household primary and disposable incomes. The intuition is simple. Personal tax transfer-system results in substantial flows to or from regions, typically increasing the disposable income of weaker regions, while reducing that of more prosperous regions. Our transfer index, called  $trsf_r$ , is computed as followed:

$$trsf_r = \frac{dispo_r / dispo_c}{prim_r / prim_c}$$

where  $dispo_i$  and  $prim_i$  [ $i = r, c$ ] are respectively the primary and disposable incomes measured in region  $r$  and in country  $c$ . A  $trsf_r$  index superior to one reveals that the region  $r$  is a net beneficiary of interregional transfers within the country  $c$ . An index inferior to one indicates that the region is a net contributor. Accordingly, we introduce in (1) two variables for the transfers,  $T1_r$  equals to  $trsf_r$  for beneficiary regions (i.e. regions displaying  $trsf_r$  values superior to one) and 0 for contributing, and  $T2_r$  equals to  $1/trsf_r$  for contributing regions (i.e. regions displaying a transfer index inferior to one) and 0 for beneficiary regions. Hence, we will try to unravel the impact of transfers on the economic growth of beneficiary regions from the effect on the performance of contributing regions. Note that by construction the higher the transfers, the higher are the transfer indicators.

This measure is obviously partial, as it does not take into account transfers induced by public spending, health care reimbursements or explicit transfers between sub-national governments<sup>8</sup>. Nevertheless, our index provides an indication of the level of interregional transfers, through interpersonal solidarity, which accounts for a big stake of interregional transfers. One can hardly imagine a region benefiting from a high level of personal solidarity that turns out to be actually a net regional transfers contributor. Moreover, the index has the crucial advantage to be based on standardized income statistics immediately available.

Our approach clearly suffers from a limitation. Coefficients of  $T1$  and  $T2$  will probably be affected by a simultaneity bias as higher transfers are associated with

<sup>8</sup> The  $trsf_r$  index does however takes into account explicit equalisation schemes that «tax» richer regions to support poorer ones («horizontal» transfers) and the interplay of national taxation and social charges, social protection payments («vertical» transfers).

higher growth for the contributors and lower growth for the beneficiaries, so that the results will have to be interpreted with caution.

## 4. Data

The data are extracted from the EUROSTAT-REGIO database (see Annex). EUROSTAT is the Statistical Office for the European Communities.

Measures for the regional GDP (in Purchasing Power Parity, PPP) *per capita*, regional population and regional primary and disposable incomes come from the EUROSTAT-REGIO database, which is widely used in empirical studies on European regions. Our sample included 230 NUTS-2 regions in 15 European countries over the period 1995-2002<sup>9</sup>: Austria (9 regions), Belgium (11 reg.), Czech Republic (8 reg.), France (22 reg.), Germany (41 reg.), Greece (13 reg.), Hungary (7 reg.), Ireland (2 reg.), Italy (19 reg.), Netherlands (12 reg.), Poland (16 reg.), Portugal (5 reg.), Slovakia (3 reg.), Spain (16 reg.), Sweden (8 reg.) and United Kingdom (37 reg.).

It is worth noticing that the PPP measure means implicitly that the computed growth rates are not the usual GDP growth but a measure of the regional performance relative to the average European growth<sup>10</sup>.

The choice of the NUTS-2 as our level of regional breakdown is dictated by data availability. Ideally, this choice should have been based on theoretical considerations, as the spatial scale of observations may affect the inference results. In the literature, this problem is referred to the modifiable areal unit problem (or MAUP) (Openshaw and Taylor, 1979)<sup>11</sup>. Accordingly, due to possible MAUP effects, we shall interpret our statistical results with caution.

## 5. OLS estimations results

Ordinary Least Squares Estimation results applied to the specification (1) are shown in Table 1.

<sup>9</sup> The choice of the observation period is simply dictated by data availability and our will to use a sample as large and homogenous as possible. Periods lasting from 1995 to 2000, 2001 or 2002 are commonly used in the literature so that we do not expect any significant impact of this choice on the results.

<sup>10</sup> One consequence of this is that our estimated coefficient should not be compared with similar coefficients in the literature, on convergence for instance.

<sup>11</sup> As an example of the MAUP issue, Dall'erba (2005) notes that the area of Castile-Leon (in Spain) is 585 times greater than the one of Brussels (Belgium), but that both are official NUTS-2 regions. Accordingly, when «the spatial units scale of observation for the data do not match up the scale and extent of the studied process, it may result in a statistical problem wherein spatially correlated and/or heteroskedastic error structures occur» (p. 126). Another problem arises from measuring a variable on a territorial unit that is artificially defined (p. 126).

**Table 1.** OLS estimates for specification (1)

<i>Variables</i>	<i>estimates</i>	<i>t-stat</i>	<i>p &gt;  t </i>
(Intercept)	-4.852	-2.274	0.006
GDP level in 1995	-0.337	-1.626	0.105
Transfers received	4.408	3.164	0.002
Transfers granted	4.575	3.273	0.001
National growth rate	0.876	13.639	0.000
Relative level of primary income	1.654	3.166	0.000
Number of observations = 230			
F(5,224) = 82.82			
Prob > F = 0.000			
R <sup>2</sup> = 0.657			
AIC = 549.014			
SC = 569.642			

The coefficient associated with the initial *per capita* GDP is negative but statistically insignificant at the conventional level of significance. The coefficients of both  $g_c$  and  $REL_r$  are found to be positive and significant. Economic growth of a region is thus all the more important as the region belongs to a growing national economy. It is also positively correlated with the relative regional wealth: a region whose primary income is higher than the national average tends to grow faster than a region displaying relatively lower income performance.

Transfers, both received and granted, have a positive impact on growth. The interpretation of the sign of the coefficients of the transfer indexes asks however for caution. We mentioned previously the likely presence of a simultaneity bias. This one should be negative for slow growing regions as they are potentially major beneficiaries from transfers and positive for fast growing regions as they are major contributors.

Taking this possible bias into account, the results shown in Table 1 suggest that transfers received have a positive impact on lagging regions' growth while the partial positive correlation between transfers granted and growth (for rich regions) stems from the simultaneity bias.

Until now, countries and regions are actually treated as independent economies, which is highly unlikely. In reality, regions do interact with each other and not only with their national regions. Spatial interactions due to geographical spillovers need then to be better taken into account in a more sophisticated way than the one adopted in the simple OLS model.

<sup>12</sup> Spatial autocorrelation has two different sources (Debarsy and Ertur, 2006). It can be detected when the observations obey to an underlying spatial process that links spatial units by an exact function which captures interaction effects among studied localizations. Spatial dependence can also result from a misspecification of the model, such as measurement error, incorrect functional form, or the omission of some spatially correlated variables.

## 6. Spatial dependence

Following Anselin (1988), spatial interactions refer to both spatial dependence and spatial heterogeneity. This author defined spatial autocorrelation as the coincidence of value similarity with locational similarity<sup>12</sup>. In other words, spatial dependence occurs when the observations at one location partly depend on the values of observations at neighbouring locations, the neighbourhood being defined by a spatial weight matrix. Spatial heterogeneity means in turn that economic behaviours are not stable over space. Spatial heterogeneity can be reflected either by varying coefficients, *i.e.* structural instability, or by varying error variances across observations, *i.e.* heteroskedasticity (Beaumont *et al.*, 2003).

In this contribution, we shall only deal with the spatial autocorrelation issue.

The spatial weight matrix is the fundamental tool used to model spatial interconnectedness of the areas in the sample<sup>13</sup>. It exogenously defines the way regions are spatially connected. By convention, the elements  $w_{ii}$  on the diagonal are set to zero whereas the elements  $w_{ij}$  indicate the strength of the connection between the pair of regions  $i$  and  $j$ . Generally, it is expected that neighbouring areas would have a stronger interaction compared to geographically distant areas.

The specification of the spatial weighted matrix is a major point of contention in the literature, because the choice of the weights can have a substantive impact on the results (Abreu *et al.*, 2004)<sup>14</sup>. There is however little formal guidance in the choice of the correct spatial weights in any given application (Anselin, 2002). One important consideration is nevertheless that, for identification reasons, the spatial weight matrix must be exogenous to the model<sup>15</sup>. Accordingly, in this paper, we chose to borrow the accessibility weight matrix from Debarsy and Ertur (2006), wherein the connection between two regions is defined by the time needed, using roads, to join the two regional capitals (which serve as reference points for regions)<sup>16</sup>. Formally, the Debarsy and Ertur (2006)'s spatial weight matrix is defined as follows:

$$\begin{cases} w_{ij}^* = (d_{ij})^{-\alpha} & ; \forall i \neq j \\ w_{ij}^* = 0 \end{cases}$$

<sup>13</sup> The specification of a spatial weight matrix is necessary because the variance-covariance matrix (in the presence of spatial autocorrelation) contains too many parameters to be estimated using cross-sectional data. Abreu *et al.* (2004).

<sup>14</sup> A range of suggestion have been offered in the literature. See Cliff and Ord (1973), Anselin (1988 and 2002), Anselin and Bera (1998).

<sup>15</sup> Actually, if the matrix contains any of the variables included in the empirical model, this one becomes highly non-linear. This pitfall explains why most spatial weight matrix are based on contiguity or distance, since these are geographic-based measures that are unambiguously exogenous (Abreu *et al.*, 2004). However, it could be interesting to investigate further the use of other non-binary spatial weights, that accounts for the socio-economic weights of the neighbours.

<sup>16</sup> Debarsy and Ertur (2006) used the ViaMichelin<sup>®</sup> website to compute distances between all pair of regions. The authors assumed that the time-distance separating two regions is identical, no matter the selected direction chosen. The ViaMichelin<sup>®</sup> recommended route is a mixed between the shortest and the quickest routes that takes deviations, road works, speed limits among others into account. The computation has been done in November 2004. Debarsy and Ertur (2006), p. 6.

where  $d_{ij}$  is a measure of the time-distance separating regions  $i$  and  $j$  and  $\eta$  is a parameter fixed a priori and set to 1. Finally, the weight matrix is row standardized so that it is the relative and not the absolute distance that matters (Beaumont *et al.*, 2003).<sup>17</sup>

Having a spatial weight matrix at our disposal, we can now turn to the modeling of spatial dependence. Two kinds of econometric specification are typically used to deal with spatial autocorrelation issue (Anselin, 1988, 2001): the endogenous spatial lag (or spatial autoregressive model, SAR) and the spatially autocorrelated errors (SEM). The former, the SAR model, incorporates a spatial lag variable, namely  $Wg$ , in the set of explanatory variables. Formally, the specification [1] becomes:

$$g = \alpha S + \rho Wg + \beta_1 y_0 + \beta_2 REL + \beta_3 TI + \beta_4 T2 + \epsilon \quad [2]$$

$$\epsilon \sim N(0, \sigma^2 I)$$

where  $S$  is a unit vector,  $\rho$  is the autoregressive parameter that indicates the intensity of spatial interaction between regions,  $W$  is the spatial weight matrix,  $g$  is the vector of the regional GDP growth rate between 1995 and 2002,  $y_0$  is the vector of the initial level of regional GDP *per capita* (in logarithm),  $REL$  measures the relative wealth of a region within its country and  $TI$  and  $T2$  stand for the level of transfer received and granted, respectively<sup>18</sup>.

Alternatively, spatial autocorrelation can be introduced by means of the error term. The so-called SEM specification transforms our initial model as follows:

$$g = \alpha S + \beta_1 y_0 + \beta_2 REL + \beta_3 TI + \beta_4 T2 + \epsilon \quad [3]$$

$$\epsilon = \lambda W\epsilon + u \quad u \sim N(0, \sigma^2 I)$$

where  $\lambda$  expresses the level of spatial autocorrelation between error terms of neighbouring regions.

According to Anselin (2002), if spatial lag model (SAR) can be referred to as dealing with substantive spatial correlation, the correlation in the error models (SEM) is usually more referred to as a nuisance<sup>19</sup>.

## 7. Estimation results

Statistical inference based on Ordinary Least Squares (OLS) when spatial dependence is present is not reliable<sup>20</sup>. Anselin (2002) notes that these models require spe-

<sup>17</sup> As pointed out by Anselin (2002, p. 16), the standardization of the spatial weight matrix suggests that a spatial lag operation (pre-multiplying a vector of observations by the matrix  $W$ ) corresponds to an averaging of the neighbouring values.

<sup>18</sup> Note that we dropped the variable  $g_c$  which became somehow redundant with the spatial lag variable.

<sup>19</sup> Indeed, as Florax and Nijkamp (2003, p. 14) point out, in the spatial error model, spatial dependence is caused either by (erroneously) omitted spatially correlated variables or is caused by boundaries of regions that do not coincide with actual behavioural unit.

<sup>20</sup> Estimation of SAR model by OLS yields biased and inconsistent estimators, because the spatially lagged variable is correlated with the error term. Estimation of the SEM model by OLS produces inefficient estimators due to non-spherical errors. Le Gallo (2002), pp. 146-147.

cialized estimation techniques, such as maximum likelihood, instrumental variables or generalized method of moments<sup>21</sup>. In this study, maximum likelihood techniques implemented through the Matlab Spatial Statistical Toolbox developed by J. Lesage have been used<sup>22</sup>. Results of the estimation by Maximum Likelihood are displayed in Table 2.

**Table 2.** Spatial autoregressive and error model estimates

<i>Variables</i>	<i>Spatial lag model</i>			<i>Spatial error model</i>		
	<i>Estimates</i>	<i>t-stat</i>	<i>p &gt;  t </i>	<i>estimates</i>	<i>t-stat</i>	<i>p &gt;  t </i>
(Intercept)	0.720	0.429	0.668	3.187	1.485	0.138
GDP level in 1995	-1.707	-8.991	0.000	-2.021	-9.126	0.000
Transfers received	3.909	3.010	0.002	4.006	3.163	0.002
Transfers granted	4.112	3.231	0.001	4.198	3.283	0.001
Relative level of primary income	2.980	5.381	0.000	3.319	5.878	0.000
RHO	0.964	39.057	0.000	n.a.	n.a.	n.a.
LAMBDA	n.a.	n.a.	n.a.	0.953	30.440	0.000
Log likelihood	-247.026			-246.199		
Sigma <sup>2</sup>	0.983			0.437		
AIC	504.052			502.398		
SC	521.242			519.588		

Table 2 shows that the spatial parameters in both the SAR and the SEM specification, respectively  $\rho$  and  $\lambda$ , are highly positive and significant, meaning that the intensity of spatial interactions is quite high.

Which specification does match best our purpose? Following the usual approach adopted in the literature, we first estimated a version of the model (1), from which the variable  $g_c$  has been removed, using Ordinary Least Squares. Then, the next step in modelling involved determining whether spatial autocorrelation was present in the residuals of the regression, and if so, whether it is best represented by a spatial lag (SAR) or spatial error (SEM) model.

Commonly used in the literature, the Moran's  $I$  test, adapted to regression residuals by Cliff and Ord (1981), is used to check the presence of global spatial dependence. Secondly, we performed the Lagrange Multiplier ( $LM$ ) tests to identify the nature of the spatial dependence: respectively  $LM_{LAG}$  and  $LM_{ERR}$  and their robust versions<sup>23</sup>. The results of these tests are shown in Table 3<sup>24</sup>.

<sup>21</sup> Maximum likelihood technique can be applied to estimate both SAR and SEM specifications. Instrumental variables provide an alternative method to estimate spatial lag models whereas the generalized method of moments may be used to estimate spatial error model. See Le Gallo and Dall'erba (2005).

<sup>22</sup> <http://www.spatial.econometrics.com>

<sup>23</sup> Lagrange multiplier (LM) error and lag tests may be affected by the presence of alternative form of spatial dependence. Hence the development of their robust versions. Trendle (2004), p.10.

<sup>24</sup> The Lagrange Multiplier tests are applied to the residuals of the OLS estimation of the model (1). (see Table 1).

**Table 3.** Tests for residual spatial autocorrelation

<i>Test</i>	<i>test value</i>	<i>p-value</i>
Moran's <i>I</i>	21530	0.000
LM error	164.593	0.000
LM lag	102.618	0.000
Robust LM error	63.281	0.000
Robust LM lag	1.306	0.253

The results of the Moran's *I* test suggest the presence of positive spatial autocorrelation, but provide no indication concerning the nature of the spatial dependence. Results of both *LM* error and lag tests are highly significant. The robust form of *LM* error test also returned significant results, but the robust *ML* lag test is not significant. This diagnosis tends to indicate the presence of spatial error autocorrelation rather than a spatial lag variable<sup>25</sup>. Finally, the Likelihood Ratio (*LR*) common factor test leads us to reject the more general spatial Durbin model.

The spatial error model (SEM) thus proves to be the appropriate specification for our dataset, what is generally confirmed by the empirical literature studying spatial dependence between European regions<sup>26</sup>. As regards the SEM results shown in Table 2, the estimation of a spatial specification leaves our conclusions unchanged. If the values of the estimated coefficients necessarily differ from previous OLS estimates, their sign, significance and therefore interpretation remain similar. In particular, the results suggest that interregional transfers received (*T1*) tend to improve the economic performance of slow growing regions. Conversely, we found no evidence that granting transfers (*T2*) hinders the economic growth of contributing regions. Note that the initial level of income is now statistically significant.

## 8. Conclusion

Is a transfer policy able to achieve equity and growth simultaneously? This paper intended to shed some light on this increasingly debated question by investigating if and how national transfer policies affect European regions' economic growth. We focused in particular on interpersonal solidarity induced transfers between regions. Our approach is modest and partial. Nevertheless it has the advantage to rest on standardized statistics.

Using some recent developments in the field of spatial data analysis, we found some evidences that interregional interpersonal transfers have a positive impact on the economic growth of poor regions. Conversely, it has not been possible to assert their impact on rich contributing regions.

<sup>25</sup> We follow the decision rule suggested by Anselin and Florax (1995). See Beaumont *et al.* (2003).

<sup>26</sup> See for instance Le Gallo and Dall'erba (2005) or Beaumont *et al.* (2003). Interestingly, Debarsy and Ertur (2006) find that spatial dependence between enlarged European Union regions is best represented by a spatial lag model (SAR).

The growth rate of a region depends on numerous determinants, other than the transfers, that are missing in our modelling. This important limitation is due to the shortage of reliable international data at a NUTS-2 spatial break-down and this issue should deserve further attention. Note however that the variable we introduced to capture the effect of structural elements that affect the performance of a region relative to its nation has been found constantly positive and significant. In relatively poor countries, rich regions tend to achieve better economic performances than poor regions and vice-versa.

Further investigations should be aimed to deal with possible spatial heterogeneity issue in our dataset as well as the computation of more detailed and comprehensive transfer statistics.

## 9. References

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## Appendix

Data for GDP per inhabitant are expressed in index in relation to the European Union (EU-25) average set to equal 100. If the index of a region is higher than 100, this region's level of GDP per inhabitant is higher than the EU average and vice versa. The volume index of GDP *per capita* is then measured in Purchasing Power Standards (PPS). For the calculation of regional GDP at level NUTS-2 the same purchasing power parity is used for all regions of one country.

Demographic data are computed on an annual average basis.

Data for primary income and disposable income come from regional household accounts (ESA-95). Both are expressed in millions of Euros (from 1.1.1999) and in millions of ECU (up to 31.12.1998).

Data for GDP *per capita* (PPS) and population are available for the whole period 1995-2002 for all the 230 regions of our sample. Primary and disposable income data are available for the whole period 1995-2002, for all sample regions, except for Austria (1995-2000): Hungary (1995-1999): Poland (1998-2001), Portugal (2000-2002) and the Netherlands (1995-2001).

We use the EUROSTAT 1995 nomenclature of statistical territorial units, which referred to as NUTS (Nomenclature of Territorial Units for Statistics). In this nomenclature, NUTS-2 means Basic Administrative Units. Our sample included 230 NUTS-2 regions in 15 European countries:

- Austria: 9 regions.
- Belgium: 11 regions.
- Czech Republic: 8 regions.
- France: 22 regions. *Guadeloupe*, *Martinique*, *Guyana* and *Reunion* are excluded because of their geographical distance.
- Germany: 41 regions.
- Greece: 13 regions.
- Hungary: 7 regions.
- Ireland: 2 regions.
- Italy: 19 regions. Autonomous provinces of *Bolzano* and *Trento* are excluded.
- Netherlands: 12 regions.
- Poland: 16 regions.
- Portugal: 5 regions. *The Azores* and *Madeira* are excluded because of their geographical distance.
- Slovakia: 3 regions.
- Spain: 16 regions. *Canary Islands*, *Ceuta* and *Mellila* are excluded.
- Sweden: 8 regions.
- United Kingdom: 37 regions.