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Decomposition of Regional Income Inequality and Neighborhood Component: a Spatial Theil Index

Miguel A. Márquez and Elena Lasarte*

Abstract

In recent decades, spatial effects have been incorporated into mainstream economics. Nevertheless, although the addition of these spatial effects to the inequality indexes would be a natural extension in this line of research, to our knowledge, there are not contributions assessing neighborhood effects in measures of regional economic inequalities. This paper proposes a Spatial Theil index that provides a decomposition of the Theil index that allows us to assess which part of regional inequalities is due to neighborhood features. The proposal is illustrated for the case of the Spanish peninsular provinces during the period 1980-2008.

Keywords: Inequality decomposition; interregional inequality.

JEL classification numbers: C43, C10; R1, R12.

Resumen

En las últimas décadas, los efectos espaciales se han incorporado a las principales líneas de investigación en economía. Sin embargo, a pesar de que la incorporación de dichos efectos espaciales en los índices de desigualdad sería una extensión natural de esta línea de investigación, hasta donde sabemos, no existen contribuciones que evalúen los efectos de vecindad dentro de las medidas de las desigualdades económicas regionales. En este trabajo se propone un índice de Theil espacial que proporciona una descomposición del índice de Theil que nos permite evaluar qué parte de las desigualdades regionales se debe a las características de los vecinos. La propuesta se ilustra para el caso de las provincias peninsulares españolas durante el período 1980-2008.

Palabras clave: Descomposición de la desigualdad; desigualdad interregional.

Clasificación JEL: C43, C10; R1, R12.

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1. INTRODUCTION

Regional inequalities is an important issue both for policy and economic research (see, among others, European Commission (2010), Alexiadis et al. (2013) and Tan and Zeng (2013)). As regional inequalities (and their links with the regional economic convergence processes) have become a debated topic in the last two decades (see, for example, Geppert and Stephan, 2008), regional disparities have been measured mainly using a variety of concentration statistics applied to spatial data (see, among others, Krugman (1991a) and Brülhart and Traeger (2005)). Within these concentration statistics, it is necessary to remark the notable usage of inequality indices as the Theil entropy indices (Theil, 1967) in a number of studies that measure regional income inequality. At the same time, this interest in regional inequalities has been generating a proliferation of studies measuring them. As a result, considerable effort has been devoted in recent years to elaborating new tools to assess and measure regional inequalities (see, among others, Akita (2003), Rey and Sastré-Gutiérrez (2010) and Bickenbach et al. (2012)).

On the other hand, regional analysts are well aware of the need to account for interconnections between regional economies. Regional interconnections are likely to be derived from the existence of externalities across regions. The earlier studies of Myrdal (1957) and Hirschman (1958) consider the role of external economies in explaining differential increases in regional economic growth, stimulating the appearance of an extensive literature related to the field of interregional externalities (see, amongst others, Krugman (1981), Kubo (1995) and Simonen (2006)). Thus, interregional externalities have been the subject of a great deal of current literature on endogenous growth theory and the new economic geography (for a survey, see Feser (1998)). Consequently, as externalities across regions are one of the major sources of spatial dependence, spatial effects are being introduced into empirical growth models (see, for example, López-Bazo (2004)). Therefore, it is not surprising that the last three decades have seen major theoretical and methodological developments in incorporating spatial effects into mainstream economics (Anselin (2010)).

Nevertheless, whereas this type of spatial analysis has been standard for Econometrics and Statistics in different fields (see, for example, Ramajo et al. (2009), Basile et al. (2012) and Anselin and Arribas-Bel (2013)), the counterpart for measures of regional disparities is much less developed. Thus, although it is possible to find recent contributions in this sense[1], a relevant question still remains: Which part of regional inequalities is explained by spatial (neighborhood) features? From this starting point, there would be two main ways of development: the first would be to analyze how the standard concentration statistics are modified by the consideration of space and what in turn, should be the contribution of these new statistical tools to the measures of regional disparities; the second is to understand how

[1] See, amongst others, Guimarães et al. (2011), where it is proposed the modification of the Ellison-Glaeser index to account for the existence of spatial autocorrelation, or Rey and Smith (2013), who propose a decomposition of the Gini coefficient that lets the detection of spatial autocorrelation conjointly with an indicator of overall inequality.

the new measures will affect the policy economic recommendations relative to regional disparities.

As suggested above, it is clear that clustering of economic performance in space has generated considerable research on the spillovers and linkages among geographical neighbors. It is well-known that economic effects can spill-over from a region to others, crossing the boundaries of regional economies. Accordingly, socio-economic activity in adjacent regions generates an inter-play between agglomeration and dispersion forces which, in turn, influence economic growth dynamics across domestic regions. In this context, understanding how regional inequalities may spread to neighbors or may hinder their economic performance is critical for policy design. Regional neighborhood provides a wider landscape of social and economic characteristics that can influence spatial inequalities. Nevertheless, to our knowledge, there are not contributions assessing neighborhood effects in measures of regional economic inequalities. Following Dietz (2002) almost all the existing research is focused on within neighborhood effects considering no interaction between neighborhoods. Although capturing the complex relationships between a regional economy and its neighborhood is difficult, this paper tries to measure the impact of neighborhood factors on inequality presenting a simple spatial Theil index. Thus, observed differences in regional per capita income might be partially attributable to neighborhood factors. Information about the relevance of regional neighborhood on the origin of regional inequality is provided by this decomposition of the Theil index of inequality over per capita incomes.

The rest of the paper is organized as follow. In Section 2, a decomposition of regional inequality by neighborhood factors is presented. Section 3 contains an empirical illustration of the proposal. Finally, some concluding remarks are given in Section 4.

2. DECOMPOSITION OF REGIONAL INEQUALITY BY NEIGHBORHOOD FACTORS

Which part of inequalities is due to neighborhood features? Although different inequality decomposition by income sources and by population subgroups have been developed to decompose inequality (a review of the theory and application of inequality decomposition techniques in a spatial and regional context can be found in Shorrocks and Wan, 2004), this issue has received little attention in the vast literature on spatial inequality.

Effectively, in the last decades spatial effects have been incorporated into econometrics and in the exploratory data analysis by means of simple descriptive statistics that have been extended to the spatial domain: directional means, circular and spatial variances, and the most famous spatial autocorrelation global/local statistics (Moran´s I, Geary´s ratio, local indicators of local spatial autocorrelation, G-Statistics, ...) [2]. Thus it

[2] For a review, see, among others, Fischer and Getis (1997), Anselin (2005) and Anselin (2010).

should be highlighted that the addition to these neighborhood effects to the inequality indexes is a natural extension in this line of research in spatial statistics.

Taking as point of departure the Theil (1967) index of inequality over per capita incomes, Duro and Esteban (1998) presented a decomposition of the Theil index of inequality into the unweighted sum of the inequality indices due to: productivity per employee worker (*y*), employment rate (*e*), active over-working age population rate (*a*), and active total population rate (*r*). In this decomposition, these authors use the country shares of aggregate population as weights. Goerlich-Gisbert (2001) extends the decomposition of Duro and Esteban (1998) to another Theil index of inequality where instead of the country shares of aggregate population, the country shares of aggregate income are used. Although others expression could be considered, we limit our attention to the paper of Goerlich-Gisbert (2001)[3].

Let x_i be the per capita income of region *i*, that is $x_i = X_i/N_i$, where X_i is a regional measure of income (Gross domestic Product or Value Added), and N_i is total population for the regional economic system (nation). Let p_i stands for the share of region *i* in the aggregate population $p_i = N_i/N$, and μ for the national average per capita income $\mu = X/N = \sum_{i=1}^{n} p_i x_i$, X and N being the corresponding national aggregate values.

Let E_i , A_i and R_i be region *i*'s total employment, active, and working-age populations, respectively; and let *E*, *A*, and R be the national aggregate values of these variables. We shall then denote regional productivity as $y_i = X_i/E_i$, the employment rate as $e_i = E_i/A_i$, the regional active over working-age population rate as $a_i = A_i/R_i$, and the working-age population over total population rate as $r_i = R_i/N_i$. It is clear that $x_i = y_i\, e_i a_i r_i$ and $\mu = y\, e\, a\, r$ where $y = X/E$, $e = E/A$, $a = A/R$ and $r = R/N$ are the average values of these variables.

Let us consider the Goerlich-Gisbert (2001, p. 305) index, where q_i stands for the share of region *i* in the aggregate income $q_i = X_i/X$:

$$T(x,q) = \sum_i q_i \log\left(\frac{x_i}{\mu}\right) = \sum_i q_i \log\left(\frac{y_i}{y}\right) + \sum_i q_i \log\left(\frac{e_i}{e}\right) + \sum_i q_i \log\left(\frac{a_i}{a}\right) + \sum_i q_i \log\left(\frac{r_i}{r}\right) \quad (1)$$

Now, our starting point is to consider the regional neighborhood as the unit of enquiry, rather than the individual region. Let $\mathrm{Wz_i}$ be the spatial lag for variable z in region *i*, where W represents the first-order spatial lag operator $\mathrm{Wz_i} = \sum_j \mathrm{w_{ij} z_j}$. In matrix notation, W is a $n \times n$

[3] For an example of the application of this decomposition, see Kataoka (2008). The present paper adapts the notation used by Goerlich-Gisbert (2001).

weighting matrix with elements w_{ij} . Wz_i is a weighted average of z_i in all regions except the i^{th} (because by convention, $w_{ii} = 0$). This way, the spatial Theil index will be: [4]

$$ST(x,sq)=\sum_i sq_i \log\left(\frac{WX_i}{s\mu}\right)=\sum_i sq_i \log\left(\frac{WX_i / WE_i}{\sum_i WX_i / \sum_i WE_i}\right)+\sum_i sq_i \log\left(\frac{WE_i / WA_i}{\sum_i WE_i / \sum_i WA_i}\right)+$$

$$\sum_i sq_i \log\left(\frac{WA_i / WR_i}{\sum_i WA_i / \sum_i WR_i}\right)+\sum_i sq_i \log\left(\frac{WR_i / WN_i}{\sum_i WR_i / \sum_i WN_i}\right) \qquad (2)$$

where sq_i stands for the share of regional neighborhood i in the aggregate regional neighborhoods $sq_i = WX_i / \sum_i WX_i$, and $s\mu$ for the neighboring average per capita income $s\mu = \sum_i WX_i / \sum_i WN_i$.

Let us subtract from the Theil index (1) the expression (2):

$$T(x,q)-ST(x,sq)=\left(\sum_i q_i \log\left(\frac{y_i}{y}\right)+\sum_i q_i \log\left(\frac{e_i}{e}\right)+\sum_i q_i \log\left(\frac{a_i}{a}\right)+\sum_i q_i \log\left(\frac{r_i}{r}\right)\right)$$

$$-\left(\sum_i sq_i \log\left(\frac{WX_i / WE_i}{\sum_i WX_i / \sum_i WE_i}\right)+\sum_i sq_i \log\left(\frac{WE_i / WA_i}{\sum_i WE_i / \sum_i WA_i}\right)+\right.$$

$$\left.\sum_i sq_i \log\left(\frac{WA_i / WR_i}{\sum_i WA_i / \sum_i WR_i}\right)+\sum_i sq_i \log\left(\frac{WR_i / WN_i}{\sum_i WR_i / \sum_i WN_i}\right)\right)$$

making a few manipulations, we obtain:

[4] It is necessary to emphasize that the definition of the weighting matrix influences the final conclusions that can be reached. Thus, we could consider different definitions of the W matrix, like contiguity/contact matrices (of different orders), other kind of distances (Euclidean, distances on networks...), etc. (even these are not used in the application). In addition, other alternative (non-geographical) definitions for the weights matrix could be contemplated.

$$T(x,q) = ST(x,sq) + \left(\sum_i q_i \log\left(\frac{y_i}{y}\right) - \sum_i sq_i \log\left(\frac{WX_i / WE_i}{\sum_i WX_i / \sum_i WE_i} \right) \right) +$$

$$\left(\sum_i q_i \log\left(\frac{e_i}{e}\right) - \sum_i sq_i \log\left(\frac{WE_i / WA_i}{\sum_i WE_i / \sum_i WA_i} \right) \right) + \left(\sum_i q_i \log\left(\frac{a_i}{a}\right) - \sum_i sq_i \log\left(\frac{WA_i / WR_i}{\sum_i WA_i / \sum_i WR_i} \right) \right) +$$

$$\left(\sum_i q_i \log\left(\frac{r_i}{r}\right) - \sum_i sq_i \log\left(\frac{WR_i / WN_i}{\sum_i WR_i / \sum_i WN_i} \right) \right) =$$

$$ST(x,sq) + ST(y,sq) + ST(e,sq) + ST(a,sq) + ST(r,sq) \qquad (3)$$

Expression (3) let us decompose expression (1), assessing which part of income inequality is due to neighbourhood factors (measured by the component $ST(x,sq)$ that isolates the neighborhood effect), and which part is explained by specific -local- factors (that is, components $ST(y,sq)$, $ST(e,sq)$, $ST(a,sq)$ and $ST(r,sq)$). These specific components isolate different factors that are free of neighborhood effects. Therefore, components $ST(y,sq)$, $ST(e,sq)$, $ST(a,sq)$ and $ST(r,sq)$ are factors related to local productivity, total employment, active population and working-age population, respectively. Specific factors try to measure the contribution of each individual factor at local level to measure aggregate inequality over per capita incomes. It is necessary to highlight that, according to Shorrocks (1982) and Goerlich-Gisbert (2001), unless the factors are not correlated, these contributions could be negative. As in this case the different factors are correlated, every component does not measure the contribution of a source of income differences to inequality of total incomes. Nevertheless, even if it is not clear what is the quantitative role of every factor, it will be possible to obtain a qualitative evaluation.

3. EMPIRICAL ILLUSTRATION: THE CASE OF THE SPANISH PROVINCES

In order to illustrate the proposal, we use data from the 47 Spanish peninsular provinces. Without loss of generality, we will perform the factor decomposition in two factors (apparent labour productivity and labour per inhabitant)[5]. Thus, expression (1) becomes:

[5] This decomposition has been used by different authors; see, amongst others, Garrido-Yserte and Mancha-Navarro (2010) for the case of the Spanish regional economic system, and Doran and Jordan (2013) for the European NUTS2 regions.

$$T(x,q) = \sum_i q_i \log\left(\frac{X_i / E_i}{X / E}\right) + \sum_i q_i \log\left(\frac{E_i / N_i}{E / N}\right) \tag{4}$$

The Theil's inequality index (4) allows us to measure which part of provincial income inequality is due to productivity differences, and which part will be caused by differences regarding the employment-population ratio. In the same way, our spatial Theil index becomes now:

$$ST(x,sq) = \sum_i sq_i \log\left(\frac{WX_i / WE_i}{\sum_i WX_i / \sum_i WE_i}\right) + \sum_i sq_i \log\left(\frac{WE_i / WN_i}{\sum_i WE_i / \sum_i WN_i}\right) \tag{5}$$

The spatial Theil's inequality index (5) presents the decomposition of neighboring inequality in per capita GDP for the Spanish provinces. Expression (5) allows us to assess which part of neighboring income inequality is due to productivity differences in neighboring provinces, and which part is caused by differences regarding the employment-population ratio in neighboring provinces.

Finally, subtracting the two ((4) minus (5)), we get:

$$T(x,q) = ST(x,sq) + \left(\sum_i q_i \log\left(\frac{X_i / E_i}{X / E}\right) - \sum_i sq_i \log\left(\frac{WX_i / WE_i}{\sum_i WX_i / \sum_i WE_i}\right)\right) +$$

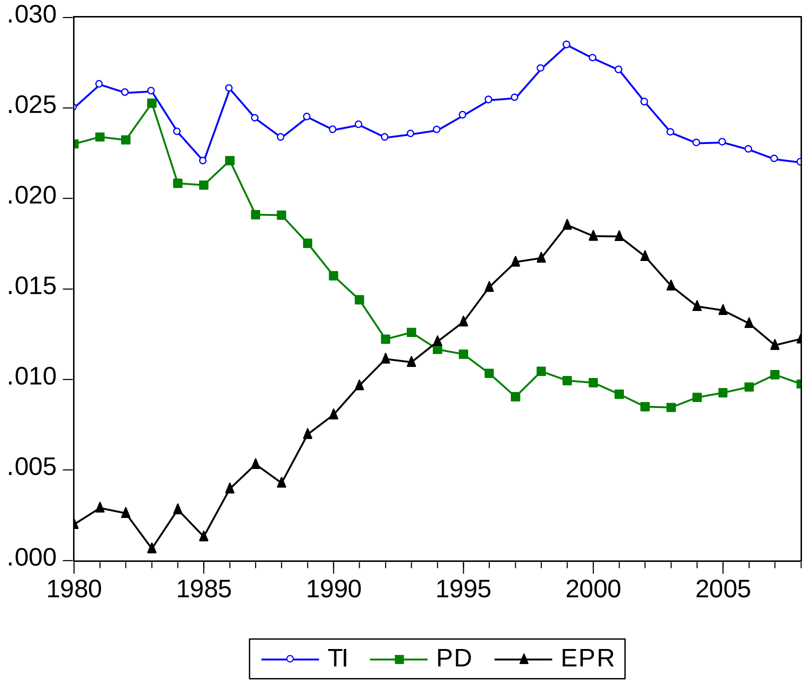
$$\left(\sum_i q_i \log\left(\frac{E_i / N_i}{E / N}\right) - \sum_i sq_i \log\left(\frac{WE_i / WN_i}{\sum_i WE_i / \sum_i WN_i}\right)\right) \tag{6}$$

Expression (6) decomposes provincial inequality into a neighborhood component (the Spatial Theil index) and two specific (local) components. These two specific are relative to both specific -provincial- productivity differences (without the influence of neighborhood features) and local employment-population ratio (in the same way, free of neighborhood influences).

With respect to the statistical sources, homogeneous series were obtained from De Llanos and Márquez (2012) for the period 1980-2008. These authors linked different series, obtaining data of annual gross domestic product for the Spanish provinces at constant euros of the year 2000[6] and of provincial total population[7]. In addition, the time series for provincial employed population (in thousands of employed persons) have been taken from the Fundación Bancaja e Ivie database (Fundación Bancaja e IVIE, 2010).

The evolution of the Theil index expressed in (4) for the provincial per capita income as well as for the two components above mentioned are plotted in Figure 1, while Table 1 offers the quantification of the Theil's index and its decomposition.

Figure 1: Theil's Index



Note: From expression (4), TI denotes Theil's index; PD is productivity differences; and EPR is employment-population ratio.

From Figure 1 and Table 2, Spanish provincial income inequality is mainly due to productivity differences from 1980 to 1993. Nevertheless, from 1994 onwards, provincial income inequality was mainly caused by differences regarding the employment-population ratio.

On the other hand, with respect to the matrix $\mathbf{W}$ in (5) and (6) reflecting the spatial connectivity structure between provinces necessary to build the spatially-lagged variables used in the Spatial Theil index, this spatial weights matrix is based on a pure geographical criterion (physical distance), a standard first-order contiguity scheme, this being defined by the existence of a common border between each two regions. Then, a binary neighborhood-

[6] Linked series from the BBVA Foundation and from the Spanish National Institute of Statistics (INE).

[7] Obtained from "Intercensal estimates of population", "population censuses" and "estimates of population" of INE.

based spatial weights matrix is built defining non-normalized weights w_{ij}^{*} as (by convention, self-neighbors are excluded, so $w_{ii}^{*} = 0$):

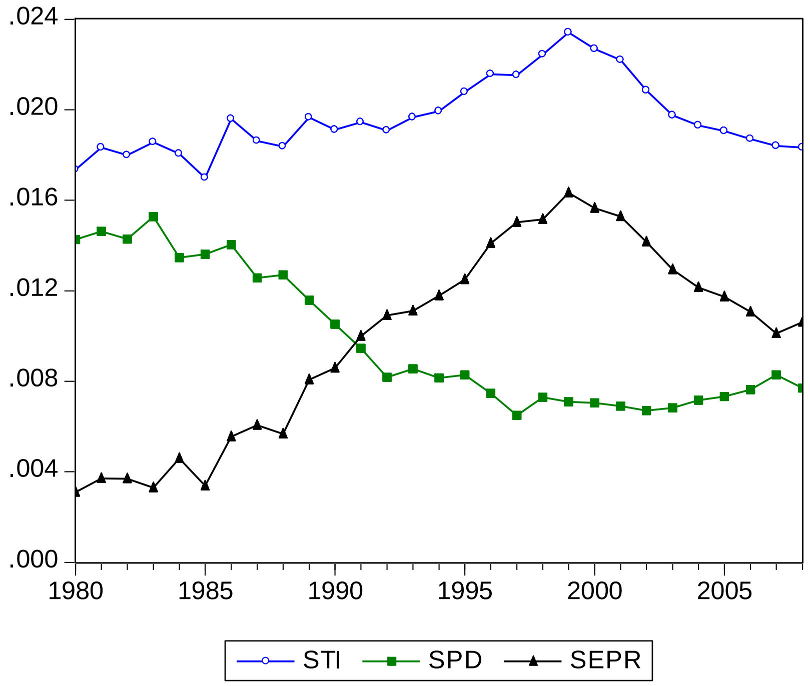
$$w_{ij}^{*} = \begin{cases} 1 & \text{if provinces } i \text{ and } j \text{ are geographical neighbors} \\ 0 & \text{otherwise} \end{cases}$$

and next a $\mathbf{W}_{geog} = (w_{ij})$ row-standardized weights matrix is defined as $w_{ij} = w_{ij}^{*} / \sum_j w_{ij}^{*}$.

Thus, for each province, the provincial weights w_{ij} form a row-standardized $N \times N$ connectivity matrix $\mathbf{W}$ with elements known *a priori* satisfying $w_{ii} = 0$ and $\sum_{j=1}^{N} w_{ij} = 1$. Then, a spatially lagged variable summarizes the state of the variable of interest in the neighboring provinces.

Figure 2 shows the Spatial Theil decomposition (expression (4)); Table 1 offers the results obtained for the Spatial Theil's index and its decomposition.

Figure 2: Spatial Theil's Index



Note: From expression (5), STI denotes Spatial Theil's index; SPD is spatial productivity differences; and SEPR is spatial employment-population ratio.

Table 1: Theil's Index, Spatial Theil's Index, and their Decompositions.

	Theil's index of type (4)					Spatial Theil's index of type (5)				
Year	TI	PD		EPR		STI	SPD		SEPR	
1980	0,02500	0,02301	92,05%	0,00199	7,95%	0,01736	0,01426	82,19%	0,00309	17,81%
1981	0,02629	0,02339	88,97%	0,00290	11,03%	0,01833	0,01462	79,76%	0,00371	20,24%
1982	0,02583	0,02323	89,93%	0,00260	10,07%	0,01799	0,01428	79,42%	0,00370	20,58%
1983	0,02591	0,02526	97,50%	0,00065	2,50%	0,01856	0,01527	82,27%	0,00329	17,73%
1984	0,02366	0,02084	88,09%	0,00282	11,91%	0,01805	0,01347	74,60%	0,00459	25,40%
1985	0,02205	0,02073	94,04%	0,00131	5,96%	0,01699	0,01361	80,12%	0,00338	19,88%
1986	0,02606	0,02210	84,79%	0,00396	15,21%	0,01960	0,01404	71,65%	0,00556	28,35%
1987	0,02441	0,01911	78,25%	0,00531	21,75%	0,01863	0,01257	67,46%	0,00606	32,54%
1988	0,02335	0,01907	81,68%	0,00428	18,32%	0,01838	0,01270	69,12%	0,00568	30,88%
1989	0,02449	0,01752	71,54%	0,00697	28,46%	0,01965	0,01158	58,93%	0,00807	41,07%
1990	0,02377	0,01572	66,13%	0,00805	33,87%	0,01911	0,01053	55,07%	0,00859	44,93%
1991	0,02406	0,01440	59,86%	0,00966	40,14%	0,01944	0,00945	48,61%	0,00999	51,39%
1992	0,02336	0,01223	52,37%	0,01112	47,63%	0,01908	0,00817	42,81%	0,01091	57,19%
1993	0,02355	0,01260	53,51%	0,01095	46,49%	0,01967	0,00855	43,48%	0,01112	56,52%
1994	0,02376	0,01166	49,06%	0,01210	50,94%	0,01994	0,00816	40,90%	0,01178	59,10%
1995	0,02458	0,01140	46,36%	0,01319	53,64%	0,02078	0,00828	39,86%	0,01250	60,14%
1996	0,02542	0,01033	40,63%	0,01509	59,37%	0,02157	0,00747	34,64%	0,01410	65,36%
1997	0,02553	0,00904	35,41%	0,01649	64,59%	0,02152	0,00649	30,17%	0,01503	69,83%
1998	0,02716	0,01045	38,46%	0,01672	61,54%	0,02245	0,00729	32,48%	0,01516	67,52%
1999	0,02847	0,00994	34,91%	0,01853	65,09%	0,02342	0,00709	30,28%	0,01633	69,72%
2000	0,02773	0,00982	35,41%	0,01791	64,59%	0,02269	0,00704	31,04%	0,01565	68,96%
2001	0,02709	0,00919	33,91%	0,01790	66,09%	0,02219	0,00691	31,14%	0,01528	68,86%
2002	0,02530	0,00850	33,59%	0,01680	66,41%	0,02085	0,00670	32,13%	0,01415	67,87%
2003	0,02364	0,00846	35,80%	0,01518	64,20%	0,01976	0,00683	34,55%	0,01293	65,45%
2004	0,02304	0,00901	39,08%	0,01404	60,92%	0,01931	0,00716	37,09%	0,01215	62,91%
2005	0,02308	0,00926	40,13%	0,01382	59,87%	0,01906	0,00732	38,43%	0,01174	61,57%
2006	0,02269	0,00959	42,28%	0,01310	57,72%	0,01870	0,00764	40,84%	0,01106	59,16%
2007	0,02216	0,01026	46,31%	0,01190	53,69%	0,01840	0,00828	45,01%	0,01012	54,99%
2008	0,02199	0,00975	44,33%	0,01224	55,67%	0,01833	0,00771	42,06%	0,01062	57,94%

Note: From expression (4), TI denotes Theil's index; PD is productivity differences, showing its share (percentage) on TI; and EPR is employment-population ratio, showing the share (percentage) on TI. From expression (5), STI denotes Spatial Theil's index; SPD is spatial productivity differences, showing its share (percentage) on STI; and SEPR is spatial employment-population ratio, showing the share (percentage) on STI.

Focusing on neighboring income inequality for the Spanish provinces, the evolution of the Spatial Theil's index is very similar to the aforementioned Theil's index. In the same way, neighboring provincial income inequality is mainly due to productivity differences in neighboring provinces from 1980 to 1990. Consequently, in this case, differences regarding the employment-population ratio in neighboring provinces obtained a larger share before.

In both cases, differences regarding the employment-population ratio are the main factor explaining income inequality.

Finally, Figure 3 offers the decomposition of provincial inequality in per capita GDP according to expression (6), and the results are reported in Table 2.

Figure 3: Neighboring Decomposition of Theil's Index

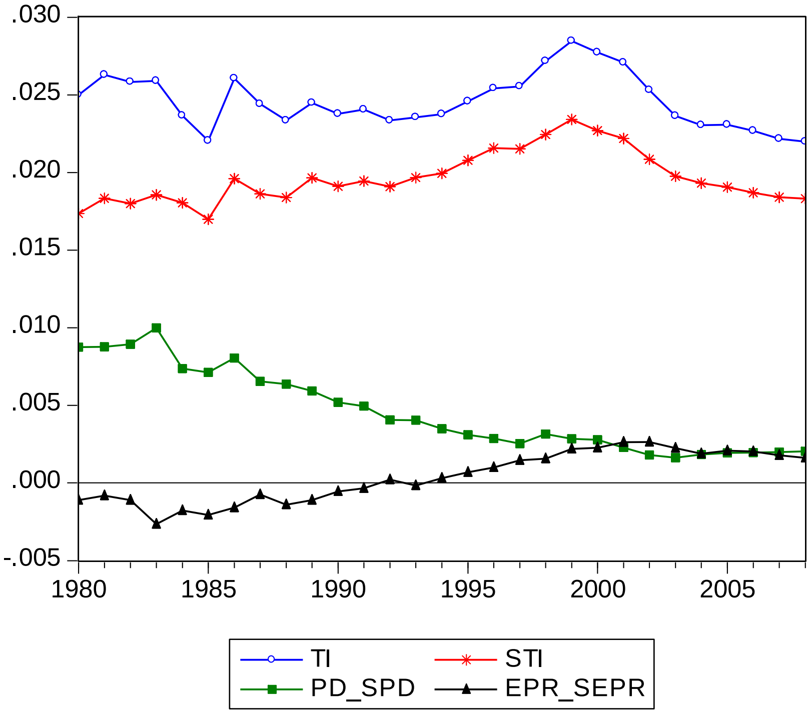
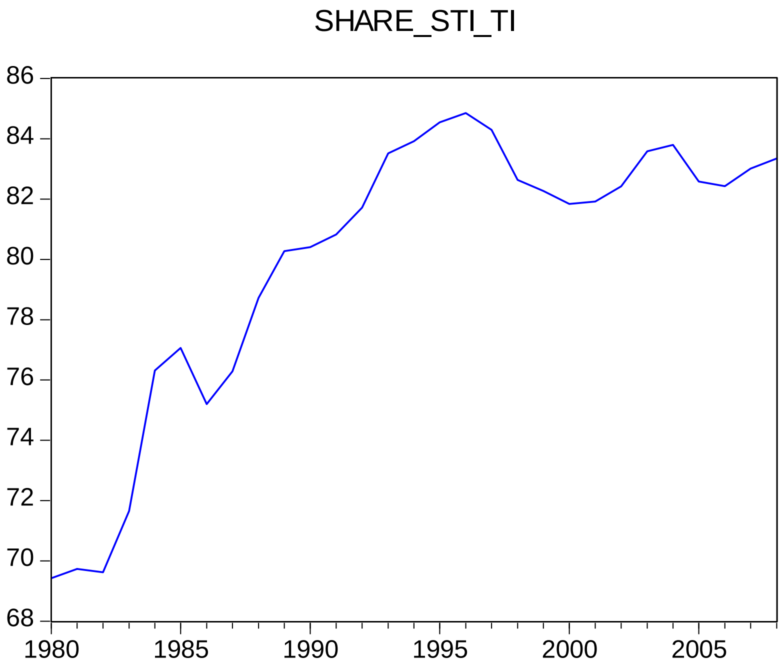


Table 2: Neighboring Decomposition of Theil's index

Year	Neighboring Decomposition of Theil's index						
	TI	STI		PD-SPD		EPR-SEPR	
1980	0,02500	0,01736	69,42%	0,00875	35,00%	-0,00111	-4,42%
1981	0,02629	0,01833	69,73%	0,00877	33,35%	-0,00081	-3,09%
1982	0,02583	0,01799	69,62%	0,00895	34,63%	-0,00110	-4,26%
1983	0,02591	0,01856	71,66%	0,00999	38,55%	-0,00264	-10,21%
1984	0,02366	0,01805	76,32%	0,00737	31,16%	-0,00177	-7,47%
1985	0,02205	0,01699	77,06%	0,00712	32,29%	-0,00206	-9,36%
1986	0,02606	0,01960	75,20%	0,00805	30,91%	-0,00159	-6,11%
1987	0,02441	0,01863	76,29%	0,00654	26,79%	-0,00075	-3,08%
1988	0,02335	0,01838	78,72%	0,00637	27,27%	-0,00140	-5,99%
1989	0,02449	0,01965	80,27%	0,00593	24,23%	-0,00110	-4,50%
1990	0,02377	0,01911	80,40%	0,00520	21,85%	-0,00054	-2,25%
1991	0,02406	0,01944	80,83%	0,00495	20,57%	-0,00034	-1,40%
1992	0,02336	0,01908	81,71%	0,00406	17,40%	0,00021	0,90%
1993	0,02355	0,01967	83,52%	0,00405	17,20%	-0,00017	-0,71%
1994	0,02376	0,01994	83,92%	0,00350	14,74%	0,00032	1,35%
1995	0,02458	0,02078	84,54%	0,00311	12,66%	0,00069	2,80%
1996	0,02542	0,02157	84,85%	0,00286	11,24%	0,00099	3,91%
1997	0,02553	0,02152	84,29%	0,00255	9,98%	0,00146	5,73%
1998	0,02716	0,02245	82,63%	0,00316	11,63%	0,00156	5,74%
1999	0,02847	0,02342	82,27%	0,00285	10,00%	0,00220	7,73%
2000	0,02773	0,02269	81,83%	0,00278	10,01%	0,00226	8,16%
2001	0,02709	0,02219	81,92%	0,00228	8,41%	0,00262	9,67%
2002	0,02530	0,02085	82,42%	0,00180	7,11%	0,00265	10,47%
2003	0,02364	0,01976	83,59%	0,00164	6,92%	0,00224	9,50%
2004	0,02304	0,01931	83,79%	0,00184	8,00%	0,00189	8,21%
2005	0,02308	0,01906	82,58%	0,00194	8,40%	0,00208	9,02%
2006	0,02269	0,01870	82,42%	0,00195	8,62%	0,00203	8,96%
2007	0,02216	0,01840	83,01%	0,00198	8,95%	0,00178	8,04%
2008	0,02199	0,01833	83,34%	0,00204	9,28%	0,00162	7,38%

The results reveal that the part of provincial inequality caused by neighboring factors was not uniform over time (see Figure 4), and two phases can be distinguished. Thus, neighborhood component increases their relevance on the Theil index during the period 1980-1996 (starting from 69,42% in 1980, and reaching 84,85% in 1996), being around 83% in the last years. The quantitative contribution of neighborhood factors to the overall inequality in per capita income shows that neighborhood factors matter more than specific factors, and this should have consequences in terms of regional policy.

Figure 4: Relevance of neighborhood factors on Theil's index



Note: From Table 2, SHARE_STI_TI denotes the share of the Spatial Theil Index on the Theil's Index.

With respect to the specific (provincial) components, there are differences in their evolutions. Thereby, while there is a continuous decline in the specific productivity differences until 2003 (increasing slightly since 2004), labor per inhabitant increases until 2003, decreasing slightly during the rest of years. Hence, the contribution of the employment rate appears to be non-relevant from 1980 to 1993 (negative values), taking positive values from 1994 onwards, and remaining almost stable from 1999. On the other hand, the specific productivity component is more important than the employment-population ratio until year 2000, being similar since year 2001.

The conclusion is that isolating neighborhood effects, the main factor behind the decrease since 2000 in per capita income inequality is not related to the specific (provincial) employment rate factor. Thus the conclusions obtained from Figure 1, Figure 2 and Table 1 are complemented. Effectively, both, the specific employment-population ratio and the specific productivity differences have remained almost stable since 2000. In other words, our decomposition shows that labor per inhabitant from Figure 1 (Theil’s index) was clearly conditioned by neighboring factors. Thus, this decomposition can shed new insights into the analysis of per capita income inequality, opening a door to neighborhood factors *vs* specific factors, and this distinction is important in the design of policy measures.

4. CONCLUSIONS AND FINAL REMARKS

To the best of our knowledge, it is not possible to measure what is the role of regional neighborhood (spatial structure) on interregional income inequality. This paper has provided a way to incorporate spatial structure within regional income inequality to take into account interregional interaction in the decomposition of cross-regional income inequality. Following the decomposition of the Theil (1967) index proposed by Duro and Esteban (1998) and extended by Goerlich-Gisbert (2001), this paper extends the mentioned contributions presenting a decomposition of inequality into neighborhood and specific (local) components. Although the statistical information required is elementary, and the neighborhood effects obtained are conditional upon the chosen neighborhood structure, the analytical possibilities that it offers are quite large. Besides, in our opinion, the present paper opens a future agenda of research in the inequality decomposition literature.

Finally, three additional comments. First, even the application is done with NUTS3 data, it is likely that microeconomic survey data, in which we can identify the enumeration district of the observation (if sample design were available), offer a wide range of more potential interesting applications, because now spatial effects are likely to be stronger; so the applications of the proposed decomposition is potentially more useful using survey data than regional data. Second, from the standard economic literature, Theil’s index can be decomposed in two ways: into the contribution to total inequality of variation in mean incomes (as it was used in the present paper); and into between and within components (see Fishlow (1972)). Following the example on the spatial decomposition of the Theil’s index into the contribution to total inequality of variation in mean incomes presented in this paper, the extension to the "between-within" decomposition of the Theil’s index into the spatial domain will be immediate. Third, the approach proposed in this article can be extended in a natural way to other concentration statistics.

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